Calcium with transport stimulant improves firmness of strawberries

Jolyon Dodgson PhD

Anna Marks

David Marks

Levity Crop Science

Contacts:

Jolyon Dodgson (Levity research):
jolyon@levitycropscience.com

Nigel Lyster (Levity sales):
nigel@levitycropscience.com

+44 7854 420227

Strawberries and calcium

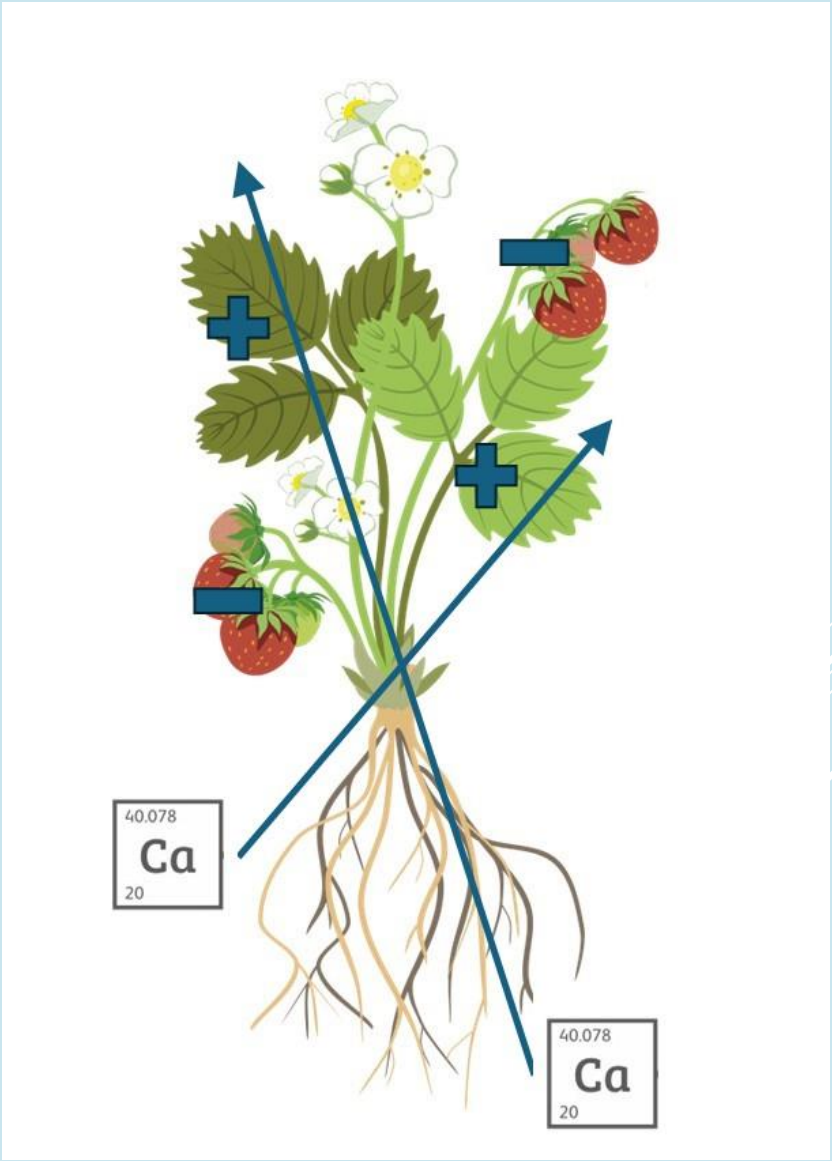
- Strawberry (*Fragaria* × *ananassa*) is a valuable crop, but susceptible to losses during harvest, transport and storage as it needs to be harvested at full maturity due to it being a non-climacteric fruit.

- Previous work has been conducted on calcium applications to strawberries to improve post-harvest firmness and shelf-life with positive effects while other work has shown no benefit.

