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FIELD EFFICACY OF SELECTED PLANT PROTECTION TREATMENTS AGAINST *APHIS POMI* AND *TETRANYCHUS URTICAE* IN APPLE ORCHARDS

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ABSTRACT

Apple orchards are affected by several arthropod pests that can reduce plant health, fruit quality and yield, requiring effective control strategies compatible with integrated pest management. This study evaluated the biological efficacy of selected insecticidal and acaricidal against the green apple aphid (Aphis pomi) and the two-spotted spider mite (Tetranychus urticae) under field conditions in a Romanian apple orchard. Prev-Am and Teppeki were assessed against A. pomi, while Limocide and Kanemite SC STD were evaluated against T. urticae. Treatment performance was determined from observed mortality and corrected biological efficacy calculated using Abbott's formula, accounting for natural mortality in the untreated control. Teppeki provided the highest corrected efficacy against A. pomi (86.25 %), compared with 67.24 % for Prev-Am. Against T. urticae, Kanemite SC STD achieved 91.45 % corrected efficacy, while Limocide reached 84.83 %. The results demonstrate clear differences in treatment performance and support the selection of pest-specific control options within integrated apple orchard management. Further replicated and multi-year field studies are required to confirm treatment consistency under variable pest pressure and environmental conditions.

INTRODUCTION

Apple (*Malus domestica* Borkh.) orchards are perennial agroecosystems in which arthropod pests, natural enemies and crop management practices interact throughout the growing season. Pest outbreaks can affect vegetative development, fruit quality and commercial production, while repeated pesticide applications may alter arthropod communities and reduce the contribution of beneficial organisms. Consequently, modern orchard protection increasingly relies on integrated pest management (IPM), combining pest monitoring, selective plant protection products and conservation of natural enemies to maintain pest populations below economically damaging levels (Cross et al., 2015; Simon et al., 2010). Recent studies conducted in commercial apple orchards have further emphasized the importance of balancing effective pest suppression with reduced disturbance of non-target arthropod fauna (Hatteland et al., 2023).

Among the aphid species associated with apple, the green apple aphid, *Aphis pomi* De Geer (Hemiptera: Aphididae), is an important pest of actively growing shoots. Colonies develop mainly on young leaves and shoot terminals, where

continuous feeding may interfere with normal shoot development, while honeydew production favours the occurrence of sooty mould. The capacity of aphid populations to increase rapidly during the growing season makes timely intervention particularly important (Borbely & Nagy, 2022; Wojciechowicz-Zytko & Wilk, 2023).

Chemical control nevertheless remains an important component of *A. pomi* management when pest pressure exceeds acceptable levels. Field studies have demonstrated that insecticides belonging to different chemical groups can provide effective suppression, although biological efficacy varies according to the active ingredient, application conditions and pest population.

Vasilev (2024), for example, reported high biological efficacy of flonicamid-based Teppeki against *A. pomi* under apple orchard conditions. More recent research also confirms the continuing need to evaluate different intervention strategies against green apple aphid directly under field conditions (Shah et al., 2026).

The two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), represents a different phytosanitary challenge. Population development is favoured by warm and dry conditions, and intensive feeding can cause leaf injury, reduced photosynthetic activity and premature deterioration of foliage. Mite management in apple orchards is closely connected with the conservation of predatory mites and other beneficial arthropods; therefore, selective acaricide use and the integration of chemical and biological control components are important elements of orchard IPM programmes (Balazs et al., 1996; Simon et al., 2010).

The availability of plant protection products with different modes of action and characteristics provides opportunities to diversify pest-management programmes and reduce dependence on a narrow range of conventional pesticides. However, product performance cannot be inferred solely from its mode of action or previous efficacy reports, because field response may vary with pest pressure, environmental conditions and orchard management. Contemporary field evaluations therefore remain necessary for identifying treatments capable of providing adequate control under specific orchard conditions (DeVisser et al., 2024; Hatteland et al., 2023).

