

Evaluation of the efficacy of magnesium sulphate against aphids in organic raspberry production

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Abstract

In a field trial, the effects of foliar application of magnesium sulfate (Epsom salt, epsoTOP®) on aphid infestation and leaf sugar content in organically cultivated raspberry plants in Switzerland were investigated. Aphid numbers tended to be 50-80 % lower in the magnesium sulfate treatment compared to untreated plants, the difference being marginally not statistically significant ($p = 0.0829$). There was a tendency towards lower sugar content in treated leaves, indicating potential effects of the treatment on sugar content. Further field trials with larger sample sizes and a more robust experimental design are needed to confirm these trends.

Keywords: organic raspberry production, magnesium sulphate, pests, aphids

Introduction

A major challenge in organic berry production is aphid control. In raspberries, aphids are economically important pests both as direct feeders, reducing plant vigor, fruit quality, and yield, and as vectors of viruses. The most important aphid species in raspberry is the small raspberry aphid (*Aphis idaei*) (Schubiger, 2025). Magnesium sulfate ($MgSO_4$), commonly used as a foliar fertilizer to improve magnesium supply, may also affect plant–aphid interactions. Dries et al. (2024) showed that foliar applications of $MgSO_4$ in peppers can reduce aphid populations by enhancing the translocation of carbohydrates and amino acids from leaves to fruits, thereby reducing nutrient availability in leaves. In a field trial the potential of $MgSO_4$ to reduce aphid infestations and the effect on sugar content in organic raspberry production was investigated.

Material and Methods

The field trial was carried out from April to June 2025 in an organically managed raspberry plantation in Schnottwil, (Switzerland, 559 m.a.s.l., around 1570 mm mean annual precipitation). Four primocane raspberry varieties (Amira, Himbotop, Polka, Regina) were tested on a total area of approximately 0.95 hectares. Foliar treatments were applied on April 27, May 2 and May 14 using a trailed fan sprayer to apply a 2.5% $MgSO_4$ solution (epsoTOP®) at 200–400 L ha⁻¹, together with standard fertilizer and biocontrol applications. Aphid infestation was monitored on all canes on May 22. For the variety Regina, leaf sap samples were pooled and analysed according to leaf age, with separate pools prepared for young and old leaves. The leaf sap analysis was performed by NovaCropControl (Oisterwijk, the Netherlands). Statistical analysis was done with R for aphid infestation and parameters (sugar, magnesium and sulphur) of the sap samples.

