

PEARLEAF BLISTER MITE

(Eriophyes pyri Pgst.): Biological Features and Measures to Limit its Harmfulness in Pear Plantations of Ukraine

Goal. To clarify the biological features of pearleaf blister mite (*Eriophyes pyri* Pgst.) and investigate the effectiveness of such preparations as: Sivanto Prime 200 SL, PK (flupyradifurone, 200 g/l), Danadim stable, KE (dimethoate, 400 g/l), Oberon Rapid 240 SC, KS (spiromesifen, 228.6 g/l + abamectin, 11.4 g/l), Fufanon 570, KE (malathion, 570 g/l) and Aktofit, KE (aversectin C, 0.2%), reduce the number and harmfulness of this phytophagan, its impact on the productivity of pears in industrial plantations. **Methods.** To determine the colonization of pear plantations by mites in horticultural farms of Ukraine, route surveys were carried out in the industrial pear plantations of Yablunivska variety. The planting scheme was 0.8 × 3.5 m. The planting year was 2014. The crown shape was thinned (improved) and story. The rootstock was a quince tree A. Stages of plant development at the time of treatment were «bursting buds (green cone)» (BBCH 10), «white buds» (BBCH 55), «end of flowering» (BBCH 69) and «fruit development» BBCH 75). The technical effectiveness of pesticides at different application rates was determined. The accounts were performed according to generally accepted methods in horticulture, plant protection and entomology. **Results.** Female pear leaf blister mite overwinter under the upper scales of the buds. In spring, at an average daily temperature above 10°C, they begin to feed with the juice of young leaves, covering them with galls, and lay eggs («bud bursting (green cone)» — «white bud») stages. The development of the first generation ends at the end of «flowering». Females of the second generation appear in late June, the third generation — in the first half of July. After the rebirth, they leave galls and populate

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the buds for wintering (mid-late June to late July/early August). During the growing season the phytophagan develops in three generations. The use of Danadim stable, KE, Fufanon 570, KE, Sivanto Prime 200 SL, PK, Oberon Rapid 240 SC and Aktofit, KE provided a reduction in the number of this species by 75.3–93.9%, allowed to increase the effectiveness of basic biometric and biochemical indices of plantations, to obtain high-quality products with a yield of 1.1–1.5 times higher comparing with the control. **Conclusions.** During the growing season, the pear gall mite develops in three generations. Taking into account the peculiarities of the biology of pears and mites in the spring, the peculiarities of the mechanism of action of drugs against this species and other phytophages (leafeating, stem, sucking, including against the brown-marble bug) are most advisable to apply: in the phase of «bud break (green cone)» —

Danadim stable, EC (2.0 l/ha); in the «white bud» phase — Fufanon 570, EC (2.0 l/ha); after the «end of flowering» — Danadim stable, EC (2.0 l/ha). In summer (against the second and third generations of the pest), Sivanto Prime 200 SL, RK (0.75–1.0 l/ha), Oberon Rapid 240 SC, KS (0.6–0.8 l/ha), Aktofit, EC (6.0 l/ha) taking into account the duration of their action

pear; protection; preparations; insecticides; technical efficiency; biometric and physiological indices; yield; marketability of fruits

According to the State Statistics Service of Ukraine, in 2020 the area of pear plantations was 13.0 thousand hectares, about 152.3 thousand tons of standard fruit products were harvested with an average yield of 12.5 t/ha [1]. In 2025, the total area of pear orchards will amount to about 20 thousand hectares, which will allow receiving at least 250 thousand tons of fruit annually [2].

There are more than 200 species of pests, mites and rodents in pear plantations of Ukraine, which weaken the vital activity of plants during the growing season. In the absence or untimely implementation of protective measures against them, the commercial yield is reduced by 21–28% [3–4]. An important role in reducing the harmful effects of phytophagans, weeds and pathogens in the agrobiocenosis of the garden belongs to the chemical measure [3–5].