An additional methodological consideration is the occurrence of natural mortality in untreated pest populations. When control mortality is appreciable, direct comparison of observed mortality percentages can overestimate the response attributable to treatment. Correcting treatment mortality relative to the untreated control therefore provides a more appropriate estimate of biological efficacy and a clearer basis for comparing products under field conditions.

The aim of the present study was to evaluate and compare the field efficacy of selected plant protection treatments against *Aphis pomi* and *Tetranychus urticae* in an apple orchard during the 2024 growing season. Specifically, mortality and survival were assessed for each treatment and the corresponding untreated control, and Abbott-corrected efficacy was calculated to quantify treatment-related pest suppression.

MATERIAL AND METHODS

The study was conducted during the 2024 growing season in an experimental apple orchard located in the Dâmbovița fruit-growing area of southern Romania. The experiment was carried out under natural field conditions and focused on two economically important arthropod pests of apple:

1) the green apple aphid, *Aphis pomi* De Geer (Hemiptera: Aphididae),
2) the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae).

Separate treatments were evaluated for each target pest. For *A. pomi*, Prev-Am was applied at a concentration of 0.60%, while Teppeki was applied at 0.015%. An untreated control was maintained. For *T. urticae*, Limocide was tested at 0.80% and Kanemite SC STD at 0.05%, together with an untreated control. The concentrations and treatment structure used in the analysis correspond to those recorded in the original experimental data.

The experimental structure, including the tested products, application concentrations and number of individuals assessed for each target pest, is summarized in Table 1.

Table 1

Experimental structure of the plant protection treatments evaluated against *Aphis pomi* and *Tetranychus urticae* in 2024

Target pest	Treatment	Concentration (%)	Assessed individuals (no.)
Aphis pomi	Control	–	260
	Prev-Am	0.60	112
	Teppeki	0.015	174
Tetranychus urticae	Control	–	570
	Limocide	0.80	305
	Kanemite SC STD	0.05	290

Source: own research design

Pest assessment

Treatment response was evaluated by recording the number of dead and surviving individuals for each treatment and the corresponding untreated control. For *A. pomi*, the assessments comprised 112 individuals in the Prev-Am treatment, 174 in the Teppeki treatment and 260 in the untreated control. For *T. urticae*, 305 individuals were assessed following Limocide treatment, 290 following Kanemite SC STD treatment and 570 in the untreated control.

Observed mortality was calculated as:

$$M(\%) = \frac{N_d}{N_t} \times 100$$

where N_d is the number of dead individuals and N_t is the total number of individuals assessed.

Survival was calculated accordingly as:

$$S(\%) = \frac{N_s}{N_t} \times 100$$

where N_s represents the number of surviving individuals.

Corrected biological efficacy

Because mortality was also recorded in the untreated controls, observed mortality was not considered equivalent to treatment efficacy. Corrected biological efficacy was therefore calculated relative to control mortality using Abbott's correction:

$$E(\%) = \frac{M_t - M_c}{100 - M_c} \times 100$$

where E is corrected biological efficacy, M_t is the observed mortality (%) in the treatment and M_c is the observed mortality (%) in the corresponding untreated control.

Abbott's correction accounts for mortality occurring independently of the treatment and therefore provides a more appropriate estimate of treatment-related mortality.

For *A. pomi*, the untreated control mortality was 37.30 %, whereas for *T. urticae* it was 39.47 %. These control values were used separately when calculating corrected efficacy for the respective treatments.

Data analysis

The original experimental records provided aggregated numbers of dead and surviving individuals for each treatment and control but did not document independent experimental replicates suitable for inferential statistical analysis. Consequently, the results were analysed descriptively. Observed mortality, survival and corrected biological efficacy were calculated for each treatment, and comparisons among treatments were interpreted as numerical differences rather than statistically significant effects.

RESULTS AND DISCUSSIONS

The field experiment revealed clear differences in the biological performance of the evaluated treatments against *Aphis pomi* and *Tetranychus urticae*. Because relatively high natural mortality occurred in both untreated controls, treatment performance was assessed using both observed mortality and Abbott-corrected efficacy. This distinction was particularly important for avoiding an overestimation of treatment effects under field conditions.