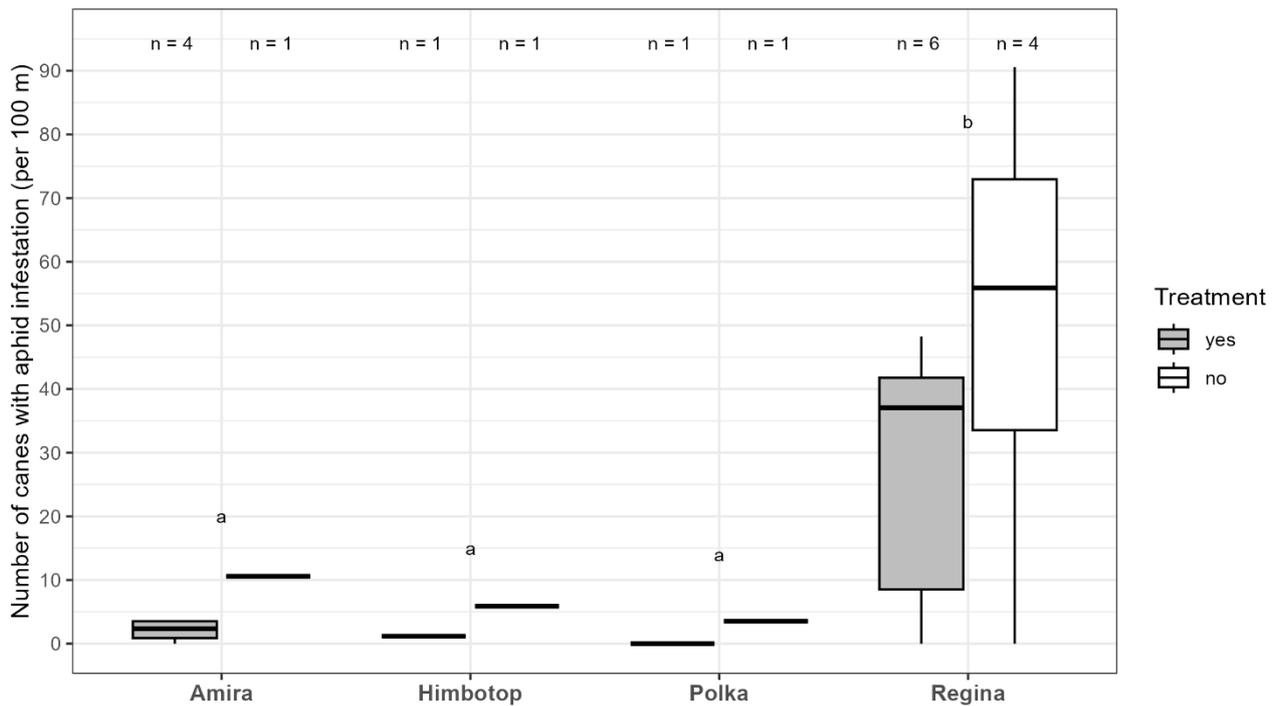
Results

Aphid infestation rate was significantly higher in the cultivar ‘Regina’ compared to the other varieties ($p = 0.0012$). The foliar application of $MgSO_4$ had no significant effect on aphid infestation ($p = 0.0829$), although a strong trend towards lower infestation was observed in

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the treated plots of the main variety 'Regina' (10 rows), with approximately 84% fewer infested canes compared to the untreated control (Figure 1).

The leaf sap analysis indicated that most parameters were influenced primarily by leaf age rather than by the treatment. Magnesium and sulphur concentrations were lower in treated plants, while higher concentrations were found in the untreated group. However, these differences were not statistically significant. Variations in sugar content between old and young leaves were mainly attributed to leaf age and not to the treatment. Although treated leaves tended to show slightly lower sugar contents, this trend was not statistically supported ($p = 0.560$) (Figure 2).



Treatment: $p = 0.0829$ (.)
 Variety 'Regina': $p = 0.0012$ (**)

Figure 1: Number of canes with aphid infestation by treatment and variety. To analyse aphid infestation, a generalized linear model (GLM) with a negative binomial distribution was applied. Each n corresponds to one row consisting of 100 meters (app. 1'200 canes, 24 canes per meter).

