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Grapevine Girdling by Morphactin in Oil

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Abstract. **Morphactin in spray oil and butanol as emulsifier applied to the bark of grapevine (*Vitis vinifera* L.) trunks caused girdling effects. Treatment of 'Thompson Seedless' after fruit set increased berry size and treatment of 'Perlette' and 'Muscat of Hamburg' before harvest advanced maturation. A comparison between chemical and mechanical girdling showed that the former was somewhat less effective than the latter.**

Morphactins are synthetic growth inhibitors (5, 6). Bark applications of morphactin have been shown to inhibit the growth of pine and eucalyptus (1, 4, 5). Chemical girdling, when used to control the alternate bearing of olives, was useful and easier to execute than knife girdling (2, 3).

Girdling is an old viticultural practice. Performed after fruit set, it increases the size of individual berries and girdling 3 to 4 weeks before ripening and enhances maturation (8). Girdling in grapevines is performed by removing a narrow ring of bark around the trunk with a double-bladed knife. This operation requires skilled workers and is rather time-consuming (2, 3, 8). In the present work, we studied the effect of morphactins as a chemical girdling agent in comparison with mechanical knife girdling.

Treatments with 200–600 mg·liter^{-1} morphactin consisted of painting the material on a 15–30-cm width of the bark of the trunk of 3 cultivars. Parallel knife girdling was performed in all plots. In the coastal plain, 'Thompson Seedless' was treated after fruit set (19 May) and 'Perlette' and 'Muscat of Hamburg' were treated 4 and 6 weeks before harvest (17 May and 20 June, respectively). In the Jordan Valley, treatments with 400 mg·liter^{-1} morphactin and knife girdling were performed on 'Perlette' vines 6, 4, and 2 weeks before harvest. In all experiments, we used a commercial morphactin formulation, CF 125, containing 12.5% total morphactin (Agan Co., Israel). The active fraction contained 8.8% methyl-2-chloro-9-hydroxy fluorene-9-carboxylate, 2.1% methyl-hydroxy fluorene-9-carboxylate, and 1.6% methyl-2-dichloro-9-hydroxy fluorene-9-carboxylate (1). The carrier of the morphactin was a narrow distillation range spray oil, "Neurol 99" (Paz Chim Co., Israel), commonly used for breaking dormancy. Five percent n-butanol was added as an emulsifier (3). Vines also were treated with the oil plus emulsifier alone, and knife- and untreated vines were used as control. The morphactin solution was applied by a paint brush at a width double that of the trunk diameter (15–30 cm). Pieces of loose bark were removed before the application. Mechanical girdling was performed with a double-bladed knife, which removed a 4.5-mm-wide ring of bark from the trunk.

Berry weight, total soluble solids (TSS), and acid content were determined at harvest (7, 8). Red color intensity of 'Muscat of Hamburg' berries was determined in the juice of macerated berries by measuring the optical density at 520 mm. (7).

Each treatment consisted of 4 replications of 3 vines. The samples from each replication consisted of 50 berries taken from 20 clusters.

Morphactin treatments of 300 and 600 mg·liter^{-1} to 'Thompson Seedless' vines after fruit set increased the average berry size to 2.82 and 2.86 g, respectively. The control was 2.65 g. Knife girdling was more effective, increasing berry size to 3.00 g (Fig. 1). Both morphactin treatments reduced the level of acidity from 0.93% in the control to 0.82% and raised the TSS level from 15% to 16.6% and 17%, respectively. The oil treatment also slightly increased berry size and TSS content, but had no effect on the acidity. Knife girdling increased the acidity slightly in the berries but had no effect on the TSS level.

Morphactin treatments to 'Perlette' 4 weeks before harvest increased berry size and TSS level, and decreased acidity. The oil plus emulsifier treatment also increased berry size and TSS and reduced the acidity. Knife girdling had the strongest effect in increasing berry size and TSS, but acidity remained high and even rose slightly over the control (Fig. 2). Vines receiving the 200 mg·liter^{-1} morphactin treatment were the first to mature, due to an early favorable TSS : acid ratio.

Morphactin at 500 mg·liter^{-1} had no effect on berry size and nearly none on acidity when applied to 'Muscat of Hamburg' 6 weeks before harvest. It did, however, increase the TSS and red color intensity of the berry skin. Knife girdling had a similar effect but also increased the berry size (Table 1). Chemical girdling with reduced morphactin concentrations had no effect on 'Muscat of Hamburg'.

Morphactin treatments of 400 mg·liter^{-1} to trunks of 'Perlette' in the Jordan Valley 6 weeks before harvest increased berry weight and TSS level and decreased acidity. Knife girdling had similar effects on berry weight and TSS but only a slight effect on acidity (Fig. 3). When given 4 weeks before harvest, the chemical girdling treatment slightly affected berry size or maturation, whereas knife girdling was still effective. Morphactin and knife girdling treatments raised sugar levels and slightly affected berry weight and acidity levels when applied 2 weeks before harvest.

Neither chemical nor mechanical girdling caused any visible weakening of the growth in the present or in the following year. In the spring of the following season, the bark in 'Perlette' in the morphactin-treated section of the trunk was somewhat soft and spongy in a few instances, but no subsequent damage to the vines was noted.

Our data show that bark application of 200–600 mg·liter^{-1} morphactin increased berry size and advanced TSS accumulation. Chemical girdling was generally was less effective than mechanical girdling. In most instances, morphactin was more active than knife girdling in reducing the acid content of the berries.