Harmful species of four-legged mites cause significant damage to plantations. The leading place in terms of harmfulness belongs to the pearleaf blister mite (*Eriophyes pyri* Pgst.), which causes the formation of galls on leaves, swelling on green shoots and fruits. Damage to buds,



ovaries, drying of leaves, disruption of photosynthesis, slow growth of fruits, deterioration of marketability are observed, loss of yield reaches 95% [6–8].

It is worth recalling the biology of this pest: the entrance to the gall is only on the underside of the leaf, which greatly complicates the effectiveness of preparations to reduce their number and harmfulness by contact method (washout, likelihood of contact with harmful object and duration of compounds reduces) [3, 5–8]. Therefore, the use of insecticides exclusively of contact or contact-intestinal action or acaricides, most of which are exclusively contact compounds, will be ineffective against this species. Among other reasons for the low effectiveness of chemical preparations from this dangerous pest there is long-term use of the same chemical compounds, resistance to certain groups, violations of application technology [3, 5, 7, 9].

Currently in Ukraine there are no preparations registered against pearleaf blister mite (except Omait 57%, EV (propargite, 570 g/l) [12, 13]. According to foreign publications, preparations Movento 100SC (spirotetramate, Kanemite 150 SC (nocil), Envidor 240 SC (spirodiclofen), Emulpar 940 EC (Camelina sativa) and Ortus 05 SC (fenpyroximate) are effective (over 80%) against pearleaf blister mite during the growing season [10]).

At the end of the growing season (females emerge from the galls on the leaves and populate the buds), it is recommended to treat the plantations with sulfur-based preparations, in particular calcium polysulfide [6, 11].

Currently, tactics to protect pears from this dangerous species should be based on reducing its numbers in those periods of development when the pest is most vulnerable (rebirth of individuals from the dormant state in which they wintered, the beginning of their migration from wintering grounds, mass openly tenacious attack of leaves surface, the beginning of the formation of galls, etc.). In addition, an important dominant issue is the use of microbiological preparations, modern

chemical compounds based on new active substances and mechanism of action.

Therefore, clarifying the biology of phytophagan, the application of preparations of different origins in the most vulnerable periods of its development (taking into account the phenophases of the tree itself) are the dominant issues of rational protection to maximize effect and environmental safety, which determined the relevance of research.

Goal. To clarify the features of the biology of pearleaf blister mite (*Eriophyes pyri* Pgst.), to investigate the effectiveness of preparations Danadim stable, KE (dimethoate, 400 g/l), Fufanon 570, KE (malathion, 570 g/l), Sivanto Prime 200 SL, PK flupiradifuron, 200 g/l), Oberon Rapid 240 SC, KS (spiromesifen, 228.6 g/l + abamectin, 11.4 g/l), and Aktofit, KE (aversectin C, 0.2%) to reduce the number and harmfulness of phytophagan, influence on indicators of productivity of a pear in industrial plantations.

Methods. Laboratory studies to clarify the biology of the pest were conducted in the insectarium of the Department of Plant Protection and Quarantine of Uman National University of Horticulture (UNUH) during 2017–2021. For this purpose, entomological gardens were used, where there were flasks with water and shoots of pear of Yablunivska variety, cut in the industrial garden in the stage of «swelling of the buds» (BBCH 01). Route surveys to determine the population of pear orchards with the mite were carried out during 2015–2021 in horticultural farms of the Steppe (Zaporizhzhia, Dnipropetrovsk, Kherson, Mykolaiv regions) and the Forest-Steppe of Ukraine (Chernivtsi, Vinnytsia, Cherkasy, Poltava, Kyiv regions). Field studies were conducted industrial pear gardens in the conditions of the educational and production department of the university during 2019–2021. Yablunivska variety trees. Planting scheme — 0.8 × 3.5 m. Year of planting — 2014. Crown shape — sparse (improved) — tiered. Rootstock — Quince A. Stages of plant development at the time of

treatment — «bud burst (green cone)» (BBCH 10), «white bud» (BBCH 55), «end of flowering» (BBCH 69) and «fruit development» BBCH 75). Soil — shallow, low-humus dusty-loamy podzolic leached chernozem: humus content — 1.3–2.5%; pH — 4.8–5.2; mobile compounds P_2O_5 — 130–180 mg/kg and K_2O — 8.9–9.2 mg/kg (by Chirikov method). Measures for the care of the experimental site are loosening the soil in the stem strips during the growing season, application of organic and mineral fertilizers, pruning, mowing the grass in between rows (row spacing), protection against pests and diseases.

