

## SUNFLOWER PROTECTION AGAINST SPREAD DISEASES IN THE WESTERN FOREST-STEPPE OF UKRAINE

Andriychuk Tetyana, <https://orcid.org/0000-0002-7718-7964>

Skoreiko Alla\*, <https://orcid.org/0000-0001-6336-0773>

Kuvshynov Alexander, <https://orcid.org/0000-0003-3649-9889>

Ukrainian Science-Research Plant Quarantine Station Institute of Plant Protection NAAS,  
v. Boiany, Ukraine

\* e-mail: [tatyana58@gmail.com](mailto:tatyana58@gmail.com)

**Summary.** The results of fungicide usage BAS 762 02 F against spread sunflower diseases: septoria leaf spot of sunflower (*Septoria helianthi* Ell. et Kell.) and alternaria (*Alternaria helianthi* (Hansf.) Tubaki & Nishih.) in the western Forest-steppe of Ukraine. The best rates of usage for preparations' input according to the studies results during 2021–2022. The fungicide highest efficiency against septoria leaf spot observed in the scope 0.8–1.0 l/ha. The preparation's technical efficiency consisted of 78.8–81.4%. The fungicide BAS 762 02 F usage against alternaria reduced the sunflower's plant disease development on 3.7–6.9 times at preparation's consumption rate 0.6–1.0 l/ha in comparison with control. The preparation's technical efficiency consisted of 72.7 – 85.5%.

**Keywords:** sunflower, fungicide, pathogens, protection, efficiency.

### Introduction

Sunflower is the main oilseed crop in Ukraine, in terms of the volume of cultivation of which the country occupies one of the leading places in the world. It's seedings increased 5 million hectares [1] on 2022. More than 70 % of sunflower seedings are concentrated in Steppe zone, and 30% in the Forest-steppe zone [2]. Changes in climatic conditions in Ukraine [3, 4] and military operations on the territory of the state lead to the movement of sunflower crops to the western region, where relatively favorable conditions for growing crops are currently developing. So the sunflowers seeding areas increases very quicker in western regions of Ukraine. So the sunflower's seedings increased in 2015-2017, respectively: Chernivtsi region in 1.7 times, Ternopil in 2.7 times, Chmelnytsky – 3.7, Rivno – 5.9, Lviv – 3.2, Ivano-Frankivsk – 2.6, Volyn in 6.4 times [5]. The yield of sunflower over the past few years (2020–2022) was 20.2–24.6 c/ha, that is, the potential yield of the crop is unrealized – the yield of modern hybrids can reach 3.5–4 tons of seeds per 1 ha with an oil content of 50% or more.

The numerous crop diseases is one of the reason for the yield lack. They considered more than 70 [2]. All aboveground plant's part and roots is nutrient medium for pathogens. Symptoms of powdery mildew, white and grey rots, phomopsis, fusarium and alternaria may appear at the germination phase. Then, the spots of different etiology appeared on leaves and aboveground plants parts. They received serious development at the end of growing period. Septoria leaf spot, alternaria, phomosis, phomopsis are dominated. Rust and powdery mildew are less identified [6-10].

The most spread sunflower's diseases were: septoria leaf spot – (*Septoria helianthi* Ell. et Kell.) and alternaria blight of sunflower (*Alternaria helianthi* (Hansf.) Tubaki & Nishih.) [11] as per studies conducted by Ukrainian Science-Research Plant Quarantine Station Institute of Plant Protection NAAS. The assimilative leaf's part decreases during defeating. It causes to premature drying of plants, yield decreases and oil content decrease in seeds.

Alternaria blight of sunflower (dark brown spotting) is caused by an imperfect fungus *Alternaria helianthi* (Hansf.) Tubaki & Nishih. Pathogen can affect shoots and young plants. Rounded yellow–brown spots with a diameter of up to 0.3 cm develop on cotyledons at the same time. Disease's symptoms also appear in later development stages – on leaves, petioles, stems and baskets in the form of black–brown spots of various sizes and shapes, which can later crack, forming necrotic ulcers. The alternaria development favored wet weather, heavy dews, and an air temperature of 15–30°C. The fungi sporulation appear in the spots during the high humidity. Alternaria blight of sunflower can penetrate into seeds and develops in form of mycelium. The source of primary infection is affected plant residues and seeds.

