Testing the Efficacy Of Pelargonic Acid And Acetic Acid For Weed Control In An Apple Orchard

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Introduction

Pelargonic acid is the most successful natural herbicide and can contribute to reducing synthetic herbicides . Pelargonic acid (hereafter: PA) ($CH_3(CH_2)_7CO_2H$, n-nonanoic acid) is a saturated, nine-carbon fatty acid. PA is present as esters in the essential oil of species of the genus Pelargonium but can easily be produced from several vegetal oils. (D. Loddo et al., 2023)

Materials and Methods

Biological material

The trial was conducted in a 5-year-old apple orchard, represented by the "Florina" and "Idared" apple cultivars. These cultivars are well known for their long-term storage qualities. "Florina" is a new variety obtained in Angers, France, in 1977 and introduced and licensed in Romania in 1993 , and "Idared" was released into the market in 1942 by The University of Idaho.

Acids

Pelargonic acid was provided by our partners, AgroLYNX Zrt, from Hungary as part of the Conserwa project.

The acetic acid used in this trial was purchased from the market and is a food product derived from refined ethyl alcohol through natural fermentation. Acetic concentration is 90 grams/liter.

Herbicide

Based on the first reading of weeds, we used a commercial herbicide with the active ingredient fluazifop-P-butil at 150 g/l, classified as a post-emergence systemic herbicide, very active in controlling annual and perennial grass weeds in broadleaf crops.

Study location

The experiment took place at Moara Domneasca base part of Research and Development Station for Fruit Tree Growing Baneasa, Bucharest. The climatic conditions and facilities were noted and are appropriate for apple tree orchards.

Experimental Design

The trial was conducted on 165 apple trees, both "Florina" and "Idared" cultivars. Trees are distributed 33 on a row, and we took a trial of 5 rows (Figure 1). The experimental variants were AWM - Agro-ecological Weed Management practice with, Natural Herbicide Treatment (Pelargonic acid) V1 – applied between plants along the row direction, Natural Herbicide Treatment (Acetic acid) V2 – applied between plants along the row direction, Mechanical treatment V4- soil disturbance or mowing between plants plants along the row direction (Melander et al, 2022) and Control with on-farm practice - Use of conventional herbicides - between between plants along the row direction V3 , No treatment V5.

Apple cultivar	*Variant*	*Treatment*
"Florina" and "Idared"	V1	Pelargonic acid
	V2	Acetic acid
	V3	Conventional herbicide
	V4	Mechanical treatment
	V5	No treatment

Figure 1. Experimental design

Preparation of herbicide substances

Pelargonic acid was prepared under the instructions provided by AgroLYNX Zrt representative. For a surface area of 29 m2, we used 58 ml of pelargoic product in 1,15 L of water.

For the acetic acid herbicide, following the exact instructions above, we used 30 ml of acetic acid purchased from a store, combined with 2,9 L of water.

The used herbicide, fluazifop-P-butil at 150 g/l , was combined with water according to the production data sheet.

Measurments

Weeds were surveyed before applying the substances. After the treatment, three more weed surveys were done. AgroLYNX Zrt indicated that the first survey would take place on the 5th day after treatment, the 2nd survey after seven more days, and the 3rd survey after 30 days.

Results and discussion

The aim was to identify weed control outcomes from applying a natural herbicide compared with a chemical herbicide.

At the beginning of the trial, a weed survey was made to see their evolution after the applied treatment.

Acid treatments (Acetic Acid, Pelargonic Acid) partially reduce both broadleaf weeds (dicots) and grasses (monocots), but important densities still remain for certain species, especially Amaranthus, Setaria, and Portulaca (Ganji, E., & Andert, S. ,2024). Conventional treatment and mechanical weeding leave, overall, fewer weeds per m^2 than "No treatment", but problematic species still occur, so control is not complete.

No Treatment naturally shows the highest total weed densities.

