kiwifruit

NEW ZEALAND KIWIFRUIT JOURNAL

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Red means go!

Strong start to the season as new variety shines

POST HARVEST CLEAN-UPS | NEW ZESPRI TRIAL TEAM | EVOLUTION OF THE BRAND

Features

FRONT COVER:

The harvest of the new Zespri Red crop is all over for the season, with plenty of lessons for growers.

Photo by Jamie Troughton/ Dscribe Media

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Working together for the better

An integrated approach to KVDS

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Italy, the second-largest kiwifruit producing country in the world, has lost 10 percent of its production in recent years to Kiwifruit Vine Decline Syndrome (KVDS). Now a comprehensive examination of environmental factors, soil quality, fertility issues and kiwifruit crop management techniques could help the industry to better understand the phenomena involved and find solutions.

Photo 1. Kiwifruit orchard affected by KVDS in Latina area (Latina area, Lazio region, Italy).

Background

Kiwifruit has a significant water demand but it is also extremely sensitive to root waterlogging and soil anoxic conditions. Kiwifruit production has a great commercial importance in Italy but, in recent years, the Italian kiwifruit industry (for both *Actinidia chinensis* var. *chinensis* and *A. chinensis* var. *deliciosa*) had been threatened by the emergence of a new syndrome. Kiwifruit Vine Decline Syndrome (KVDS) leads to vine collapse within a few years from the appearance of the first symptoms. The major symptoms associated with KVDS are browning, disruption and decomposition of tissues, starting from feeding roots, followed by leaf necrosis, twig wilting and, at its acute stage, plant death (*Photo 1*).

Unfortunately, the causes of KVDS are still unknown. Through a Zespri Innovation project *'Water & soil management of Gold3 in Italy'*, in collaboration with the University of Basilicata (UNIBAS), some observations and measures have been made in kiwifruit orchards affected by KVDS and innovative soil and irrigation management plans are being developed to support European growers with managing this syndrome.

Study findings

Trials have been exploring the soil conditions of a KVDS affected orchard over a period of a season. The experimental orchard was located in Latina (Lazio region) with this orchard applying an

Photo 2. Groundwater level in September 2020 in kiwifruit orchard affected by KVDS.

Photo 3. Excavation trenches in kiwifruit orchard were replenished by the aquifer.

irrigation volume of around 7,000-8,000m^3 in the 2020 season.

In September (late summer) 2020, soil excavations (trenches 2 x 1m) revealed an impermeable layer at 1m soil depth, with soil compaction starting from a depth of 40cm. Only the top 30cm of soil was appropriate for root growth. In the trenches, the groundwater level was at a soil depth of approximately 40-50cm (*Photo 2, 3*).

The winter rainfall events increased soil water stagnation and lack of oxygen, while shallow groundwater was found in the soils nearby KVDS-affected vines (*Photo 4*).

These compacted and waterlogged soils had relatively high concentrations of carbon dioxide, a marker of anoxic soil conditions (*Figure 1*). In addition, physicochemical soil analysis highlighted that soils in KVDS-affected areas had less macropores, the number of which is directly correlated to oxygen content. It was also observed that water saturation was influenced by soil structure and topography, being more acute in clay and low elevation soils.

Some potentially pathogenic microorganisms (*Paraphaeosphaeria michotii, Fusarium oxysporum* and *Ilyonectria vredenhoekensis*) were identified from kiwifruit roots but it is still uncertain if they can be considered the cause of the syndrome, or a consequence of root

Photo 4. Off-season period in kiwifruit orchard affected by KVDS: (A) soil stagnation and waterlogging, (B) trench full of water in the vine row.

decline and poor soil aeration. Indeed, KVDS is prevalent in soils affected by waterlogging and/or compacted, as revealed by excavations.

The researchers of UNIBAS also believe these play a key role in the rhizosphere microbial communities, since saprophytic and pathogenic microorganisms of anoxic soils can differ greatly from those of well aerated and healthy soils. In addition, microscopic analysis revealed damaged root systems (*Photo 6*) in the plants affected by KVDS**.** All these phenomena could cause unbalances in the root uptake of water and nutrients, with consequent negative repercussions on the status of kiwifruit vines.

Supporting growers

The Zespri Innovation and UNIBAS teams are confident that the plausible solutions to the problem may lay in optimising soil conditions for healthier root growth. First of all, it is necessary to remove excess water from the orchards in order to restore soil fertility and improve soil aeration adopting appropriate agricultural practices.

An integrated approach to combat KVDS was developed by UNIBAS and Zespri. The first step is to improve soil drainage through the installation of subsurface drainage systems, one line per row, at a soil depth of 80cm and at 1m from the vine trunk. This system will also avoid the temporary waterlogging conditions during the irrigation season.