The causative agent of septoria (brown leaf spot) is an imperfect fungus *Septoria helianthi* Ell. et Kell. Pathogen damage symptoms appear in the second half of growing season (however, they can also be observed in the early stages of sunflower development) in the form of light yellow rounded spots (up to 1 cm in diameter), which eventually acquire a dark brown color. Small pycnids -fungus fruiting form from the upper side of leaf. The defeated tissue may fall out, and the leaves may become perforated. Leaves dry out prematurely and spots joins during the strong disease development. Disease symptoms observed on baskets, more often on rounding leaves in the form of brown and rather big spots at the favorable terms. The pathogen overwinters in pycnids forms on affected plant remains and seeds.

Both pathogens cause premature drying of sunflower plants, which leads to significant losses of yield and oil content in seeds.

**Purpose** our research was to study the efficiency of sunflower seeds chemical protection using the fungicide BAS 762 02 F against common spots *Septoria helianthi* Ell. et Kell. and *Alternaria helianthi* (Hansf.) Tubaki & Nishih. in the western Forest-steppe of Ukraine.

### Materials and methods

The study conducted in the conditions of the western Forest-steppe of Ukraine on the experimental fields of Ukrainian science research plant quarantine station of the Institute of plant protection of the National Academy of Sciences during 2021–2022. The fungicide BAS 762 02 F (active ingredient of fungicide mefentrifluconazole, 100 g/l + boscalide, 200 g/l) used at the following consumption rates: 0.6 l/ha; 0.7 l/ha; 0.8 l/ha; 0.9 l/ha; 1.0 l/ha for processing vegetative sunflower plants. The preparation Amistar Extra used as a reference with consumption rate 0.75 l/ha. The operation solution consumption rate is 300 l/ha. Plant development phase – star phase (BBCH-51); processing quantity is singular, four times repeatability experiment.

The sod-podzolized gray hard loamy soils character for the area UkrSRPQS IPP NAAS. The following average weighted indicators of the nutrient content elements: humus – 2.0%, easily hydrolyzed nitrogen – 80 mg/kg, mobile phosphorus – 56 mg/kg, exchange potassium – 87 mg/kg, boron – 0.78 mg/kg, manganese – 19.12 mg/kg, copper – 0.82 mg/kg, iron – 5.20 mg/kg, zinc – 0.57 mg/kg, lead – 0.25 mg/kg, cadmium – 0.03 mg/kg. The index of weighted average acidity is 5.7 pH. The average weighted agrochemical score of soils in the farm is 33 points. The agroecological score of soil is 30 points.

The seeding rate was 45.5 thousand plants/ha. The young growth recorded on 10 (in 2021) and 12 (in 2022) days. The previous crop was winter cereals. The plowing was carried out after predecessor harvesting; in the spring – harrowing and pre-sowing preparation of the soil. Mineral and organic fertilizers don't use.

The diseases record and assessment of the degree of their development on plants was carried out on 10 plots located on 40 plants in 1 row in 10 places that were located at the same distance along 2 diagonals of the field. The number of defeated plants by each disease calculated separately at the same time.

The scale T. N. Selivanova's. V. V. Zatyamina used for determining spot defeatine plants (septoria leaf spot, alternaria blight of sunflower [12].

- 0 – healthy plants;
- 1 – up to 10% of the plant (bodies) surface is affected;
- 2 – 11-25% of the plant (body) surface is affected;
- 3 – defeated 26-50% of plant (body) surface;
- 4 – defeated more than 50% of plant's (body) surface

The disease spread determined as per formula:  $N = n \cdot 100 / N$ , where

– disease spread, %

n – number of diseased plants in the sample (or individual bodies);

N – the total number of plants (individual bodies) examined.