Chen et al., 2011; Marks et al., 2019, Vance et al., 2017

Strawberries and calcium

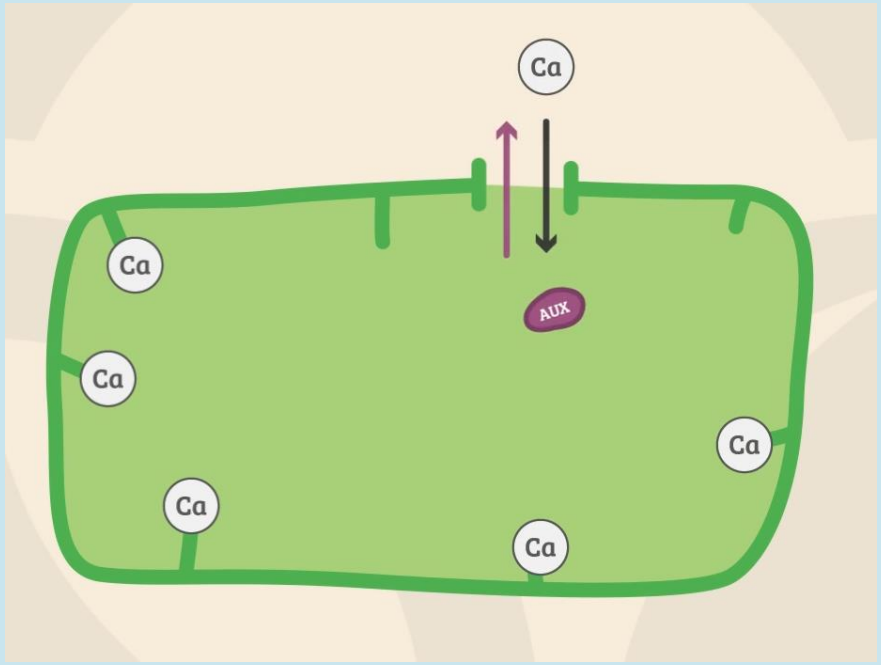
- Calcium is an essential nutrient that also acts as a messenger, so it is strongly regulated by plants.
- Calcium has a structural role in cell walls and for membrane stability.
- Calcium is transported from the roots to the shoots via the xylem.
- Mass flow of calcium is towards leaves rather than or fruit.

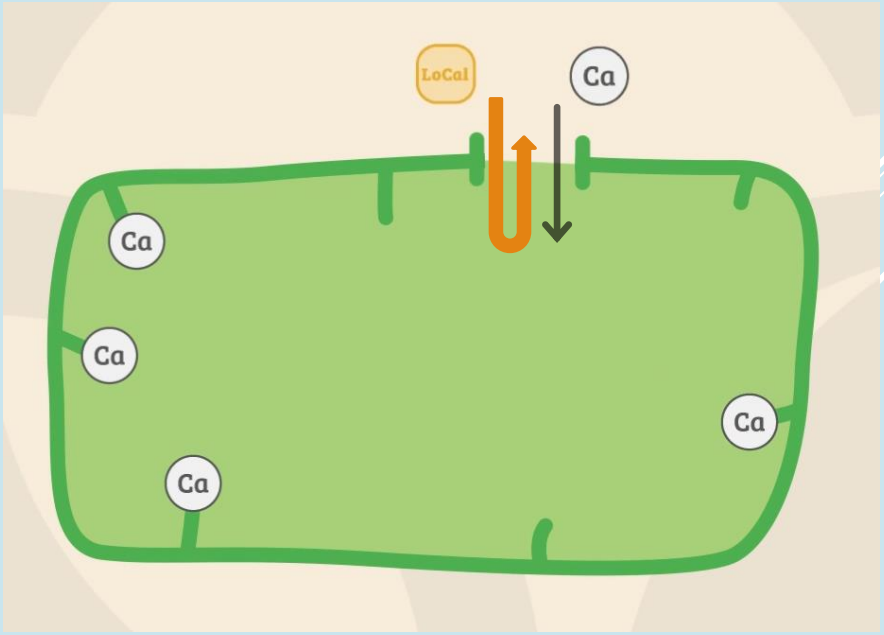


Demidchik et al., 2018; Thor, 2019; White & Broadley, 2003

Strawberries and calcium

- Auxin mediates transport of calcium across cell membranes.
- In strawberries, once cells have stopped dividing, auxin levels reduce.
- To ensure that calcium is transported into cells efficiently, calcium transport stimulants (MCAS) need to be used.
- The calcium functional fertiliser Albina (Levity Crop Science, UK) contains the MCAS, LoCal.