Photo 5. (A) Healthy roots, (B) Damaged roots.

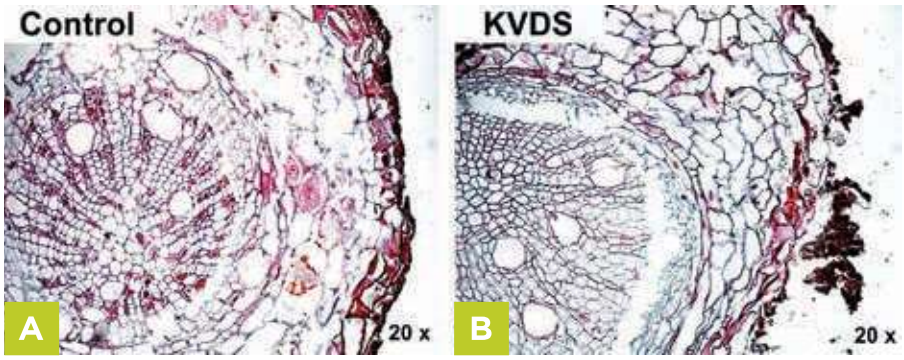

Photo 6 (A) Control root. (B) Cross section of a root affected by KVDS. It can be observed a flaked rhizoderm, a cortical area with evident loss of cellular turgor and an initial disruption of the stele. The detachment of the cortex from the central conducting tissues is evident.

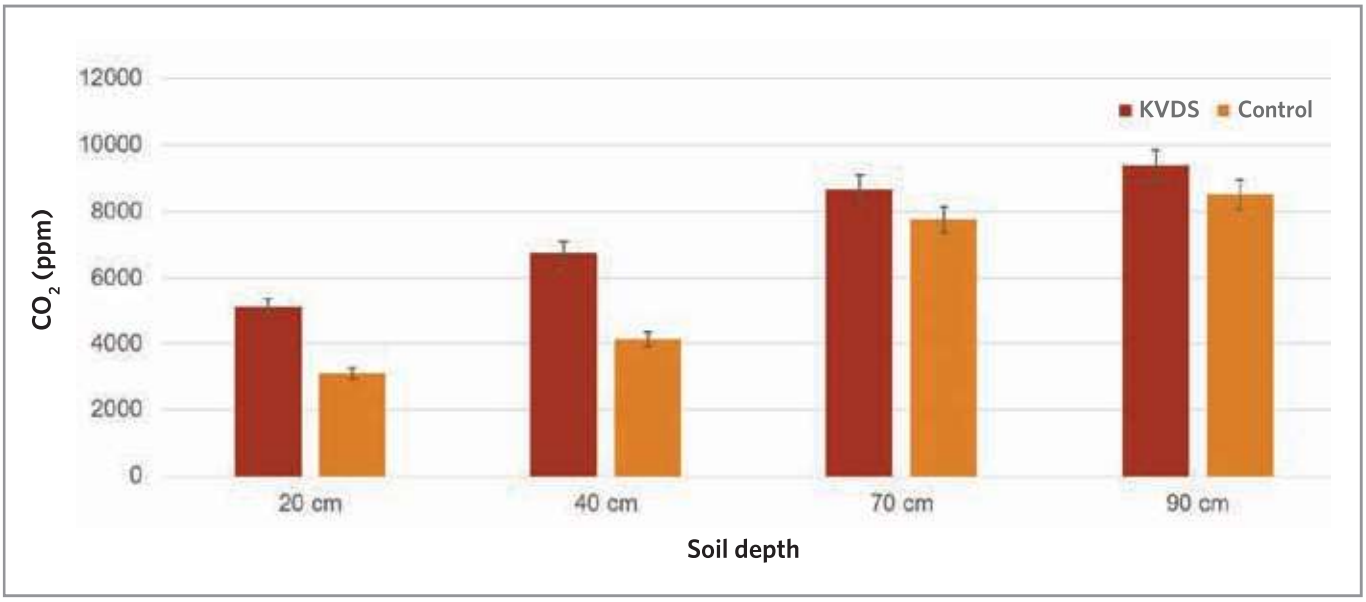

Figure 1. Soil CO_2 concentration in the KVDS and control sites. Bars = standard deviations.