The disease development degree was determined as per formula:  $P = \sum(a \cdot d) \cdot 100 / N \cdot k$ , where

P – disease development, %;

$\sum(a \cdot b)$  – the sum of the products of the number of plants and the corresponding lesion score;

N – total number of accounting plants;

k – highest score on the accounting scale;

#### Experiment scheme:

| №<br>S / P | Preparation   | Treating period    | Preparation's<br>consumption rate,<br>l / ha |
|------------|---------------|--------------------|----------------------------------------------|
| 1.         | Control       | (without treating) | –                                            |
| 2.         | BAS 762 02 F  | BBCH 51            | 0.6                                          |
| 3.         | BAS 762 02 F  | BBCH 51            | 0.7                                          |
| 4.         | BAS 762 02 F  | BBCH 51            | 0.8                                          |
| 5.         | BAS 762 02 F  | BBCH 51            | 0.9                                          |
| 6.         | BAS 762 02 F  | BBCH 51            | 1.0                                          |
| 7.         | Amistar Extra | BBCH 51            | 0.75                                         |

The sunflower crops observation for the purpose of diseases accounting was carried out: in the phase of fully unfolded cotyledons (BBCH 10; first ten-days of May); in the phase of eight real leaves (BBCH 18); in the star phase (BBCH 51; second ten-days of June); at the beginning of flowering (BBCH 61; third ten-days of June); at the end of flowering (BBCH 69; second ten-days of July); in the seed development phase (BBCH 71; first ten-days of August); in the maturation phase (BBCH 81); in the physiological phase ripeness (BBCH 87).

#### Results and discussion

Weather conditions during the study period characterized by elevated temperatures (exceeding the monthly average by + 0.6...+2.1°C) and minimal periodic rains in June-July (precipitation was 53-88% of the norm), which suppressed the development of many pathogenic organisms. The defeated plants were not recorded during unfolded cotyledon phase (BBCH 10).

The first **septoria leaf spot** symptoms were discovered at the phase of eight true leaves (BBCH 18). Plant defeating by diseases consisted 18,4% in average, and disease development consisted of 5,7% during preparation treating BAS 762 02 F (star phase, BBCH 51). The plant defeating consisted of 11.5-6.2% at the preparations consumption rate 0,6-1,0 l/ha (in control-30,2%) at the blossoming beginning (BBCH 61). The disease development consisted of 1,0-2,0% (in control -7,6%). The plant defeating seriously increased at the phase of seeding development (BBCH 71) and it was consisted of 14,8-23,6% (on control – 37,1%), at disease development 1,9-4,3% (in control -14,8%). The disease defeating plant at the phase of physiological ripeness (BBCH 87) consisted of 17.1-25.4% (in the control – 45.3%), with disease development 4.2-8.1% (in the control – 22.6%). Preparation's technical efficiency consisted of 64.2-81.4%. Preparation's Amistar Extra technical efficiency consisted of 79,2% (table 1).

**Table 1**

**Fungicide BAS 76202F activity efficiency against Septoria leaf spot *Septoriahelianthi* Ell.et Kell.,(variety Florian, UkrSRPQS IPP NAAS, average 2021-2022).**

| Research variants | Preparations consumption rate, l/ha | Plant damage, % BBCH 61 | Disease development% BBCH 61 | Plant damage, % BBCH 71 | Disease development% BBCH 71 | Plant damage, % BBCH 87 | Disease development% BBCH 87 | Technical efficiency, % |
|-------------------|-------------------------------------|-------------------------|------------------------------|-------------------------|------------------------------|-------------------------|------------------------------|-------------------------|
| Control           | -                                   | 30.2                    | 7.6                          | 37.1                    | 14.8                         | 45.3                    | 22.6                         | -                       |
| BAS 762 02 F      | 0.6                                 | 16.2                    | 2.0                          | 23.6                    | 4.3                          | 25.4                    | 8.1                          | 64.2                    |
| BAS 762 02 F      | 0.7                                 | 14.8                    | 1.7                          | 20.4                    | 3.9                          | 22.4                    | 7.2                          | 68.1                    |
| BAS 762 02 F      | 0.8                                 | 13.8                    | 1.3                          | 18.6                    | 2.4                          | 20.5                    | 4.8                          | 78.8                    |
| BAS 762 02 F      | 0.9                                 | 12.0                    | 1.2                          | 16.7                    | 2.1                          | 17.2                    | 4.6                          | 79.6                    |
| BAS 762 02 F      | 1.0                                 | 11.5                    | 1.0                          | 14.8                    | 1.9                          | 16.0                    | 4.2                          | 81.4                    |
| Amistar Extra     | 2.0                                 | 12.3                    | 1.2                          | 15.2                    | 2.0                          | 17.1                    | 4.7                          | 79.2                    |
| LSD <sub>05</sub> | -                                   | 0.5                     | 0.3                          | 0.6                     | 0.3                          | 0.3                     | 0.6                          | -                       |