Control of *Aphis pomi*

The treatments applied against *A. pomi* produced different levels of mortality compared with the untreated control (Table 2). Prev-Am resulted in 89 dead individuals from a total of 112 aphids, corresponding to an observed mortality of 79.46 %. Teppeki provided substantially stronger suppression, with 159 dead individuals from 174 observed and a mortality rate of 91.38 %. In comparison, mortality in the untreated control reached 37.31 %, confirming the occurrence of considerable background mortality within the aphid population.

Table 2

Biological efficacy of the evaluated treatments against *A. pomi* in field conditions

Treatment	Concentration (%)	Total aphids observed	Dead individuals	Observed mortality (%)	Abbott-corrected efficacy (%)
Control	–	260	97	37.31	–
Prev-Am	0.6	112	89	79.46	67.24
Teppeki	0.015	174	159	91.38	86.25

Source: own results

The correction for control mortality provided a more realistic measure of treatment-related suppression. Prev-Am achieved a corrected efficacy of 67.24 %, whereas Teppeki reached 86.25 %, representing a difference of approximately 19 percentage points between the two treatments. Therefore, although both treatments reduced aphid survival relative to the untreated control, Teppeki provided the higher level of control under the experimental conditions.

The superior performance of Teppeki is consistent with the results reported by Vasilev (2024), who found high biological efficacy of flonicamid-based treatment

against *A. pomi* in apple orchards. Flonicamid acts primarily by rapidly inhibiting aphid feeding, which can limit further plant injury before mortality is fully expressed. From an IPM perspective, such targeted suppression is relevant because aphid management should combine effective population reduction with measures that preserve the regulatory role of beneficial arthropods (Borbely and Nagy, 2022; Wojciechowicz-Zytko and Wilk, 2023).

Prev-Am showed a lower corrected efficacy, but its 67.24 % reduction relative to the untreated control indicates a measurable biological effect under field conditions. Its performance should therefore not be interpreted solely through comparison with the more effective Teppeki treatment. Products providing moderate suppression may potentially contribute to diversified pest-management programmes, particularly where reducing reliance on repeated applications of the same insecticidal mode of action is desirable. Nevertheless, the present experiment evaluated biological efficacy only; consequently, conclusions regarding compatibility with natural enemies or long-term integration into IPM programmes would require additional experimental evidence.

Control of *Tetranychus urticae*

A similar pattern of treatment differentiation was observed for *T. urticae* (Table 3). Limocide resulted in 277 dead mites from 305 individuals assessed, corresponding to an observed mortality of 90.82%. Kanemite SC STD produced the highest mortality, with 275 dead mites from 290 individuals and an observed mortality of 94.83 %. The untreated control showed a mortality of 39.47 %, again demonstrating the need to account for natural mortality when interpreting field efficacy.

Table 3

Biological efficacy of the evaluated treatments against *T.urticae* in field conditions

Treatment	Concentration (%)	Total mites observed	Dead individuals	Observed mortality (%)	Abbott-corrected efficacy (%)
Control	–	570	225	39.47	–
Limocide	0.8	305	277	90.82	84.83
Kanemite SC STD	0.05	290	275	94.83	91.45

Source: own results

After correction according to Abbott's formula, Limocide retained a high efficacy of 84.83 %, while Kanemite SC STD reached 91.45 %. The difference between the two treatments was therefore considerably smaller than that observed between the products evaluated against *A. pomi*. Both treatments achieved more than 80% corrected efficacy, indicating strong suppression of the mite population under the experimental conditions.

Kanemite SC STD provided the highest level of control, exceeding 90 % corrected efficacy. This result supports its role as an effective acaricidal treatment when *T. urticae* populations require direct intervention. However, the relatively high performance of Limocide is also noteworthy. Despite producing lower mortality than Kanemite SC STD, its Abbott-corrected efficacy of 84.83 % indicates a strong treatment response under the experimental conditions.

