

# Can glycine betaine be used to improve 'Hass' avocado production?

## Progress report – Year 2

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### ABSTRACT

Glycine betaine (GB) is a compound that naturally accumulates in plants during abiotic stress. An exogenous application of GB has been shown to be beneficial in increasing the tolerance of plants to environmental stress. Preliminary trials at farms near Tzaneen Dam and in Mooketsi suggested that GB was beneficial in increasing yields. The trial was moved to Macnoon Estate, between Modjadjiskloof and Westfalia Estate, and the trial layout improved. This trial will be harvested in the second quarter of 2015.

### INTRODUCTION

This report follows after year one's report (Blakey *et al.*, 2014) and details the findings from this project between February 2014 and February 2015.

Environmental stress during flowering and fruit set can reduce pollination, increase "November fruit drop", increase small fruit from premature seed coat senescence, and ultimately reduce yield (Moore-Gordon & Wolstenholme, 1996). Good orchard management is the primary tool to alleviate environmental stress, but assuming this has been addressed, there are compounds available to increase plants' tolerance to environmental stress, and which could play a role in increasing yield. Glycine betaine (trade name Greenstim®) is such a compound. Glycine betaine (GB) is a naturally-occurring osmolyte in plants that is produced in response to drought, salinity and heat stress (Ashraf & Foolad, 2007; Ahmad *et al.*, 2012).

### Aims

Determine the effect of glycine betaine on fruit drop, yield, and subsequent flowering in 'Hass' avocados.

### MATERIALS AND METHODS

In the first trial (2013/14), the trial sites were at Tzaneen Dam (Ballygowan farm) and Mooketsi (Goedgelegen Estate). In the second trial (2014/15), two orchards at Macnoon Estate, between Modjadjiskloof and Westfalia Estate, were selected. The orchards at Macnoon are 'Hass' on 'Dusa®' and came into bearing with a small crop in 2014.

The trial design for Macnoon is: One row of buffer trees (B), two rows of control trees (C), one buffer row and two rows of Greenstim-treated trees (G). Hence the pattern is: B-C-C-B-G-G and so forth. Approximately 320 trees (the equivalent of 1 ha at a spacing of 8 x 4 m) were used in each treatment. This design was chosen to account for variation through the orchards.

Three applications of glycine betaine were made, with a shorter interval (5 weeks) compared to the previous year (11 weeks; Table 1). This was because the flower was particularly protracted and asynchronous in 2014.

Tree health, flower intensity and flower stage of

**Table 1.** Application details for glycine betaine (Greenstim®) for two orchards at Macnoon Estate.

Year	Site	Rate 1	Volume	Application date	Evaluations
2013/14	Tzaneen Dam Ballygowan	5.0 kg/ha	2000 L/ha	Week 34 & 45	Week 34, 40, & 10
2013/14	Mooketsi Goedgelegen	7.5 kg/ha	3000 L/ha	Week 31 & 45	Week 30, 42, & 7
2014/15	Modjadjiskloof Macnoon S13	2.5 kg/ha	1000 L/ha	Week 31, 36 & 41	Week 30, 36 & 6
2014/15	Modjadjiskloof Macnoon G13	3.75 kg/ha	1500 L/ha	Week 31, 36 & 42	Week 30, 36 & 6

<sup>1</sup>The concentration was constant at 2.5 kg/1000 L. The applied volume depends on the canopy volume.



each tree was recorded before spraying, before November drop and again before harvest. Yield per tree was also recorded. The two trial sites at Macnoon will be harvested in the second quarter of 2015.

## RESULTS AND DISCUSSION

A single application of glycine betaine seemed to increase yield by 9.9 ton/ha, and a second spray – while not further improving yield – seemed to improve fruit size distribution at the Tzaneen Dam site (Fig. 1). At Mooketsi, the yield increase was not as large (2.0 ton/ha; Fig. 2), perhaps because the growing conditions are more limiting there, but still promising. Unfortunately, pack out for the Tzaneen Dam site and the fruit size distribution for the Mooketsi trial site are not available. It will be interesting to see if glycine betaine can consistently improve yields to the same degree.