The first symptoms **alternaria blight of sunflower** recorded on single plant leaves in the eight true leaf phase in early June (BBCH 18). The plant preparation treating BAS 762 02 F conducted on the star phase (BBCH 51). The plant disease defeating consisted of 17,2%; during disease development – 4.6%. The plant defeating consisted of 19,7; 18,5 (at control – 35,4%), at preparation's consumption rate 0.6 and 0,7 l/ha at the blossoming beginning (BBCH 61).

**Table 2**

**The fungicide BAS 762 02 F efficiency action against alternaria blight of sunflower *Alternaria helianthi* Fries. (variety Florian, UkrSRPQS IPP, average at 2021-2022)**

| Research variants | Preparation consumption rates, l/ha | Plant damage, % BBCH 61 | Disease development, % BBCH 61 | Plant damage, % BBCH 71 | Disease development, % BBCH 71 | Plant damage, % BBCH 87 | Disease development, % BBCH 87 | Technical efficiency, % |
|-------------------|-------------------------------------|-------------------------|--------------------------------|-------------------------|--------------------------------|-------------------------|--------------------------------|-------------------------|
| Control           | -                                   | 35.4                    | 12.8                           | 57.1                    | 23.2                           | 84.3                    | 31.1                           | -                       |
| BAS 762 02 F      | 0.6                                 | 19.7                    | 3.2                            | 26.5                    | 6.0                            | 38.5                    | 8.5                            | 72.7                    |
| BAS 762 02 F      | 0.7                                 | 18.5                    | 2.7                            | 22.6                    | 5.1                            | 32.2                    | 7.1                            | 77.2                    |
| BAS 762 02 F      | 0.8                                 | 17.4                    | 1.9                            | 20.4                    | 3.5                            | 25.1                    | 5.0                            | 83.9                    |
| BAS 762 02 F      | 0.9                                 | 17.1                    | 1.7                            | 18.1                    | 3.3                            | 23.1                    | 4.9                            | 84.2                    |
| BAS 762 02 F      | 1.0                                 | 16.9                    | 1.5                            | 17.2                    | 2.9                            | 22.7                    | 4.5                            | 85.5                    |
| Amistar Extra     | 2.0                                 | 17.5                    | 1.7                            | 18.0                    | 3.4                            | 27.5                    | 4.8                            | 84.6                    |

|                   |   |     |     |     |     |     |     |   |
|-------------------|---|-----|-----|-----|-----|-----|-----|---|
| LSD <sub>05</sub> | - | 0.5 | 0.1 | 1.0 | 0.1 | 1.5 | 1.1 | - |
|-------------------|---|-----|-----|-----|-----|-----|-----|---|

Disease development consisted of 3.2; 2.7 (at control – 12,8%). The plant defeating consisted of 17,2 –26,5% (at control – 57,1%) at the preparation treating at the phase seeds development (BBCH 71), at disease development 2.9 – 6.0% (at control – 23,2%).

### Conclusions

The sunflower treating by fungicide BAS 762 02 F against septoria leaf spot (*Septoria helianthi* Ell. et Kell.) and alternaria blight of sunflower (*Alternaria helianthi* (Hansf.) Tubaki & Nishih.) at the star phase allows to receive the reliable protection of leaf plant surface.

All preparation's applied doses inhibited the spots development (septoria leaf spot and alternaria blight of sunflower) in sunflower. The highest efficiency in disease inhibiting was observed with doses of 0.8-1.0 l/ha. The fungicide BAS 762 02 F efficiency against septoria leaf spot was consisted of 78.8-81.4%, against alternaria blight of sunflower consisted of 84.2-84.6%.

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