The technical effectiveness of insecticides against pearleaf blister mite and their effect on pear productivity in industrial plantations were determined. To do this, trees were sprayed on the experimental plots (at the stage of «bud burst (green cone)» (BBCH 10), «white bud» (BBCH 55), «end of flowering» (BBCH 69) and «fruit development» (BBCH 75) with preparations Danadim stable, KE, Fufanon 570, KE; Sivanto Prime 200 SL, PK, Oberon Rapid 240 SC, KC and Aktofit, KE at different application rates.

Our choice of these preparations against pearleaf blister mite is explained by the fact that:

- Aktofit, KE as a contact acaricide is used in garden plantations against spider mites;
- Oberon Rapid 240 SC, KC is used in apple orchards against herbivorous mites;
- Sivanto Prime 200 SL, PK is primarily designed against latently living harmful objects, is characterized by high systemic action in the acropetal direction of the phloem of plants;
- Danadim stable, KE due to the latest formulation and original formulation of its preparative form has a high contact and long-term (10–15 days) systemic action, which ensures its rapid penetration into plant tissues and vessels, moving evenly to all parts,
- Fufanon 570, KE is charac-

terized by strong contact action and powerful fumigation effect.

The latter are currently registered only in apple trees [12, 13].

Accounting was performed according to the methods adopted in horticulture, plant protection and entomology [14, 15]. Location of plots was randomized. Tree — repetition.

The effectiveness of the preparations was determined by reducing the mite population of tree leaves and the intensity of the formation of galls on them relative to the control [15].

The yield of plantations in the experimental plots was determined on the day of harvest: the third decade of September. Accounts of biochemical and biometric indicators of trees for the growing season were conducted in the late third decade of August.

Results and discussions. According to the results of surveys, there is an increase in the area of pear plantations in Ukraine, inhabited by this harmful species, up to 10 thousand hectares.

It is established that females pass the winter under the upper integumentary scales of buds, their number is up to 150 individuals per bud. They wake up in the spring at an average daily temperature above 10°C, without leaving the buds, begin to feed on the juice of young, not yet fully opened leaves and lay eggs, massively inhabiting leaves and covering them with galls (stages of «bud burst (green cone)») (BBCH 10) — «white bud» (BBCH 55). The development of the first generation, which lasts 30—35 days and ends at the «end of flowering» (BBCH 69), occurs first inside buds and then on the surface of young leaves, where young females make galls next to parent and lay eggs. The female lays up to 18 eggs. The second generation emerges in the late June (BBCH 74), the third — in the first half of July (BBCH 77), which after rebirth migrate from the galls for 35—40 days (mid — late June to late July — early August) and populate the buds for wintering. The development of summer generations lasts 15—20 days.

Thus, during the growing season this phytophagan develops in three generations.

Galls on the leaves are first light green, later — dark brown, first they are located along the central vein (Fig. 1), then cover the entire leaf blade (Fig. 2), blacken and dry. Damaged buds are enlarged, are one and a half—two weeks behind in development, dry up.

Thus, the development of the first generation of the pest continues during the second-third decade of April (stages «bud burst (green cone)») (BBCH 10) — «white bud» (BBCH 55) to the third decade of May («the end of flowering»)

(BBCH 69). That is why, in our opinion, it is especially important and first and foremost to conduct protective measures against phytophagan during the spring growing season, when the leaf apparatus of the tree is most actively formed and its generative organs begin to be laid.

It should be added that during this growing season the number of useful species will also be low, as entomophages and acariphages are still regenerating after winter [3].

