

Do smaller navel-ends mean lower pest levels?

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Introduction

Large navel-end openings can provide a refuge for insect pests, such as mealybugs, which protect them against control measures (Berlinger and Goldberg, 1978; Hattingh et al., 1995; Moore et al., 1997). Foliar application of the plant growth regulator and synthetic auxin, 2,4-dichlorophenoxy acetic acid (2,4-D), during flowering reduces the size of the navel-end opening and the proportion of navel-ends that are open (Mupambi et al., 2015; Stander et al., 2017). The ideal timing for optimal results for such an application is during full bloom (Mupambi et al., 2015). Consequently, 2,4-D is registered for such use on Navel oranges as a medium cover diffuse spray (in combination with tebuconazole) (Standar, 2018). This inhibits the premature development of micro-cracks on the fruit style, caused by ethylene, which results in its eventual abscission (Standar et al., 2014). In addition, 2,4-D stimulates growth of the rind tissues at the stylar-end of the fruit which results in a stronger rind and reduced susceptibility to stylar-end fruit splitting (Cronjé et al., 2013; Standar et al., 2014). Here we report on some trials that investigated the role that the reduction in open navel-ends played in infestation levels of mealybug and false codling moth (FCM).

Materials and methods

Over a three-season period, 2008 to 2011, 2,4-D was applied to citrus trees in spring in several trials conducted in Navel orange orchards in the Western and Eastern Cape. Either 2,4-D Ester or 2,4-D Amine was used at rates ranging from 5 to 25 ppm at full bloom or at petal drop. The adjuvant, Break-Thru (polyether-polymethylsiloxane-copolymer) was added to each spray mixture at a rate of 5 ml per 100 L water. Medium cover diffuse sprays were applied using a hand gun sprayer. In all the trials, each treat-

ment consisted of eight single tree replicates in a randomised complete block design with buffer trees between treated trees.

At three of the sites, mealybug infestation was at a level that evaluation of differences in infestation between treatments could be justified. One was an orchard of Washington Navels in Citrusdal, Western Cape, during the 2008/09 season; the other two were Autumn Gold Navel orchards in Heidelberg, Western Cape, during 2008/09 and 2009/10. All results reported are for sprays applied at full bloom.

Mealybug infestation of fruit was evaluated during May for the first two trials and during December for the third trial. This was done by inspecting 10 fruit on each tree (in the navel-end and under the calyx) and recording percentage of fruit infested.

At 10 sites, fruit with FCM eggs was determined, again by inspecting 10 fruit per tree during May. Additionally, FCM larval infestation of fruit was recorded at three sites (Palmer Navels during 2009/10 and two orchards of Newhall Navels during 2010/11, all in the Sundays River Valley, Eastern Cape) by collecting and dissecting fallen fruit under all trial trees on a weekly basis, for a 15-week period from January to April.

At commercial maturity, approximately 80 fruit were collected from all sectors of each tree in each treatment. The percentage of fruit with closed navel-ends was calculated by dividing the number of fruit with closed navel-ends by the total number of fruit (80) evaluated per replicate tree.

Values were compared between treatments by using an ANOVA and LSD multiple range test (Statistica Version 14.4.0.14, 2018).

Results and Discussion

Reduction in open navel-ends

Of the 13 sites where navel-end diameters were

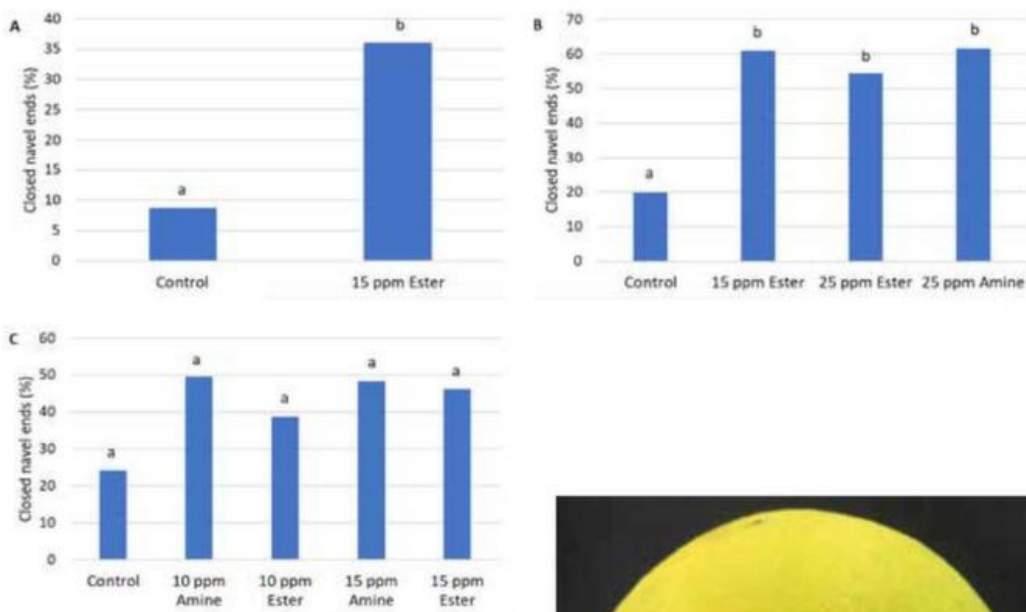


Fig. 1. Percentage of navel-ends closed at A. 2008/09 Washington Navel site, B. 2008/09 Autumn Gold Navel site, and C. 2009/10 Autumn Gold Navel site

measured, the proportion of navel-ends closed versus open was significantly increased for at least some of the 2,4-D applications at 10 of the sites. Of the three sites where mealybug infestation was evaluated, a higher percentage of navel-ends was closed for all 2,4-D treatments, relative to untreated fruit (Fig. 1). This was significant at two of the three sites.

