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EFECTUL ERBICIDAL AL ÎNGRĂȘĂMÂNTULUI ANORGANIC ZI-END ÎNTR-O LIVADĂ PE ROD DE PIERSICI
HERBICIDAL EFFECT OF THE INORGANIC FERTILIZER ZI-END IN A FRUIT-BEARING PEACH ORCHARD

Rankova Zarya[1], Marinov-Serafimov Plamen[2], Tityanov Miroslav[3],
[1]Agricultural Academy – Sofia, Fruit Growing Institute – Plovdiv, Bulgaria. Corresponding author Zarya Rankova, e-mail rankova_zarya@abv.bg
[2]Agricultural Academy – Sofia, Institute of Ornamental and Medicinal Plants – Sofia, Bulgaria
[3]Summit Agro – Sofia, Bulgaria

Abstract

The study was conducted at the Fruit Growing Institute – Plovdiv during the period 2022–2023 in a fruit-bearing peach orchard of the 'Petrichka' cultivar, grafted on the vegetative rootstock GF 677. The herbicidal contact effect of the inorganic fertilizer ZI-END (14% water-soluble zinc) was investigated. The following treatment variants were applied: 1. Control (untreated); 2. ZI-END – 20.0 L/ha; 3. ZI-END – 30.0 L/ha; 4. Dikva 20 SL (200 g/L diquat) – 5.0 L/ha. On the 10th day after treatment, signs of phytotoxicity were observed in all herbicide-treated variants on weed species: anthocyanin coloration in grass species and chlorosis in broadleaf species – much more pronounced in variants 3 and 4 (ZI-END – 30.0 L/ha and Dikva 20 SL – 5.0 L/ha). The effectiveness of the contact action of ZI-END is largely determined by the phenological stage of weed development. When treatment is applied at an earlier stage of the ontogenetic development of weeds, a suppression of growth and development of the weed vegetation is observed. No visual symptoms of phytotoxicity or growth depression were observed in the trees. The obtained results regarding the contact herbicidal effect of both ZI-END doses and the absence of phytotoxicity on the trees provide a basis for the product to be used as a total, contact foliar herbicide during the vegetation period in fruit-bearing peach orchards.

Cuvinte cheie: buruieni, ZI-end, erbicide, fitotoxicitate.
Key words: weeds, ZI-END, herbicides, phytotoxicity.

1. Introduction

Weed vegetation is one of the limiting competitive factors affecting the development of fruit crops in relation to the main vegetative factors – moisture, light, and nutrients from the soil and those applied through fertilization (Buckelew et al., 2018; Moreno-Preciado and Balaguera-Lopez, 2021).Weed control during the growing season is carried out using mechanical methods (soil surface cultivation in the row strip with tillers equipped with deflecting sections) and through chemical methods using foliar herbicides (Mia et al., 2020). At present, the number of registered active substances with foliar, contact action authorized for use in orchards is limited (Rankova et al., 2014; Rankova et al., 2021; Rankova and Tityanov, 2023). Over the past two decades, the research of various scientists has focused on the implementation of biologically synthesized herbicides (such as pelargonic acid) into plant protection practices, as well as the use of organic acids, essential oils, fertilizers, and others that exhibit similar phytotoxic effects on existing weed species (Fallahi, 1997; Coleman and Penner, 2008; Penner et al., 2011; Li et al., 2015; Webber et al., 2018; Ciriminna et al., 2019; Casella et al., 2023; Loddo et al., 2023; Win et al., 2023; Ganji and Andert, 2024). The inorganic zinc fertilizer ZI–END, when applied at a specific dose, causes rapid desiccation of plant foliage and can be used as a desiccant in crops such as alfalfa, potatoes, and others. Its desiccating effect highlights the potential for ZI–END to be used as an inorganic contact herbicide (Summit Agro. *Product Catalog* https://sab.bg/katalog/#).