It is established that the use of preparations Danadim stable, KE (2.0 l/ha), Fufanon 570, KE (2.0 l/ha), Sivanto Prime 200 SL,



Fig. 1. Damage to pear leaves by pearleaf blister mite («end of flowering» stage (BBCH 69))



Fig. 2. Damage to pear leaves by pearleaf blister mite («fruit development» stage (BBCH 75))



PK (0.75–1.0 l/ha), Oberon Rapid 240 SC, KC (0.6–0.8 l/ha) and Aktofit, KE (6.0 l/ha) reduced the number of pests by 75.3–93.9% (Table 1). This ensured the recovery of high-quality pear products with a yield of 1.1–1.5 times higher than the control. The yield of non-standard products did not exceed 10.1% against 19.7% in the control (water treatment) (Table 2). The use of these preparations allowed to increase the effectiveness of the main biometric indicators of trees, namely: length by 6.1–45.5%, thickness of annual shoots by 1.1 times, leaf surface thickness by 3.9–40.2% (Table 2) what is important for laying potential fruit buds and future harvests. The results of biochemical analysis of fruits also indicate the feasibility of such protection:

compared to the control variant (water treatment) is higher in fruit dry matter by 0.7–14.4%, sugars — by 1.1–4.5%, titrated acids — by 5.9–11.1%, pectic substances — by 16.7%, and ascorbic acid — by 3.2–4.5% [3].

The research results are identical to the research results of foreign authors. They also emphasize that the protection of plantations is most effective in the spring-summer growing season [5, 7–10] with the use of modern insecticides of various origins and mechanisms of action. This will effectively reduce the harmfulness of the pearleaf blister mite and, accordingly, the future stock of wintering females in the buds.

The use of sulfur-based preparations, in particular calcium polysul-

fide [6, 11], at the end of the growing season (emergence of females from the galls on the leaves and attack of buds), due to the extended migration of females (35–40 days) and short duration of these acaricides (no more than 5–7 days), causes an increase in the number of treatments and the rise in price of the resulting products. These arguments convince us of the feasibility of protective measures against the pest in the early spring and summer growing season.

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1. Effectiveness of preparations against pearleaf blister mite in industrial pear plantations (educational and production department of UNUH, Yablunivska variety, average 2017–2021)

No.	Variant (preparation, application rate)	Technical effectiveness, %			
		«Bud burst (green cone)» (BBCH 10)	«White cone» (BBCH 55)	«The end of flowering» (BBCH 69)	«Fruit development» (BBCH 75)
1	Water (water treatment)	0.0	0.0	0.0	0.0
2	Omaid 57 %, EB, 2.0 l (standard)	91.9	90.6	91.3	92.1
3	Sivanto Prime 200 SL, PK, 0.75 l	81.8	82.9	83.8	83.7
4	Sivanto Prime 200 SL, PK, 1.0 l	82.7	83.4	84.5	84.1
5	Oberon Rapid 240 SC, KC, 0.6 l	83.6	88.1	91.5	91.7
6	Oberon Rapid 240 SC, KC, 0.8 l	86.2	91.4	92.3	93.9
7	Danadim stable, KE, 2.0 l	91.5	93.3	93.7	92.4
8	Fufanon 570, KE, 2.0 l	88.4	89.1	90.4	92.6
9	Aktofit, KE, 5.0 l	71.1	80.7	80.1	80.2
10	Aktofit, KE, 6.0 l	75.3	81.4	80.7	81.3
	HIP ₀₅	1.2	1.3	1.1	1.2

2. Influence of application of preparations against pearleaf blister mite on indicators of pear tree development and quality indicators of yield in industrial plantations (educational-scientific production department of UNUH, Yablunivska variety, average 2017–2021)