Marks et al., 2019

Aim and methods

- To assess the ability of the calcium functional fertiliser Albina, containing the MCAS, LoCal, (Levity Crop Science, UK) to improve the firmness of strawberries in the laboratory and after being grown in a glasshouse.

- Conducted in laboratory using supermarket bought, UK produced strawberries (var. Malling Centenary).
- Strawberriess were misted with water, 1.5% calcium without LoCal and 1.5% calcium with LoCal.
- Kept in fridge at 4°C for 10 days and scored for firmness every 2 or 3 days.
- Experiment was run twice.

Methods

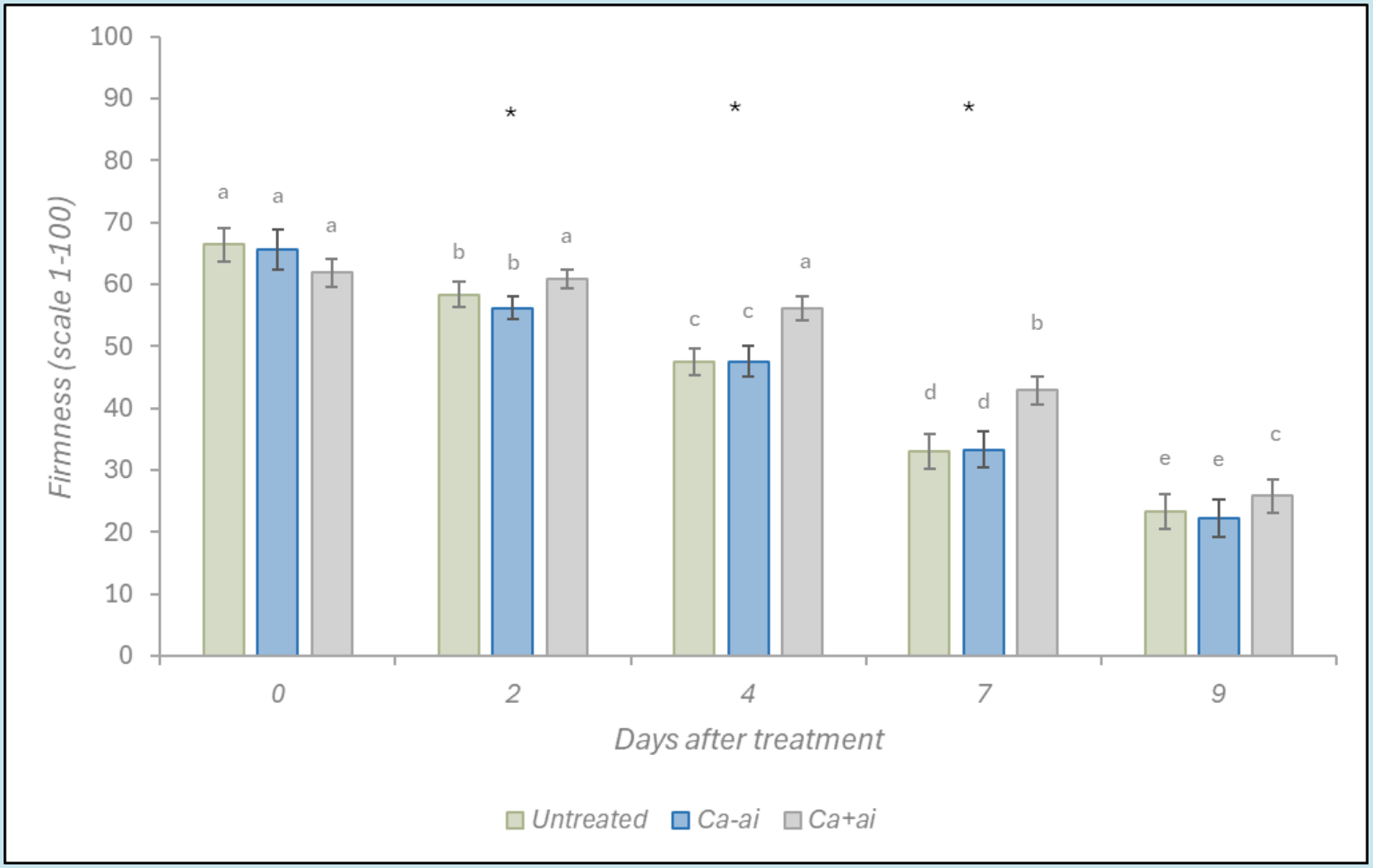
- Elsanta strawberry plants were overwintered outside and as flowers were forming transferred into a glasshouse.
- The experiment was run twice, with one and two year old plants, and an industry standard NPK fertiliser was applied weekly following the manufacturer's instructions.
- 10 untreated and 10 plants treated with calcium with LoCal, applied at the recommended label rate (1l Ha^{-1}) every two weeks throughout the fruit development period (starting at flowering and continuing until fruit was harvested for 5 treatments giving 0.91 Kg ha^{-1} of calcium).
- The first fruit that formed on each plant were tagged and harvested when ripe.
- Firmness was scored before and after being stored in a fridge for 3 days.