These results are relevant in the context of integrated mite management in apple orchards. *T. urticae* populations can increase rapidly under favourable environmental conditions, whereas intensive pesticide programmes may disrupt predatory arthropods involved in their natural regulation. Earlier orchard IPM research emphasized the integration of selective interventions with biological regulation rather than reliance on repeated chemical control (Balazs et al., 1996; Simon et al., 2010). The high efficacy obtained with both Kanemite SC STD and Limocide in the present study therefore supports treatment diversification according to pest pressure and orchard conditions. This interpretation is consistent with recent orchard research showing that effective pest suppression should be considered together with pesticide intensity and its potential effects on beneficial arthropod communities (Hatteland et al., 2023; DeVisser et al., 2024).

Comparative treatment response

The comparative response of the two target pests is summarized in Figure 1. The highest corrected efficacy recorded in the experiment was obtained with Kanemite SC STD against *T. urticae* (91.45%), followed by Teppeki against *A. pomi* (86.25%) and Limocide against *T. urticae* (84.83%). Prev-Am showed the lowest Abbott-corrected efficacy (67.24%) among the evaluated treatments.

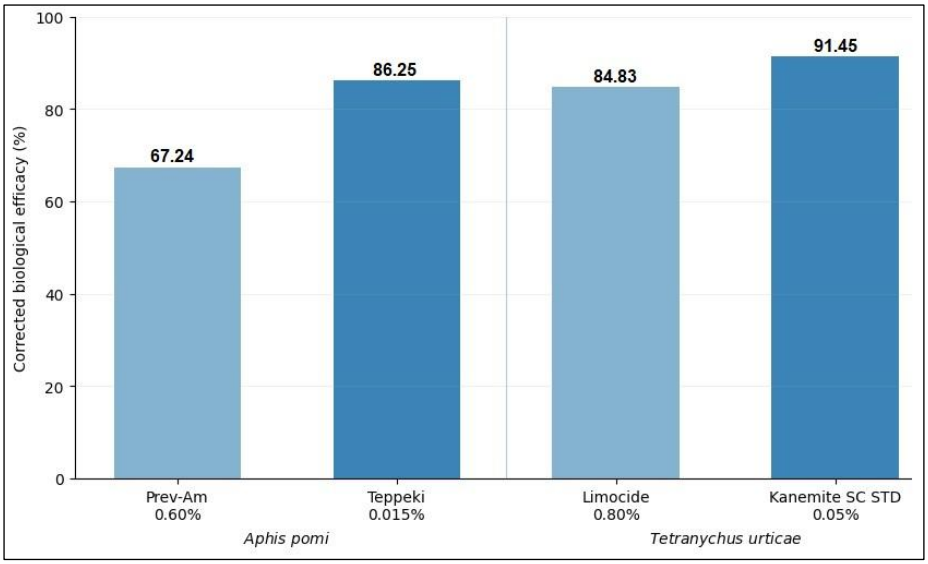


Figure 1. Abbott-corrected efficacy (%) of the evaluated treatments against *Aphis pomi* and *Tetranychus urticae* under field conditions

Figure 1 highlights two distinct response patterns. Against *A. pomi*, the difference between treatments was pronounced, with Teppeki exceeding Prev-Am by 19.01 percentage points. Against *T. urticae*, both products provided high levels of control, and the difference between Kanemite SC STD and Limocide was only 6.62 percentage points. Thus, treatment differentiation was considerably greater for aphid control than for mite control.

The results also demonstrate why corrected efficacy is preferable to direct comparison of mortality percentages in this experiment. Untreated mortality

approached 40 % for both target organisms, reaching 37.31 % for *A. pomi* and 39.47 % for *T. urticae*. Without correction, the biological contribution of the treatments would consequently appear greater than that attributable specifically to treatment exposure. The Abbott-adjusted values provide a more conservative and experimentally appropriate estimate of treatment performance.