No.	Variant (preparation, application rate)	Biometric indicators of annual shoots		Leaf plate surface area, cm ²	Yield, t/ha	Marketability, %	
		length of shoots, m	the thickness of shoots, mm			Standard products (No. I grade + No. II grade)	n/s
1	Water (water treatment)	0.33	4.2	10.2	16.9	80.3	19.7
2	Omaid 57 %, EB, 2.0 l (standard)	0.41	4.3	13.3	25.4	92.4	7.6
3	Sivanto Prime 200 SL, PK, 0.75 l	0.38	4.3	11.9	23.1	92.1	7.9
4	Sivanto Prime 200 SL, PK, 1.0 l	0.44	4.4	12.6	24.9	93.2	6.8
5	Oberon Rapid 240 SC, KC, 0.6 l	0.35	4.2	11.4	22.8	93.3	6.7
6	Oberon Rapid 240 SC, KC, 0.8 l	0.47	4.4	12.1	23.9	92.9	7.1
7	Danadim stable, KE, 2.0 l	0.45	4.4	14.3	25.6	92.6	7.4
8	Fufanon 570, KE, 2.0 l	0.48	4.4	13.9	24.8	93.1	6.9
9	Aktofit, KE, 5.0 l	0.36	4.3	10.6	19.3	87.9	10.1
	HIP ₀₅	0.9	0.9	0.9	2.1	–	–

3. Influence of application of preparations against pearleaf blister mite on physiological indicators in industrial pear plantations (educational-scientific production department of UNUH, Yablunivska variety, average 2017–2021)

No.	Variant (preparation, application rate)	Indicators				
		dry substances,%	pectin substances,%	sugars,%	titrated acids,%	ascorbic acid, mg/100 g
1	Water (water treatment)	14.6	0.5	8.8	0.17	3.14
2	Omaid 57 %, EB, 2.0 l (standard)	16.4	0.7	9.1	0.20	3.26
3	Sivanto Prime 200 SL, PK, 0.75 l	15.1	0.6	9.0	0.19	3.25
4	Sivanto Prime 200 SL, PK, 1.0 l	15.9	0.7	9.1	0.20	3.27
5	Oberon Rapid 240 SC, KC, 0.6 l	14.9	0.6	8.9	0.18	3.23
6	Oberon Rapid 240 SC, KC, 0.8 l	15.4	0.7	9.1	0.20	3.26
7	Danadim stable, KE, 2.0 l	16.7	0.7	9.2	0.21	3.28
8	Fufanon 570, KE, 2.0 l	16.4	0.7	9.1	0.20	3.27
9	Aktofit, KE, 5.0 l	14.6	0.6	8.8	0.17	3.22
10	Aktofit, KE, 6.0 l	14.7	0.6	8.8	0.18	3.24
	HIP ₀₅	0.9	0.1	0.7	0.1	0.1

females appear in late June (BBCH 74) and the third in the first half of July (BBCH 77) which after re-birth leave the galls and populate buds for the winter. Their migration lasts from the mid—late June to late July—early August, during the growing season this phytophagan develops in three generations. The use of preparations Sivanto Prime 200 SL, PK (0.75—1.0 l/ha), Oberon Rapid 240 SC, KC (0.6—0.8 l/ha), Danadim stable, KE (2.0 l/ha), Fufanon 570, KE (2.0 l/ha) and Aktofit, KE (6.0 l/ha) effectively reduces the harmfulness of pearleaf blister mite in plantations and controls its number during the growing season.

Given the peculiarities of pear biology in the spring (the duration of the stage of «bud burst (green cone)» (BBCH 10) is not more than ten days, and the stage of «white bud» (BBCH 55) — up to seven days), peculiarities of pest biology (concentrates on young leaves in newly formed galls) and peculiarities of the mechanism of action of these insecticides against this species and other phytophagans (leaf-eating, stem, sucking, including against brown-marble bug), it is most appropriate to use: preparation Danadim stable, KE in the stage of «bud burst (green cone)» (BBCH 10); Fufanon 570, KE in the stage of «white bud» (BBCH 55); after «end of flowering» (BBCH 69) it is advisable to spray with insecticide Danadim stable, KE against pearleaf blister mite and other mentioned species; in the summer growing season (against the second and third generations of blister mite) it is advisable to use preparations Sivanto Prime 200 SL, PK; Aktofit, KE and Oberon rapid 240 SC, KC taking into account the duration of their action.

The results of research on the effectiveness of Sivanto

Prime 200 SL, PK; Danadim stable, KE; Oberon Rapid 240 SC; Fufanon 570, KE and Aktofit, KE allow to recommend to the Ministry of Energy and Environmental Protection of Ukraine for further registration of these preparations on pears in the specified application norms and their inclusion in the current national «List of pesticides and agrochemicals approved for use in Ukraine».