It was decided to move the trial to Macnoon Estate, between Westfalia Estate and Modjadjiskloof, which is a new planting of 'Hass' on 'Dusa®' that came into bearing in 2014. Macnoon is a new development which is a more suitable site for a trial as there is less variation in the tree health. The improved trial design will also permit a better statistical analysis of the data.

After a fruit count late in January 2015, there does not seem to be a significant difference between the treatments at either site. The fruit set was higher on the trees treated with glycine betaine, but there was a subsequent higher fruit drop (Fig. 3). The trial will have to be repeated for at least two seasons before firm conclusions can be made. This could be because of a strong windstorm that passed through the farm late in January 2015.

## CONCLUSION

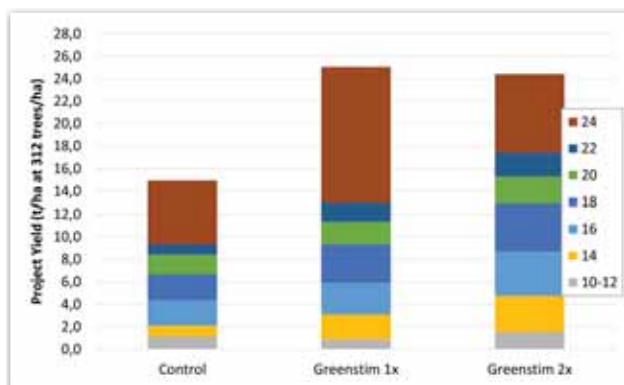
After the first season, glycine betaine (Greenstim®) seems to increase yield of 'Hass' avocados when sprayed at 50% full flowering. It must be stressed that glycine betaine is not a substitute for good orchard management. Irrigation during flowering and fruit set, developing a good mulch layer, fertilisation and pruning for good light penetration into the canopy are vital. However, early results indicate that glycine betaine can contribute to improved yields when these factors are managed correctly. The trials on glycine betaine will continue, and in the coming years the focus will be on optimising the number of applications, the application interval and the dose rate.

## ACKNOWLEDGEMENTS

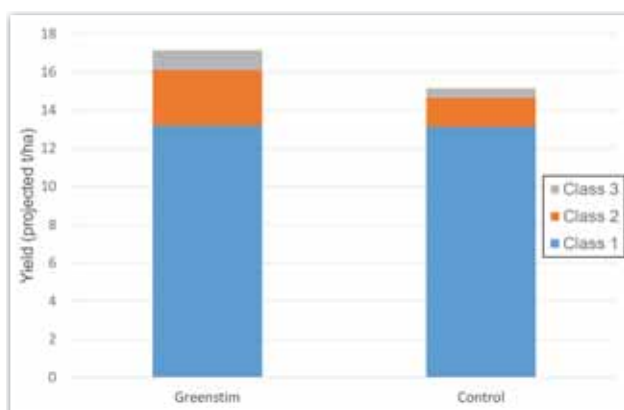
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## REFERENCES

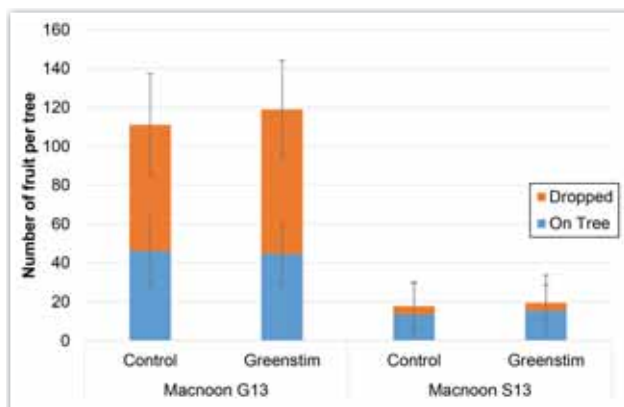
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**Figure 1.** Projected yield and fruit size distribution from Ballygowan farm (adjacent to Tzaneen Dam) in 2014. Yield is projected for a spacing of 8 x 4 m.



**Figure 2.** Projected yield and pack out from Goedjelegen Estate (Mooketsi) in 2014. Yield is projected for a spacing of 8 x 4 m.



**Figure 3.** Fruit number per tree, either on the tree or dropped on the floor, at two trial sites (Macnoon G13 and S13) for trees sprayed with Greenstim and untreated control trees. The evaluation was done in weeks 5 and 6 of 2015.

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