The aim of the present study was to analyze the contact herbicidal effect of the inorganic fertilizer ZI-END and to assess its potential for inclusion in integrated weed management systems in fruit orchards.

2. Material and methods

The study was conducted at the Fruit Growing Institute – Plovdiv during the period 2022–2023 in a fruit-bearing peach orchard of the 'Petrichka' cultivar, grafted on the vegetative rootstock GF 677. The contact herbicidal effect of the inorganic fertilizer ZI-END (14% water-soluble zinc) was investigated.

According to its product specification, ZI-END is an EC fertilizer containing 14% water-soluble zinc. It combines the nutritional properties of zinc with a desiccant effect, due to its formulation with a special polymer. No additional adjuvant is required for its application.

The herbicidal activity of ZI-END was assessed in comparison to a standard total contact herbicide containing diquat – the commercial product Dikva 20 SL (200 g/l diquat), as well as against a weedy untreated control. The experimental setup included the following treatment variants:

1. Control (untreated);
2. ZI-END – 20.0 L/ha;
3. ZI-END – 30.0 L/ha;
4. Dikva 20 SL (200 g/l diquat) – 5.0 L/ha.

The treatments were applied once during the growing season (July) within the in-row strip of the orchard, using directed spraying that avoided contact with the green biomass of the trees. The following indicators were monitored: the time of onset of initial phytotoxic symptoms in weed species, duration of the herbicidal effect, and the occurrence of external symptoms of phytotoxicity or any visible growth disturbances in the trees.

The impact of the applied herbicides on tree growth was evaluated by recording biometric indicators at the end of the vegetation period (November), including: tree height (m), trunk cross-sectional area (cm^2), crown volume (m^3), and crown projection area (m^2). The obtained results were statistically processed using analysis of variance (ANOVA).

3. Results and discussions

The results regarding the weed species composition and herbicidal efficacy of the applied products were consistent across the study years. The following weed species were identified in the in-row strip of the orchard: *Stellaria media* L., *Veronica hederifolia* L., *Geranium dissectum* L., *Sonchus oleraceus* L., *Chenopodium album* L., *Amaranthus retroflexus* L., *Portulaca oleracea* L., *Sorghum halepense* L., *Cirsium arvense* L., and *Convolvulus arvensis* L.

The first symptoms of phytotoxicity in weeds appeared on days 4–5 in variants 3 (ZI-END – 30.0 L/ha) and 4 (Dikva 20 SL – 5.0 L/ha). These symptoms included anthocyanin coloration in grass species (*Sorghum halepense*) and chlorosis (white leaf spots) in annual broadleaf weeds such as *Stellaria media*, *Sonchus oleraceus*, and *Chenopodium album*.

By day 10, phytotoxicity symptoms were observed in all herbicide-treated variants. In grass species, anthocyanin coloration and chlorosis were strongly expressed, particularly in variants 3 and 4 (ZI-END – 30.0 L/ha and Dikva 20 SL – 5.0 L/ha). In variant 2 (ZI-END – 20.0 L/ha), the symptoms were noticeably weaker. In variant 3, phytotoxic effects were also strongly expressed in taller weed species, indicating that the higher dose of ZI-END had greater efficacy.

The herbicidal effect of ZI-END persisted for approximately 60 days, with visible suppression of weed growth and development. Thus, the effectiveness of the contact action of ZI-END is largely dependent on the phenological stage of weed development. Weed species at the emergence stage and up to about 10 cm in height were highly affected by ZI-END treatment, showing strong phytotoxic symptoms such as white leaf spots in broadleaf species or anthocyanin coloration in grasses, followed by chlorosis and plant death.

No visual symptoms of phytotoxicity (chlorosis, necrosis) or growth depression were observed on the trees in the experimental orchard. The results of the biometric analysis conducted at the end of the vegetation period are presented in Figures 4 and 5. For all monitored biometric parameters, the values in the herbicide-treated variants were similar to those in the control. The differences were not statistically significant.