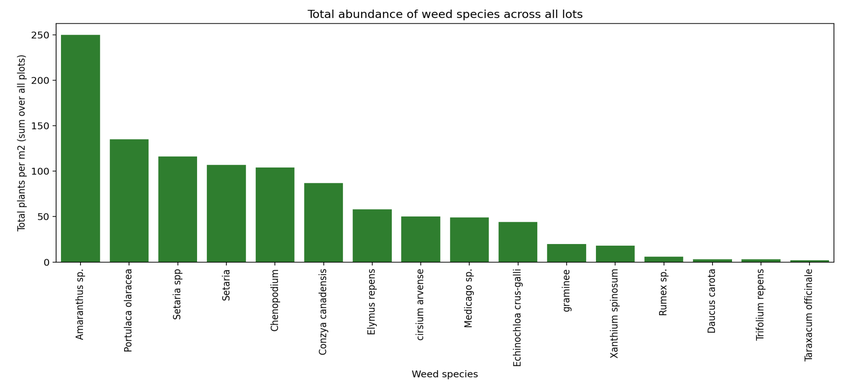
Some species seem more resistant (or re-infest quickly) under certain treatments; in the examples from the table, Amaranthus sp. remains at relatively high densities in the acid treatments.Setaria spp. (a monocot/grass) is consistently present, suggesting that the treatments do not eliminate it completely.Portulaca oleracea reappears at appreciable densities, especially under Acetic Acid.

Mechanical weeding remains the treatment with the lowest total number of weeds.

Intermediate level: "Conventional" is in the middle, with more weeds than mechanical weeding, but fewer than the acid treatments and "No Treatment".

Weakest (highest total weed pressure): Acetic Acid, Pelargonic Acid," No Treatment"

Overall, mechanical weeding provides the best weed control, while acid treatments and the untreated variant show the highest infestations.

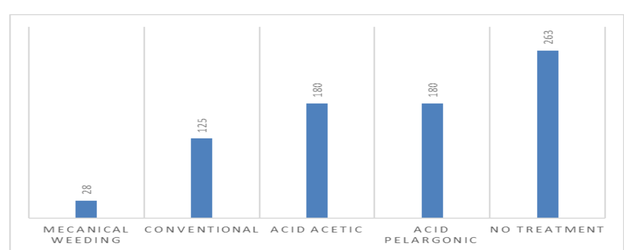


Across all treatments, the weed community is clearly dominated by dicotyledonous species, while monocotyledonous weeds represent a smaller share of the total infestation.

When separating weeds into functional groups (monocots vs dicots), all treatments show higher total densities of dicots than monocots. This indicates that, in the current stage of the experiment, dicot weeds are the main target group that needs to be controlled.

Preliminary results show that:

- All treatments leave a substantial number of dicot weeds,
- Monocot weeds occur at lower overall densities and are less critical than dicots in this dataset.
- In practical terms, weed management strategies for this experiment should prioritize broadleaf (dicot) control, as they currently represent the majority of the weed pressure in the field.



Conclusion

Conventional treatment was the most effective and consistent option, reducing total weed density from 105 → 36 → 21 plants/m^2 (about 66% by T1 and 80% by T2) and also reducing the number of weed species (from 9 at T0 to 3 at T1/T2).

Pelargonic acid (PA) showed a moderate, more gradual effect, with weeds decreasing from 29 → 27 → 17 plants/m^2 (about 41% by T2) and a reduction in weed species richness (from 8 to 4). This suggests partial control, likely needing repeated applications and/or integration with other methods.

Acetic acid (AA) showed limited and inconsistent control, with 87 → 93 → 75 plants/m^2 (a small net reduction of about 14% by T2).

No Treatment stayed essentially unchanged (130 → 127 → 131 plants/m^2), which supports that the reductions seen in treated plots are due to the interventions rather than normal seasonal variation.

Mechanical Weeding has only T0 data in this file (≈ 28 plants/m^2), so its persistence/effectiveness over time can't be concluded from the available records.

Overall: under your field conditions, the Conventional approach delivered the strongest and most stable weed suppression; among the alternative AWM acids, Pelargonic acid performed better than Acetic acid, but neither matched the conventional program in sustained control.

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