Methods

- Firmness was recorded using a non-destructive penetrometer, Durofel (CTIFL Copa Technologie, Saint Etienne du Gr` es, France) with a bolt of 8 mm diameter (0.50 cm^2).

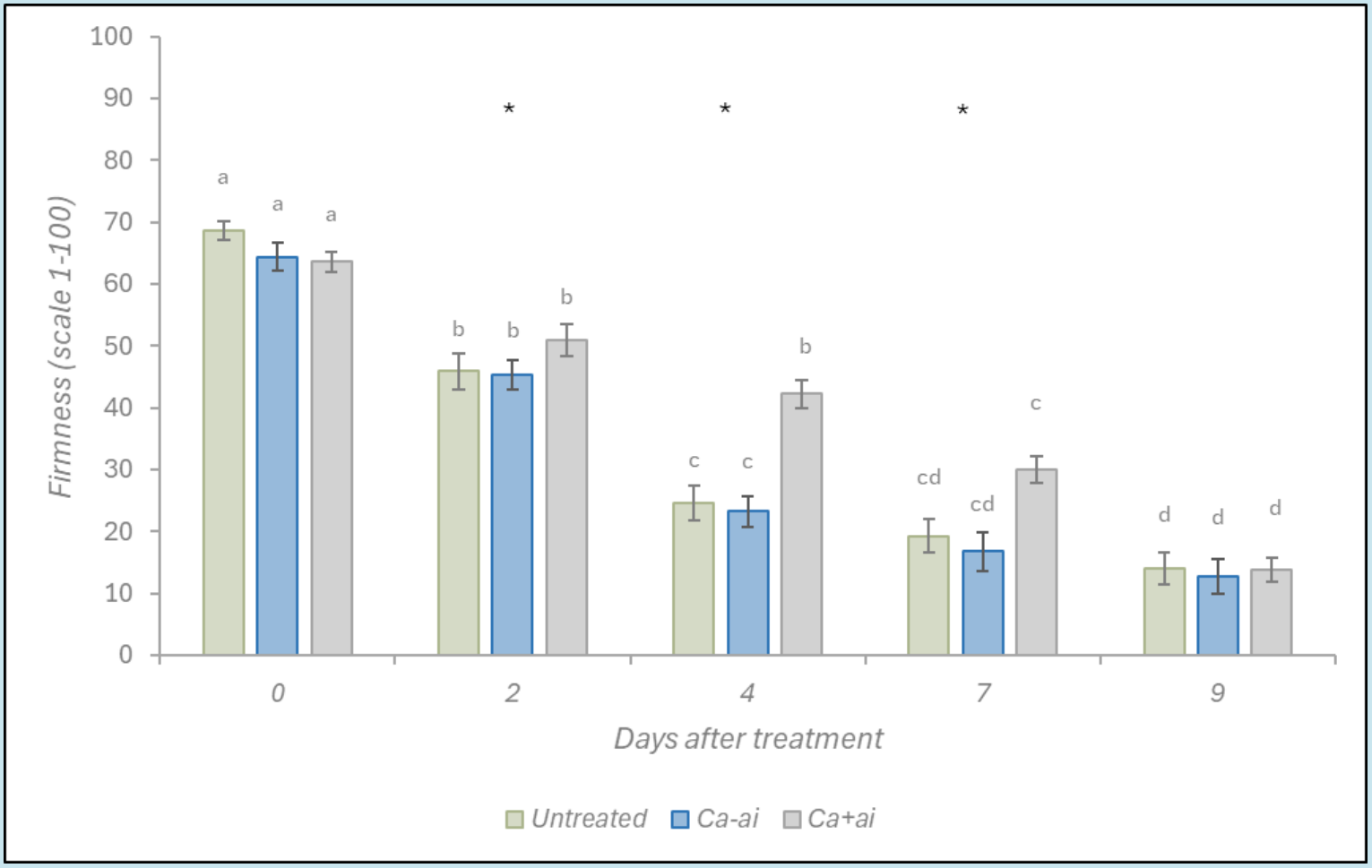
- Each strawberry had its firmness recorded twice (on opposite sides of the fruit) and an average was taken to give the firmness for each sampling date.