The size of seedless grape berries can be increased appreciably by knife girdling during the first period of rapid berry growth (8). Chemical girdling with morphactin at that time also could increase berry size but also could enhance maturity when the TSS in the control was low, whereas knife girdling could not. Knife girdling enhanced maturation when applied a few weeks before harvest (8). Chemical girdling had an effect similar to that of knife girdling and, with seedless cul-

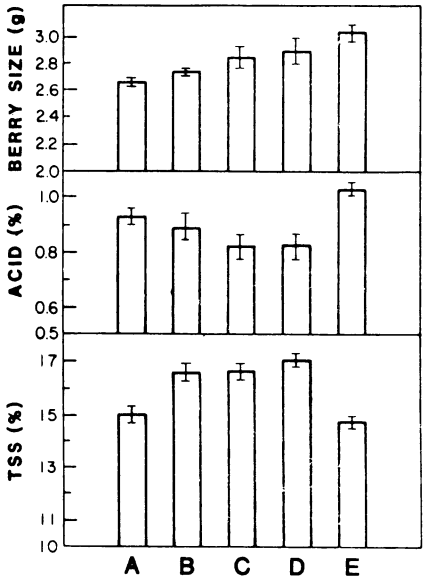

Fig. 1. The effect of morphactin application and knife girdling (± SE) after fruit set on berry size and maturation of 'Thompson Seedless' fruit. A = untreated, B = oil + emulsifier, c = 300 mg·liter^{-1} morphactin in oil, D = 600 mg·liter^{-1} morphactin in oil, and E = knife girdling (treatment 19 May, harvest 25 July).

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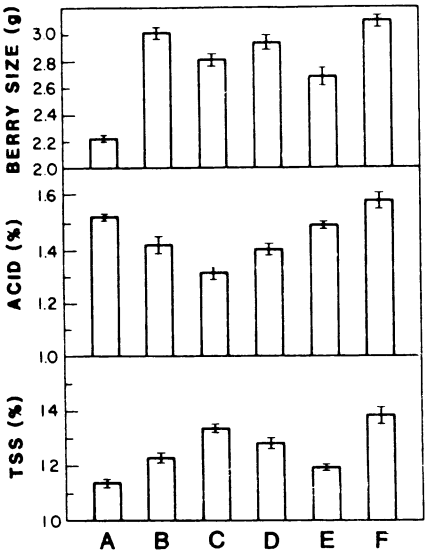

Fig. 2. The effect of morphactin application and knife girdling (±SE), 4 weeks before harvest, on berry size and maturation of 'Perlette' fruit. A = untreated, B = oil + emulsifier, C = 200 mg·liter^{-1}, D = 400 mg·liter^{-1}, E = 600 mg·liter^{-1} morphactin in oil, F = knife girdling (treatment 17 May, harvest 16 June).

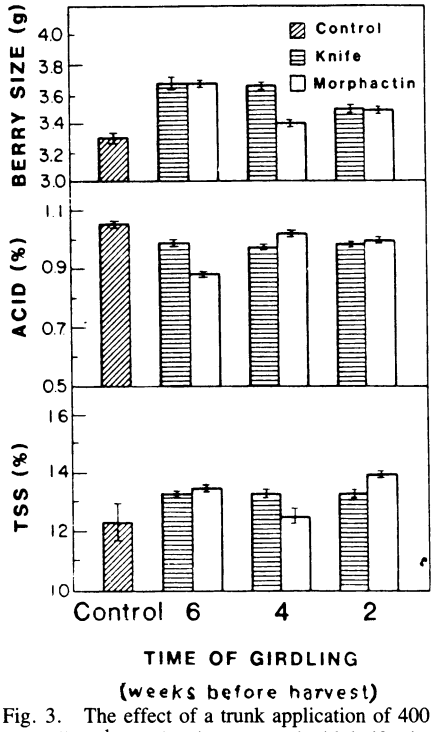

Fig. 3. The effect of a trunk application of 400 mg·liter^{-1} morphactin compared with knife girdling (±SE) 6, 4, and 2 weeks before harvest on berry size and maturation of 'Perlette' vines in the Jordan Valley (harvest 5 June).

tivars, the effect was increased due to reduced level of acidity.

The lack of response in some instances can be attributed to differences in season or in management practices.

The softening of the morphactin-treated sections of the trunk probably was due to changes in cambial and peridermal activity (1, 6). Hence, the rate of assimilates and plant hormones movement in the vine probably was reduced.

Table 1. The effect of trunk application of 500 mg·liter^{-1} morphactin 6 weeks before harvest, on berry size and maturation (±SE) of 'Muscat of Hamburg' grapevines (treatment 20 June, harvest 13 July).

Treatment	Berry size (g)	TSS (%)	Acidity (%)	Color (o.d. 520 nm)
Control	3.87 ± 0.07	13.58 ± 0.35	0.67 ± 0.01	0.67 ± 0.07
Morphactin in oil	3.80 ± 0.06	14.58 ± 0.36	0.63 ± 0.03	0.87 ± 0.12
Knife girdling	4.21 ± 0.25	14.92 ± 0.24	0.59 ± 0.02	0.93 ± 0.14

An oil base as carrier for the morphactins has been shown to be necessary for penetrating the bark (1, 4). In previous experiments with olives and other trees, oil controls rarely caused girdling effects (1, 3). In this work the oil together with butanol caused an independent girdling effect, probably due to some direct damage caused to the bark of grapevines.

Girdling is an important tool in viticulture for enhancing berry set, fruit size, and maturation (8). Chemical girdling might be a new and efficient way to achieve these objectives. However, further work is needed before it can be commercially applied.

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