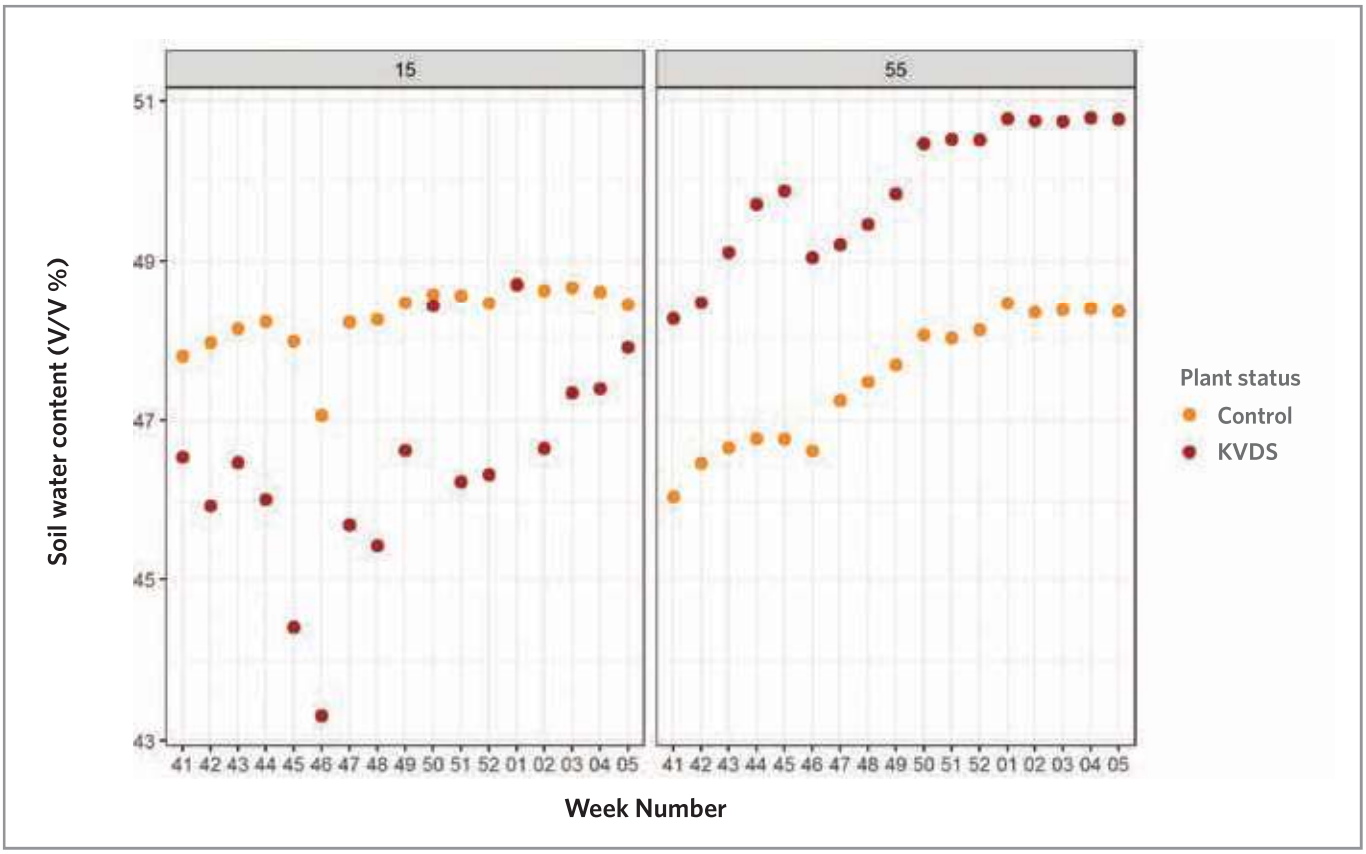

Figure 2. Soil water content over time as measured near the soil surface (15 cm) and in the deeper soil (55 cm) in the KVDS and control sites.

An innovative soil management aimed at increasing soil organic matter and reducing compaction (weed mix planting on the rows and compost, manure and pruning residues soil application) will be applied to help horizontal and vertical water movement in the soil.

Accurately matching irrigation inputs to plant water needs, by modifying irrigation system and management, through the assessment of crop irrigation requirements and soil moisture monitoring, can all be ways to provide kiwifruit roots with the oxygen needed to mitigate the effects of potentially pathogenic microorganisms.

Manipulation of canopy and root growth will be applied to balance root/leaf area ratio and enhance the capability of vines to recover from this physiological decline.

Conclusions

The preliminary results suggest the primary cause of KVDS is a physiological response, where compacted, waterlogged soils have characteristics predisposing root asphyxia (*Figure 1 and 2*), that may finally evolve in KVDS. This trial has been extended to include additional sites and work is ongoing to support developing our understanding of KVDS. With this study we are confident that we will be able propose a precise protocol of sustainable soil and water management to reduce the risk of KVDS in the next years. ■