Results – Laboratory experiment



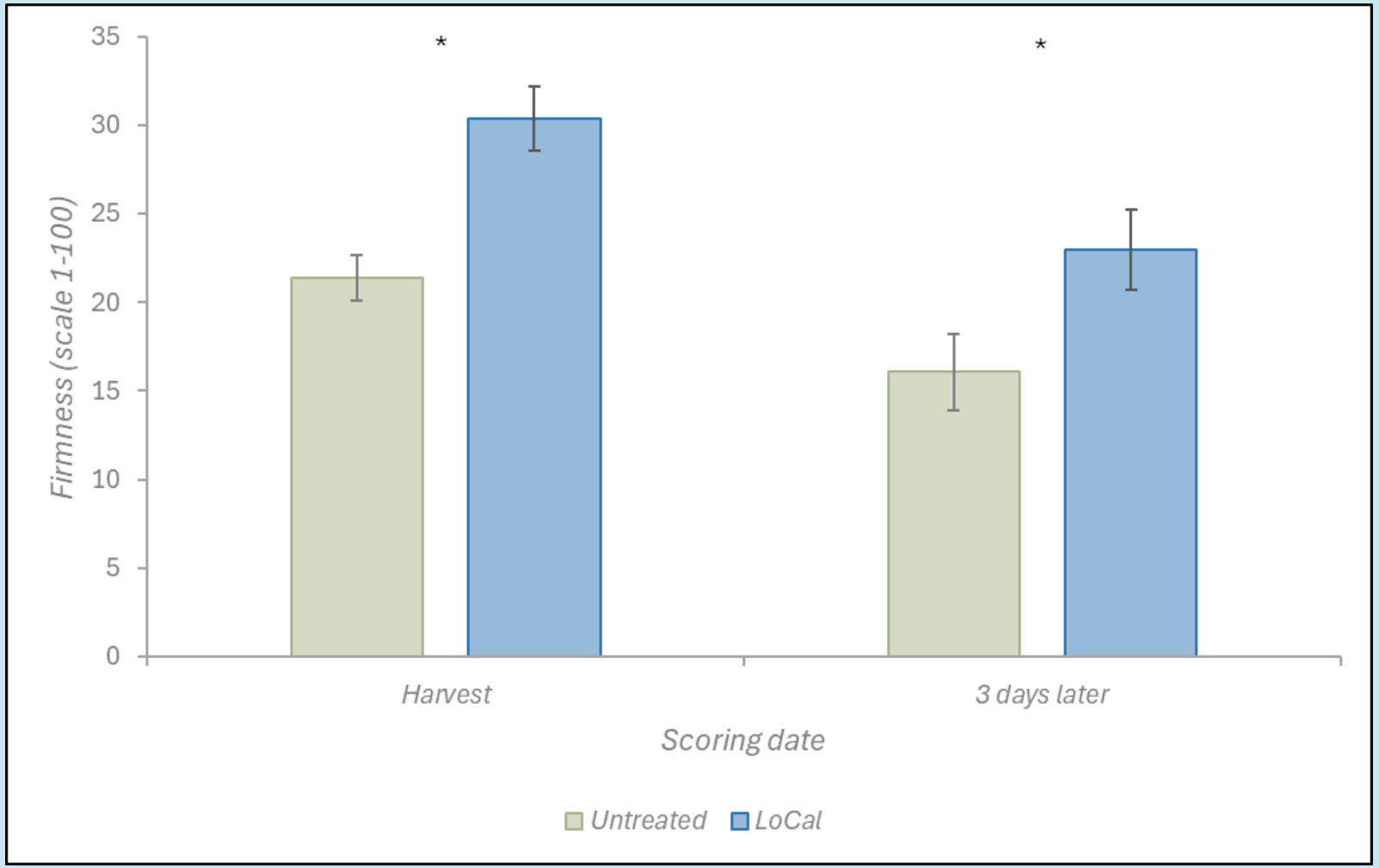
- Figure 1a. Firmness of untreated, Ca without active ingredient (Ca-ai) or Ca with the active ingredient, LoCal (Ca+ai) treated strawberries.
- * sig. dif. between firmness values for that sampling date between Ca+ai and the other two treatments (ANOVA, independent sample t-tests, $P<0.05$).
- Lowercase letters sig. dif. between sampling dates within each treatment for untreated, Ca-ai and Ca+ai treated samples (One-way ANOVA (non-parametric), Dwass-Steel-Critchlow-Fligner pairwise comparisons, $P<0.05$).