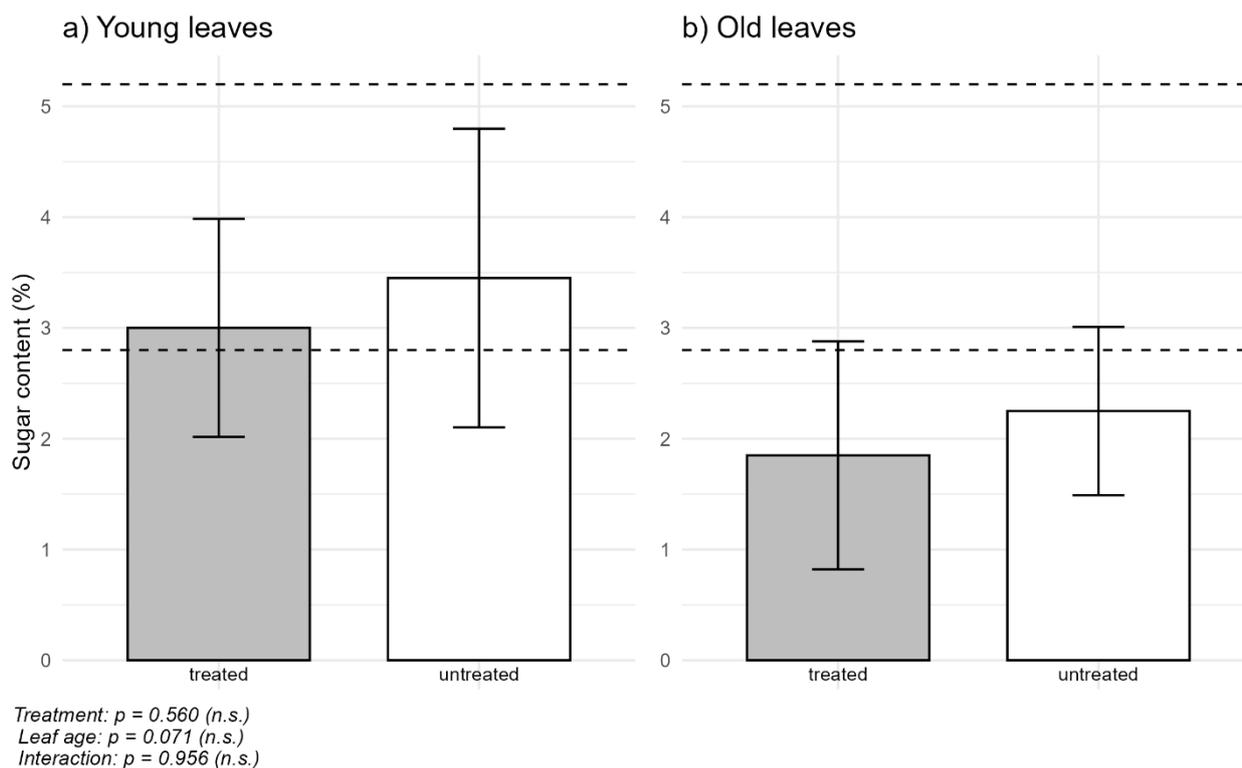


Figure 2: Average sugar content (%) in young and old leaves by treatment for the variety 'Regina'. To analyse the data of the sugar content, a linear mixed-effects model (LMM) was applied. The dotted lines show the minimal and the maximal value of the optimal range as defined by NovaCropControl. Only old leaves were treated, whereas young leaves developed after the treatments with MgSO_4 .

Discussion

The raspberry variety 'Regina' was found to be more susceptible to aphid infestation than the other tested varieties (Amira, Himbotop, Polka). Consequently, its use is not recommended under conditions of high aphid pressure. Treatment with MgSO_4 showed a strong tendency towards lower aphid infestation on treated plants, the effect being only marginally not significant. Additional analysis focusing only on the variety 'Regina' was limited by the small sample size of just ten rows, resulting in inconclusive significance despite observed effects.

The leaf analysis shows that almost all analysed leaf components differed significantly between old and young leaves. The MgSO_4 applications were limited to the older leaves during their growth phase, while the young leaves developed after the applications. Therefore, direct effects on leaf components were expected mainly in older leaves. Young leaves, which developed after the treatments, could only have been influenced indirectly, for instance through nutrient redistribution from older leaves (e.g. magnesium).

Sugar content was primarily determined by leaf age, with no direct effect of MgSO_4 treatment detected. Older leaves contained sugar levels below the optimal range recommended by NovaCropControl, while young leaves were at the lower end of the optimal range. A tendency towards lower sugar content in treated older leaves was observed but was not statistically significant. The consistently lower sugar content in old leaves, including untreated ones, suggest that leaf age is the dominant factor influencing the sugar metabolism, likely due to physiological changes during leaf maturation, rather than the different MgSO_4 application between young and old leaves itself.

Contrary to expectations, magnesium and sulphur concentrations were not higher in treated leaves. In fact, the untreated plants tended to show slightly higher levels of magnesium and sulphur in both old and young leaves, although differences were not statistically significant (data not shown). These findings contrast with those of Dries et al. (2024), who reported a marked increase in leaf magnesium and sulphur following MgSO₄ foliar application. Unlike the peppers cultivated under controlled greenhouse conditions in the referenced study, the raspberries of the trial were grown outdoors. In addition, species-specific differences in foliar nutrient uptake may have contributed to the observed differences in response to MgSO₄ foliar application.

In summary, the observed trends partially align with findings by Dries et al. (2024), which demonstrated that foliar MgSO₄ application reduced aphid infestation and decreased sugar content in pepper leaves. In our trial, however, MgSO₄ treatments did not lead to statistically significant differences in neither aphid infestation nor leaf sugar content in raspberry plants. Nevertheless, the observed tendencies towards reduced aphid infestation and lower sugar content in treated older leaves strongly suggest possible treatment effects. These preliminary findings warrant further investigation with a larger sample size and a more robust experimental design to clarify the observed trends.

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