Mealybug infestation

A lower percentage of fruit treated with 2,4-D, and thus with reduced open navel-ends, was infested with mealybug (Fig. 2) at all three sites evaluated. At two of the sites, this was significantly so, at least for some of the treatments (Fig. 3). This is supported by the findings reported by Stander et al., 2017.

Not only would the closing of a significant proportion of navel-ends dramatically reduce the available protected sites for infestation of mealybug on fruit, but mealybug would now be more exposed to chemical sprays and biological control. Moore et al., 1997 demonstrated that parasitism of citrus mealybug by *Coccidoxenoides perminutus*, was 2.6 times higher under the fruit calyx than in the navel-end, demonstrating the high degree of protection of mealybug provided by the navel-end.

FCM infestation

At none of the 10 sites monitored was there any



Fig. 2. Mealybug infestation within the enlarged navel-end of a Navel orange (PHOTO: PETER STEPHEN).

significant difference in numbers of FCM eggs laid on fruit between any of the treatments. Nor was there any significant difference in FCM infestation of fruit between any of the treatments. Consequently, navel-end size, as manipulated by 2,4-D application, made no notable difference in the attractiveness of Navel oranges to FCM, nor to the susceptibility of the oranges to infestation by FCM (Fig. 4). It has been anecdotally reported by some that Navel oranges with larger navel-ends are more susceptible to FCM attack. However, it appears that this is related to the Navel cultivar, some of which tend to have larger navel openings than others, rather than to the size of the navel opening.

Conclusion

The application of 2,4-D to Navel oranges during full bloom generally, and often significantly, reduced the proportion of open navel-ends. In turn, this reduced the proportion of fruit infested with mealybug, as the accessibility of the protective navel-end was reduced. However, reduction in navel-end openings did not reduce FCM infestation.

Fig. 3. Percentage of fruit infested with mealybug at A. 2008/09 Washington Navel site, B. 2008/09 Autumn Gold Navel site and C. 2009/10 Autumn Gold Navel site

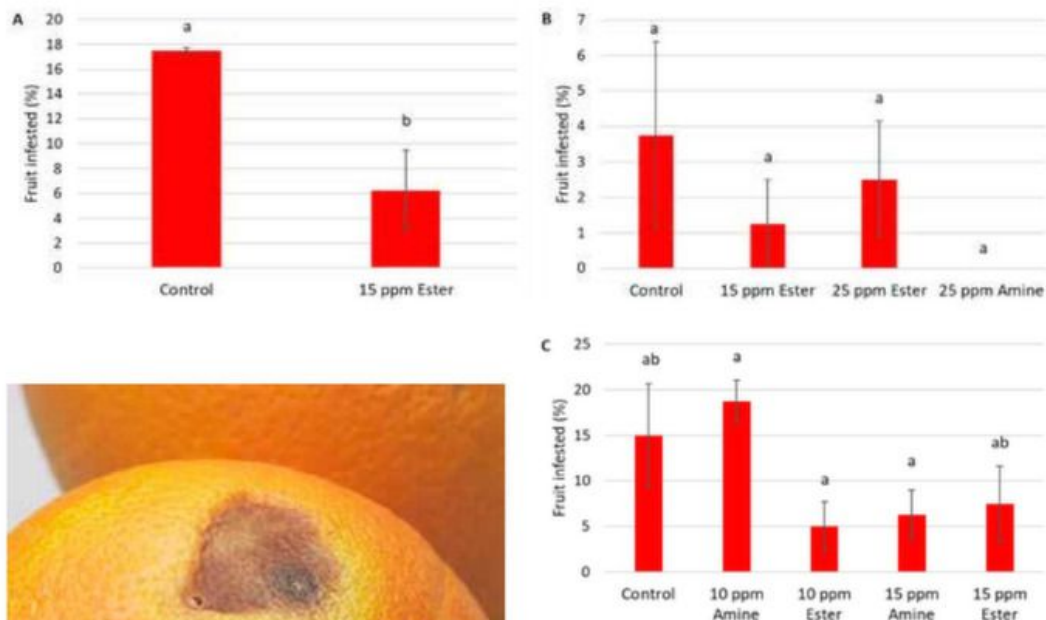


Fig. 4. An FCM larval penetration mark on the side of a Navel orange, despite the existence of an enlarged navel-end



Opsomming

Groot nawelente kan 'n skuilplek bied vir insekplae soos witluis, wat hulle dan teen beheermaatreëls kan beskerm. Bespuiting van die plantgroeireguleerder en sintetiese oksien, 2,4-dikloorfenoksie-asynsuur (2,4-D), tydens blomtyd, verminder die grootte van die opening van die nawelent en die hoeveelheid nawelente wat oop is. Die toediening van 2,4-D

op Navel-lemoene tydens volblom in die Oos- en Wes-Kaap, het oor die algemeen, en dikwels betekenisvol, die proporsie van oop nawelente verminder. Gevolglik is die hoeveelheid vrugte wat met witluis besmet is, verminder, aangesien die toeganklikheid van die beskermende nawelent verminder is. Intendeel het vermindering in nawelent-openings egter nie valskodlingmotbesmetting verminder nie. ❀

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