The obtained results regarding the herbicidal effect of the tested ZI-END doses provide grounds to assume its potential use as an analogue to foliar contact herbicides. In 2018, the European Commission published Regulation (EU 2018/1532), banning the use of the active substance diquat in herbicidal commercial formulations within the Union, as a result of requirements to reduce pesticide usage. Against the backdrop of increasing demands for the application of environmentally friendly approaches to weed control and pesticide reduction, the need to implement modern, ecologically oriented practices in weed management has become particularly relevant. Similar screening studies have established the suitability of **Segador** (a biological fertilizer with contact herbicidal effects for weed control) as a means to limit the spread of *Rumex crispus L.* in uncultivated areas (Marinov-Serafimov and Golubinova, 2015), and to control **dodder** (*Cuscuta epithymum L.*) in alfalfa (*Medicago sativa L.*). It has been established that Segador can be applied independently (as a 5.0% solution) or in combination with the adjuvant Melamiel

(400.0 mL/ha) in alfalfa (*Medicago sativa L.*) during the establishment year at the third–fourth trifoliate leaf stage, as well as at the budding stage in the seed production year, to control *Cuscuta epithymum L.* (Marinov-Serafimov et al., 2018).

4. Conclusions

On the 10th day, phytotoxicity symptoms were observed in all herbicide-treated variants: anthocyanin coloration in grassy weed species and chlorosis in broadleaf weed species – much more pronounced in variants 3 and 4 (ZI-END – 30.0 L/ha and Dikva 20 SL – 5.0 L/ha). The phytotoxicity symptoms in the variant with the lower dose of ZI-END (20.0 L/ha) were less pronounced.

The efficacy of the contact action of ZI-END largely depends on the phenophase of the weed vegetation. Treatment at an earlier phenological stage results in growth and development inhibition of the weed vegetation.

No visual symptoms of phytotoxicity or growth depression were observed on the trees in the experimental orchard. Parameters such as trunk cross-sectional area, crown volume, and crown projection area tended to show similar values in the variants treated with both tested doses of ZI-END compared to the control.

The obtained results on the contact herbicidal action of both doses of ZI-END and the absence of phytotoxicity on the trees support the use of this product as a total, contact foliar herbicide during the growing season.