Results – Laboratory experiment



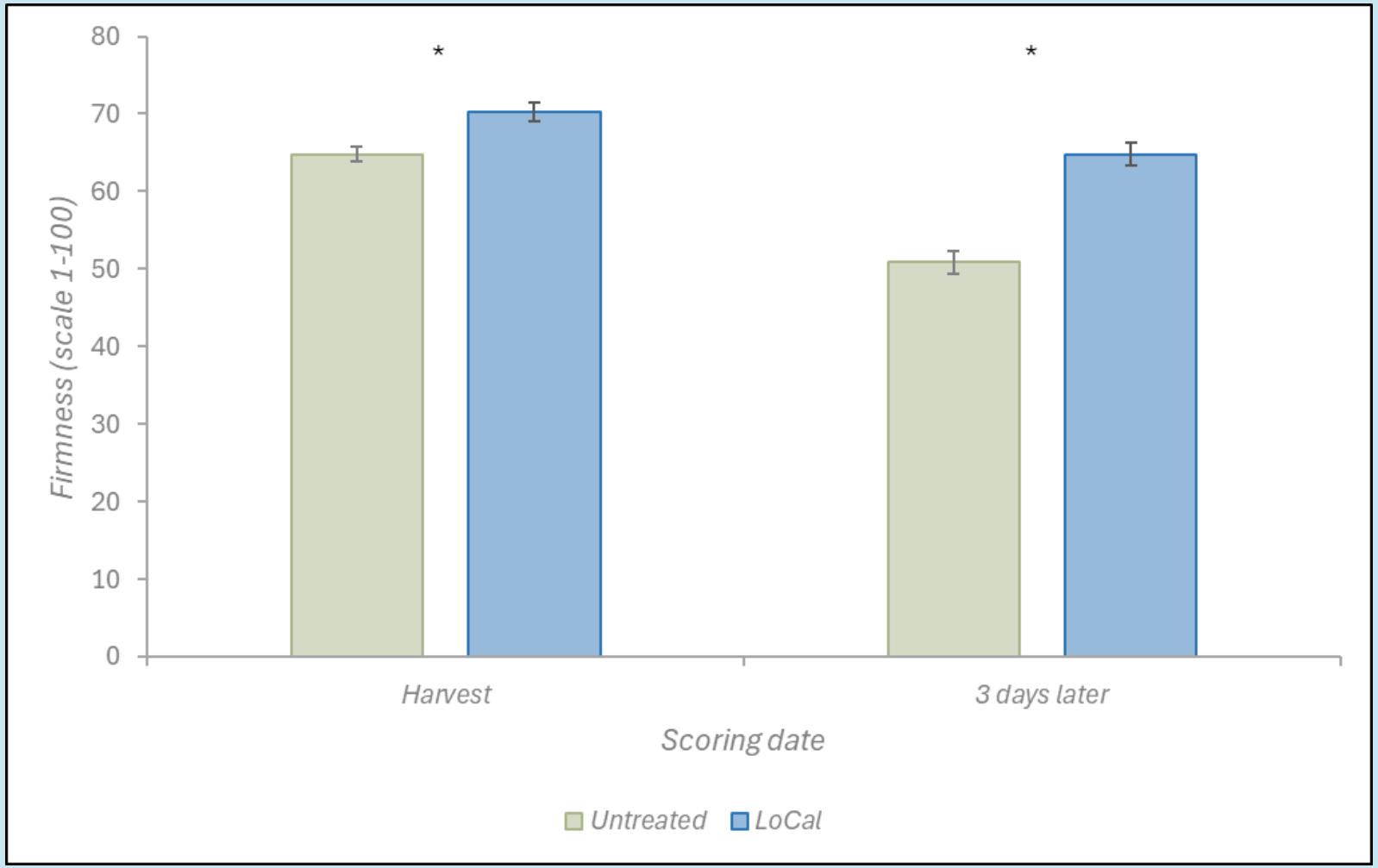
- Figure 1b. Firmness of untreated, Ca without active ingredient (Ca-ai) or Ca with the active ingredient, LoCal (Ca+ai) treated strawberries.
- * sig. dif. between firmness values for that sampling date between Ca+ai and the other two treatments (ANOVA, independent sample t-tests, $P<0.05$).
- Lowercase letters sig. dif. between sampling dates within each treatment for untreated, Ca-ai and Ca+ai treated samples (One-way ANOVA (non-parametric), Dwass-Steel-Critchlow-Fligner pairwise comparisons, $P<0.05$).