Overall, the results support a differentiated approach to arthropod management in apple orchards rather than the selection of treatments based solely on observed mortality. Teppeki and Kanemite SC STD provided the strongest corrected suppression of their respective target pests, while Limocide also achieved high efficacy against *T. urticae* and Prev-Am produced a moderate but measurable effect against *A. pomi*.

From an IPM perspective, these differences are relevant because treatment selection should consider not only immediate efficacy, but also mode of action, pest pressure, resistance-management requirements and compatibility with beneficial arthropods (Cross et al., 2015; Hatteland et al., 2023). Further replicated and multi-year field experiments are nevertheless required before broader recommendations regarding treatment integration can be established.

CONCLUSIONS

The results obtained under orchard conditions showed that the tested products differed in their ability to control two economically important apple pests, *Aphis pomi* and *Tetranychus urticae*. Against *A. pomi*, Teppeki applied at 0.015 % provided the highest corrected biological efficacy (86.25 %), clearly exceeding the 67.24 % recorded for Prev-Am at 0.6 %. These results indicate that Teppeki ensured more effective aphid control under the experimental conditions.

For *T. urticae*, both tested products achieved high levels of control. Kanemite SC STD at 0.05 % recorded the highest Abbott-corrected efficacy (91.45 %), while Limocide at 0.8 % reached 84.83 %. Thus, although the standard acaricide provided the strongest effect, Limocide also showed substantial potential for reducing mite populations.

Overall, the results highlight the importance of selecting pest-specific products and support the consideration of products with different modes of action and characteristics within diversified apple pest-management programmes. The performance of Prev-Am and Limocide supports their further evaluation as components of diversified pest-management strategies, while Teppeki and Kanemite SC STD provided useful efficacy benchmarks under the same orchard conditions. Further multi-year evaluations would be valuable to determine the consistency of these responses under different levels of pest pressure and environmental conditions.

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REFERENCES

Balazs K., Jenser G., Bujaki G. 1996. Eight years' experiences of IPM in Hungarian apple orchards. Acta Horticulturae, 422, 95-101.

Borbely C., Nagy C. 2022. Providing sugar sources for ants improves the biological control of *Aphis* spp. in apple orchards. Biological Control, 175, 105056.

Cross J., Fountain M., Marko V., Nagy C. 2015. Arthropod ecosystem services in apple orchards and their economic benefits. Ecological Entomology, Insects and Ecosystems Services Special Issue, 40(S1), 82-96.

DeVisser A. K., Wheeler C. E., Wilson J. K., Wise J. C. 2024. Season-long control of insect pests in apple, 2023. Arthropod Management Tests, 49(1), tsae042.

Hatteland B. A., De Andrade Moral R., Jaastad G., Myren G., Bjotveit E., Sekse I. L., Westrum K., Trandem N. 2023. Pesticide use, arthropod fauna and fruit damage in apple orchards in a Nordic climate. Pest Management Science, 79(12), 5292-5303.

Shah M. A., Tramboo H. A., Rehman S. A., Rasool R., Rasool K., Yaqub S., Jaiswal R., Nabi S. U. 2026. Pre-Bloom Application of Petroleum Spray Oil for the Control of Green Apple Aphid, *Aphis pomi* De Geer in Apple Orchards. Journal of Applied Entomology, 150(1), 67-78.

Simon S., Bouvier J. C., Debras J. F., Sauphanor B. 2010. Biodiversity and pest management in orchard systems. A review. Agronomy for Sustainable Development, 30(1), 139-152.

Vasilev P. 2024. Biological efficacy of selected insecticides for the control of the green apple aphid *Aphis pomi* (De Geer, 1773) on apple in Bulgaria. Agricultural Sciences, 16(42): 22-26.

Wojciechowicz-Zytko E., Wilk, E. 2023. Surrounding semi-natural vegetation as a source of aphidophagous syrphids (Diptera, Syrphidae) for aphid control in apple orchards. Agriculture, 13(5): 1040.