References

1. Buckelew J., Mitchem W., Chaudhari S., Monks D., Jennings K., 2018. Evaluating weed control and response of newly planted peach trees to herbicides. International Journal of Fruit Science, 18(4), 383–393.
2. Casella F., Vurro M., Valerio F., Perrino E., Mezzapesa G., Boari A., 2023. Phytotoxic effects of essential oils from six lamiaceae species. Agronomy, 13(1), 257.
3. Ciriminna R., Fidalgo A., Ilharco L., Pagliaro M., 2019. Herbicides based on pelargonic acid: Herbicides of the bioeconomy. Biofpr., 13(6), 1476–1482.
4. Coleman R., Penner D., 2008. Organic Acid Enhancement of Pelargonic Acid. Weed Technology, 22(1), 38–41.
5. Fallahi E., 1997. Applications of Endothalic Acid, Pelargonic Acid, and Hydrogen Cyanamide for Blossom Thinning in Apple and Peach. HortTechnology, 7, 395–399.
6. Ganji E., Andert S., 2024. The effect of two-year application of pelargonic acid on the growth of *Cirsium arvense* (L.) Scop. and *Sonchus arvensis* L. Frontiers in Agronomy, 6:1330199.
7. Li J., Zhang Q., Hu W., Yang X., H.Xe, 2015. Stability of phenolic acids and the effect on weed control activity. Journal of the Korean Society for Applied Biological Chemistry, 58, 919–926.
8. Loddo D., Jagarapu K., Strati E., Trespidi G., Nikolić N., Masin R., Berti A., Otto S., 2023. Assessing Herbicide Efficacy of Pelargonic Acid on Several Weed Species. Agronomy, 13(6), 1511.
9. Marinov-Serafimov P., Golubinova I., 2015. The efficiency of organic herbicide Segador in controlling growth and regrowth of Curly Dock (*Rumex crispus* L.) in non-cropped areas. International Journal of Pharmacy & Life Sciences, 6(10-11), 4760-4767.
10. Marinov-Serafimov P., Golubinova I., Kertikova D., Kertikov T., 2018. Opportunities of use of the Segador (organic fertilizer with contact herbicidal effect) for control of dodder (*Cuscuta epithymum* L.) in alfalfa (*Medicago sativa* L.). Journal of Mountain Agriculture on the Balkans, 21 (5), 84-94.
11. Mia M., Massetani F., Murri G., Neri D., 2020. Sustainable alternatives to chemicals for weed control in the orchard – a Review. Horticultural Science (Prague), 47, 1–12.
12. Moreno-Preciado O., Balaguera-Lopez H., 2021. Caracterización de la comunidad de malezas y su diversidad en una modelación estadística en un cultivo de duraznero (*Prunus persica* (L.) Batsch.). Revista U.D.C.A Actualidad & Divulgación Científica, 24(1), 1734.
13. Penner D., Coleman R., Michael J., Devisetty B., Dean S., 2011. Novel Formulations of an Organic Acid Herbicide. Journal of ASTM International, 8, 103400.
14. Rankova Z., Tityanov M., Kolev K., 2014. Efficiency and Selectivity of the Herbicide Flumioxazin (Pledge 50 WP) in Intensive Cherry Orchards. Journal of Mountain Agriculture on the Balkans, 17(2), 469-480.
15. Rankova Z., Staneva I., Tityanov M., 2021. Efficiency and Selectivity of the Herbicide Combination Pledge 50 WP and Targa Super 5 EC in Peach Orchards. Journal of Mountain Agriculture on the Balkans, 24(2), 221-231.
16. Rankova Z., Tityanov M., 2023. Efficiency and selectivity of the herbicides Pyrafludim and Ecopart Turbo in peach plantations. Journal of Mountain Agriculture on the Balkans, 26(4), 355–366.

17. Regulation (EU) 2018/1532 on the non-renewal of the approval of the active substance diquat. Available at: ELI: http://data.europa.eu/eli/reg_impl/2018/1532/oj.
18. Summit Agro. *Product Catalog*. Available at: https://sab.bg/katalog/#
19. Webber Ch., White Jr. P., Shrefler J., Spaunhors D., 2018. Impact of Acetic Acid Concentration, Application Volume, and Adjuvants on Weed Control Efficacy. Journal of Agricultural Science, 10(8), 1-10.
20. Win P.P., Park H.H., Kuk Y.I., 2023. Control Efficacy of Natural Products on Broadleaf and Grass Weeds Using Various Application Methods. Agronomy, 13(9), 2262.

Figures

Fig. 1. Chlorosis (white spots) on *Amaranthus retroflexus* leaves treated with ZI-END – 30.0 L/ha, 15th day after application

Fig. 2. Chlorosis (white spots) on *Chenopodium album* leaves treated with ZI-END – 30.0 L/ha, 15th day after application

Fig. 3. Phytotoxicity symptoms on *Sorghum halepense* leaves treated with ZI-END – 30.0 L/ha, 15th day after application

