

Matching Nitrogen Supply with Demand in Raspberry Fertigation

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- In raspberry, too much nitrogen can lead to excessive plant growth, which increases water use, cane management and picking costs, whilst also increasing the risk of fungal disease and reducing light levels in the crop canopy
- Researchers at Niab have been able to reduce nitrogen applications by up to 76% in raspberry crop trials without affecting marketable yields or berry quality

Niab collaborated with industry partners on two SMARTFert+ projects aimed at matching the supply of nitrogen to raspberry crop requirements to improve resource use and productivity and reduce waste and emissions.

In the first project, scientists adapted an existing nitrogen demand model called VegSyst-DSS, which had previously been used with tomatoes in the south of Spain. This model estimates a plant's nitrogen needs by considering its growth stage and key environmental factors, such as photosynthetically active radiation (PAR) and temperature, that influence how the plant uses and distributes nitrogen. It was calibrated for raspberry using environmental data along with the dry weight and nutrient composition of leaves, stems and fruit of *Malling™ Bella* raspberry plants grown at the Niab Water Efficient Technologies (WET) Centre in the UK (Figure 1).

CAUTION! The VegSyst-DSS model estimates water requirements of the plants by measuring evapotranspiration and applying crop coefficients. After the initial trial in 2022, the scientists saw that the model had overestimated how much water the plants were using due to inaccurate coefficients. This resulted in too little nitrogen being applied as it was diluted and lost in the drain water.

Further trials were conducted in 2023 to re-validate the model using more accurate estimates of crop water use based on the volume of water actually used by the crop. Every two weeks, the fertiliser formulation was adjusted based on how much water the plants had used in the previous two weeks, along with the environmental variables such as temperature.

The results of the 2023 trials were much improved! Compared to the commercial control, the model gave rise to a 76% reduction in nitrogen and 27% reduction in water use, without affecting marketable yields or berry quality (Figure 2). In addition, leaf and cane growth were reduced leading to lower harvest and cane management costs (Figure 3).

Note: Reductions in nitrogen use vary widely during the season and between varieties, but the model is dynamic, and accounts for changing nitrogen use depending on environment fluctuations throughout the season.

In their second project, Niab used EDT directiON's hand-held NPK sensors to study nutrient delivery in real time, so that fertiliser formulations could be adjusted more readily to better match demand with supply. In this trial, the nitrogen demand model was adjusted for a *Malling™ Bella* primocane raspberry crop grown as 1-year-old root blocks with 80 cm spacing and 10 canes per pot in a fan-shaped growing system.

The nitrogen demand model was used during the vegetative phase of growth (only) and was compared to a commercial control. Total seasonal Class 1 yields of 5.2 kg/pot were picked from the control compared to 5.0 kg/pot from the Nitrogen demand model (Figure 4). The model gave rise to water savings of 35% and nitrogen savings of 48% over the season compared to the commercial control. Dry matter (cane and leaf growth) production was lower under the nitrogen demand model in July and August.



Figure 1. Malling™ Bella raspberry plants in 2022 trials at the WET Centre Photo credit: Niab