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Рис. 3. Сад груші, оброблений проти галового грушевого кліща інсектоакарицидами («bud burst (green cone)» stage (BBCH 10), «white bud» (BBCH 55), «end of flowering» (BBCH 69)) Yablunivska variety, June 15, 2021



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Грушевий галовий кліщ (*Eriophyes rugi* Pgst.): особливості біології та заходи обмеження його шкідливості в грушевих насадженнях України

Мета. Уточнити особливості біології грушевого галового кліща (*Eriophyes rugi* Pgst.). Вивчити ефективність проти цього фітофага інсектоакарицидів — Данадим стабільний, KE (диметат, 400 г/л), Фуфанон 570, KE (малатіон, 570 г/л), Сіванто Прайм 200 SL, PK (флу-

пірадіфурон, 200 г/л) та акарицидів — Оберон Рапід 240 SC, KC (спіромезіфен, 228,6 г/л + абамектин, 11,4 г/л), Актофіт, KE (аверсектин С, 0,2%). Дослідити їхній вплив на показники продуктивності груші в промислових насадженнях. **Методи.** Для визначення заселення насаджень груші кліщем у садівничих господарствах України здійснювали маршрутні обстеження в промислових насадженнях груші сорту Яблунівська. Схема садіння — 0,8 × 3,5 м. Рік садіння — 2014. Форма крони — розріджено (покращено)-ярусна. Підщепка — Айва А. Фази розвитку рослин в момент обробок — «розпукування бруньок (зелений конус)» (ВВСН 10), «білий пуп'янок» (ВВСН 55), «закінчення цвітіння» (ВВСН 69) та «розвиток плодів» (ВВСН 75). Визначали технічну ефективність препаратів проти шкідника у різних нормах витрат. Обліки проводили за загальноприйнятими в садівництві, захисті рослин і ентомології методиками. **Результати.** Самиці грушевого галового кліща зимують під верхніми лусками бруньок. Навесні, за середньодобової температури повітря вище 10°C, вони розпочинають жити у бруньках соком молодих листків, укриваючи їх галами, і відкладають яйця у фази «розпукування бруньок (зелений конус)» — «білий пуп'янок». Розвиток першого покоління закінчується наприкінці «цвітіння». Самиці другого покоління з'являються наприкінці червня, третього покоління — у першій половині липня. Після відродження залишають гали і заселяють бруньки для зимівлі (середина — кінець червня до кінець липня —

початок серпня). За вегетацію фітофаг розвивається в трьох поколіннях. Застосування препаратів (Данадим стабільний, KE; Фуфанон 570, KE; Сіванто Прайм 200 SL, PK; Оберон Рапід 240 SC, KC; Актофіт, KE) забезпечило зниження чисельності цього виду на 75,3—93,9%, дало змогу підвищити результативність основних біометричних і біохімічних показників насаджень, отримати високосортну продукцію з урожайністю в 1,1—1,5 раза вищою порівняно з контролем. **Висновки.** За період вегетації грушевий галовий кліщ розвивається в трьох поколіннях. Враховуючи особливості біології груші та кліща навесні, особливості механізму дії препаратів проти цього виду та інших фітофагів (листогризучих, ствольових, сисних, у т.ч. й проти коричнево-мармурового клопа) найбільш доцільно застосовувати: у фазу «розпукування бруньок (зелений конус)» — Данадим стабільний, KE (2,0 л/га); у фазу «білий пуп'янок» — Фуфанон 570, KE (2,0 л/га); після «закінчення цвітіння» — Данадим стабільний, KE (2,0 л/га). Влітку, проти другого та третього поколінь шкідника, варто застосовувати Сіванто Прайм 200 SL, PK (0,75—1,0 л/га), Оберон Рапід 240 SC, KC (0,6—0,8 л/га), Актофіт, KE (6,0 л/га) з урахуванням тривалості їхньої дії.

груша; захист; препарати, інсектоакарициди; технічна ефективність; біометричні та фізіологічні показники; врожайність; товарність плодів

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