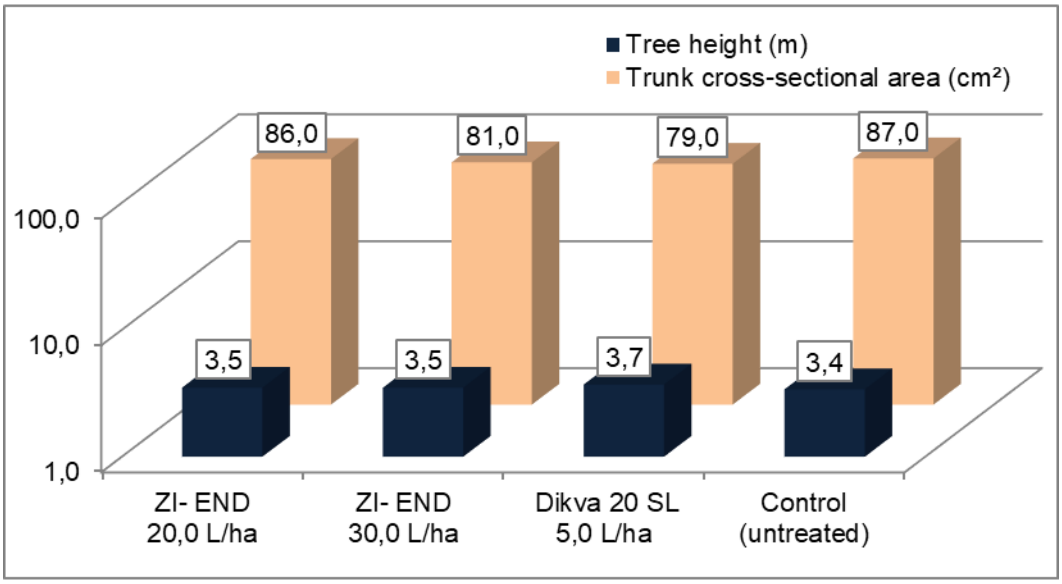

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Fig. 4. Effect of applied herbicides on the height and trunk cross-sectional area of peach trees, *'Petrichka'* cultivar, grafted on the vegetative rootstock GF 677

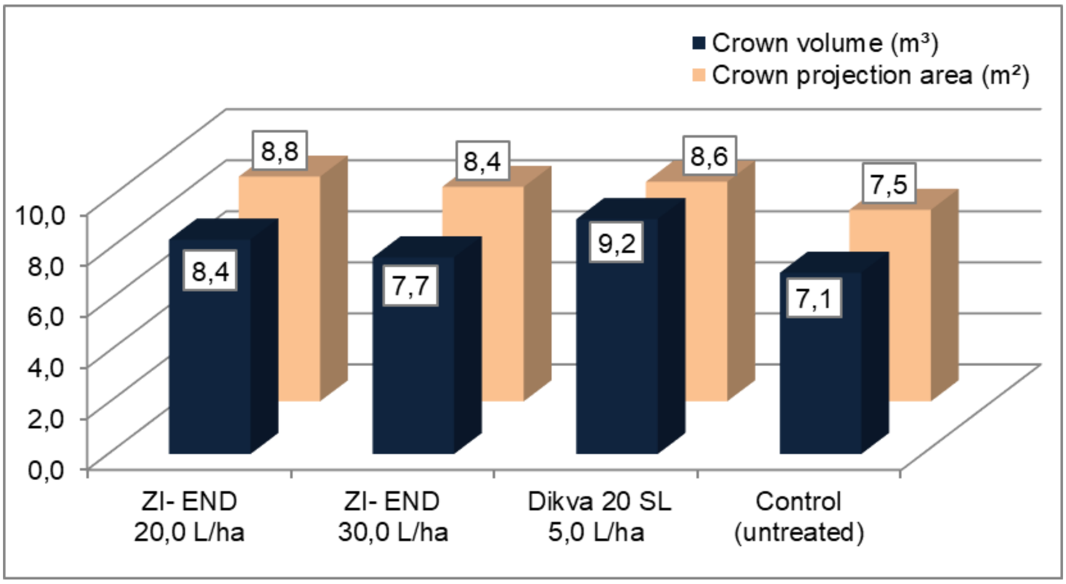

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Fig. 5. Effect of applied herbicides on the volume and projection area of the crown of peach trees, *'Petrichka'* cultivar, grafted on the vegetative rootstock GF 677