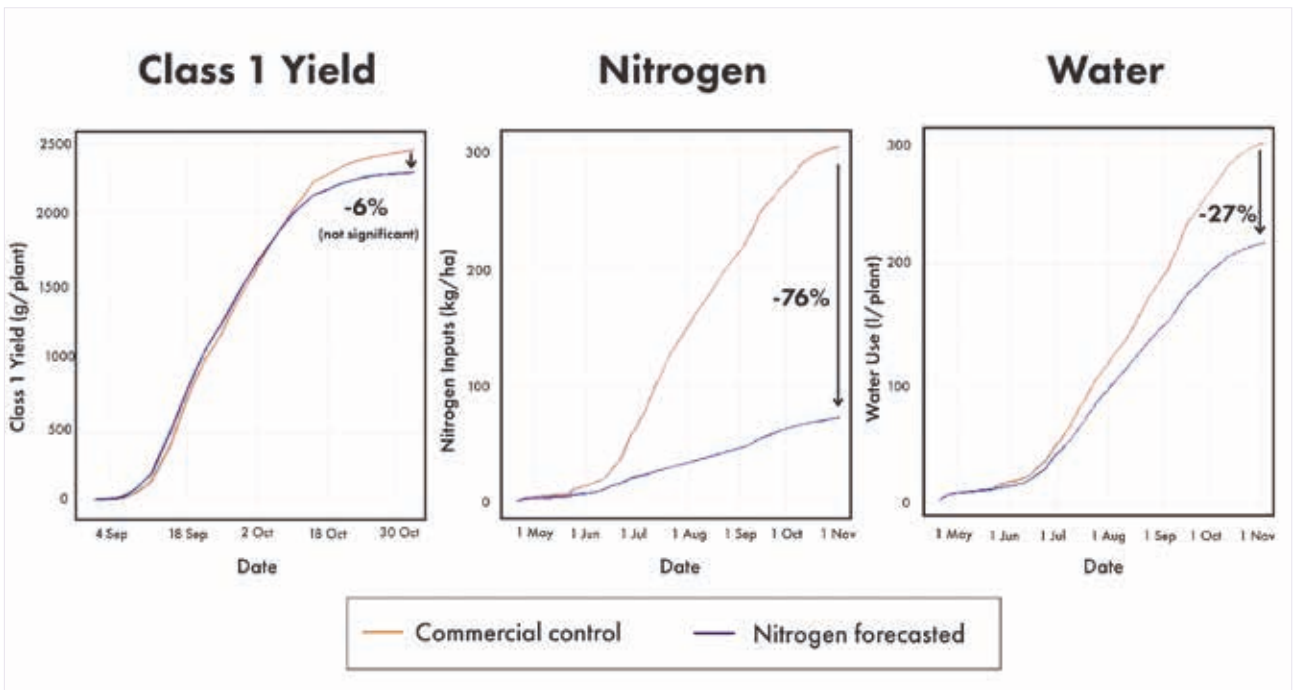


Figure 2. Results of trials in 2023 on Malling™ Bella (first year primocanes, 50cm spacing)



Figure 3. *Malling™ Bella* (first year primocanes, 50cm spacing) in 2023 trials. The commercial control (left row) used 76% more nitrogen than the Nitrogen demand model (right row) Photo credit: Niab

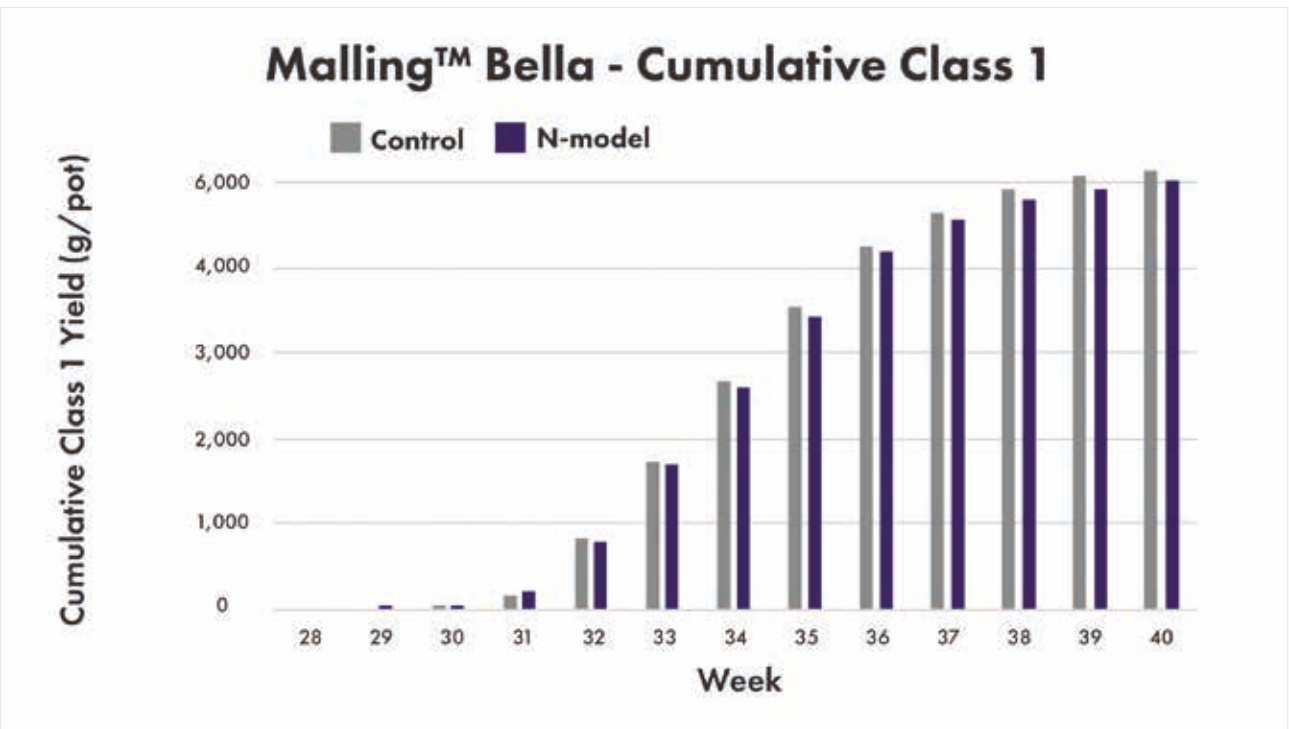


Figure 4. Results of trials in 2024 on *Malling™ Bella* (1-year-old root blocks, 80cm spacing)

Future work

Niab hope to conduct further testing to quantify any legacy effects of low-N treatments in subsequent cropping seasons and to identify the optimum planting density or number of canes per linear metre of crop row in commercial production. Further testing and refinement is also needed to develop a user-friendly version of the model for growers.

More information

Niab holds Soft Fruit Technical Webinars annually in November/December to provide an update on all research activities currently being undertaken by their team. Visit www.niab.com/node/3479

The WET (Water Efficient Technologies) Centre at Niab's East Malling site in Kent holds events for Rubus and strawberry growers and can be visited throughout the year by appointment. Visit www.niab.com/the-wet-centre

A copy of the original VegSyst irrigation and nitrogen model can be found at bit.ly/ABJ-VegSyst-DSS

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