Results – Glasshouse experiment



- Figure 2a. Firmness of fruit from Elsanta strawberry plants that were untreated or treated with Ca with LoCal while fruit was developing.
- Firmness measured at harvest and again after three days of storage in a fridge.
- * sig. dif. between firmness values for that sampling date (Independent samples T-test, $P<0.05$).

Results – Glasshouse experiment



- Figure 2b. Firmness of fruit from Elsanta strawberry plants that were untreated or treated with Ca with LoCal while fruit was developing.
- Firmness measured at harvest and again after three days of storage in a fridge.
- * sig. dif. between firmness values for that sampling date (Independent samples T-test, $P<0.05$).

Conclusions

- When misting fruit post-harvest, there was no impact on the firmness compared to untreated when just calcium was applied, but when the same amount of calcium was applied while formulated with the MCAS as LoCal, there was a significant improvement in the firmness.
- When applying the calcium with LoCal to fruit while they were still on the plant, we also found a significant improvement in post-harvest firmness over the untreated.

Conclusions

- Previous work showed no impact from foliar calcium applications to strawberries when just calcium chloride was applied without the addition of an MCAS, while the results in the current study show that the addition of the MCAS enabled the increased firmness of strawberries, thereby suggesting that the MCAS was able to transport the calcium to the developing fruit and improve the post-harvest firmness and shelf-life.

- This work has shown that when an MCAS is formulated into a calcium functional fertiliser, such as in LoCal, it improves the effect of the calcium as the firmness and shelf-life are both improved compared to when just the same amount of calcium is applied without the MCAS.

Vance et al., 2017

References

- Chen, F., Liu, H., Yang, H., Lai, S., Cheng, X., Xin, Y., et al. (2011). Quality attributes and cell wall properties of strawberries (Fragaria annanassa Duch.) under calcium chloride treatment. Food Chem 126, 450–459. https://doi: 10.1016/j.foodchem.2010.11.009
- Demidchik, V., Shabala, S., Isayenkov, S., Cuin, T.A., and Pottosin, I. (2018). Calcium transport across plant membranes: mechanisms and functions. New Phytologist, 220(1), 49–69. https://doi.org/10.1111/nph.15266
- Marks, D.J., Weston, A.K., and Wilkinson, S. (2019). Calcium absorption in strawberry, the link between polar-auxin transport, ripening and fruit firmness. Nordic Association of Agricultural Science Conference on Horticulture.
- Thor, K. (2019). Calcium—Nutrient and messenger. Frontiers in Plant Science, 10. https://doi.org/10.3389/fpls.2019.00440
- Vance, A. J., Jones, P., and Strik, B. C. (2017). Foliar Calcium Applications Do Not Improve Quality or Shelf Life of Strawberry, Raspberry, Blackberry, or Blueberry Fruit. HortScience 52, 382–387. https://doi: 10.21273/HORTSCI11612-16
- White, P.J., and Broadley, M.R. (2003). Calcium in plants. Annals of Botany, 92(4), 487–511. https://doi.org/10.1093/aob/mcg164

Levity CROP SCIENCE

Thank you

Any questions?

Contacts:

Jolyon Dodgson (Levity research):
jolyon@levitycropscience.com

Nigel Lyster (Levity sales):
nigel@levitycropscience.com

+44 7854 420227