SESVANDERHAVE ROOT-KNOT NEMATODE RESISTANT SUGAR BEET VARIETIES

AN INNOVATIVE BREEDING SOLUTION HELPING GROWERS TO SUSTAIN THEIR CROP ROTATION.

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INTRODUCTION

Plant-parasitic nematodes are economically important pests associated with nearly all agricultural crops. **Cyst nematodes** (*Heterodera and Globodera spp.*), **root-knot nematodes** (*Meloidogyne spp.*) and **lesion nematodes** (*Pratylenchus spp.*) rank at the top of the list of most important species.

Root-knot nematodes M. chitwoodi and M. fallax can cause **significant economic damage** in crops such as potatoes, carrots, black salsify, and certain flower bulbs (gladiolus – dahlia). In sugar beet, they can **reduce plant stand**. M. incognita and M. javanica, present under warmer climates, **impact normal sugar beet root development** and thus sugar yield.

Keeping root-knot nematode populations under control is challenging, due to their wide host plant range, low damage threshold and fast multiplication. Current measures such as black fallow or inundation are effective but are demanding and expensive. A limited number of nematicides are available but are moderately effective and not sustainable in time. Future solutions must therefore come from the development of resistant crops.

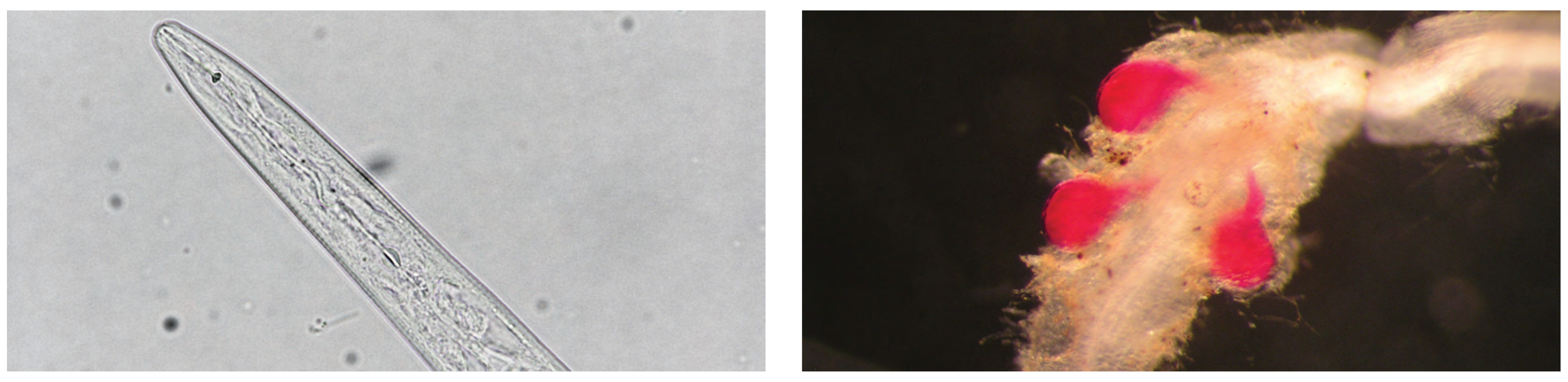

Fig. 1: J2 juvenile (infectious stage) and adult female in the root (colored with Fuchsine acid) (Wesemael, ILVO)

SESVANDERHAVE GENETIC SOLUTION DEVELOPMENT

A root-knot nematode (RKN) resistance source was identified in a wild accession and was integrated through classic breeding methods into SESVanderHave elite material.

Bioassays were set up to **check the level of resistance** against various *Meloidogyne species*. Twenty susceptible plants were compared with twenty plants carrying the resistance. A significant shift towards more plants belonging to a lower egg mass class was noted for all tested species.

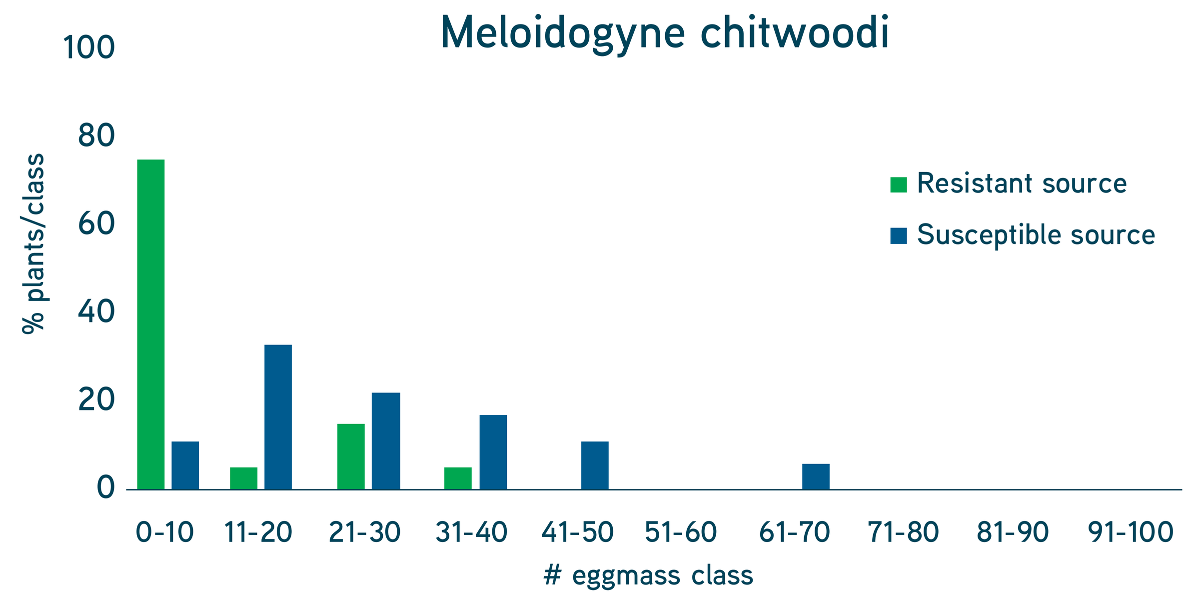

Fig. 3: Testing of susceptibility for M. chitwoodi in bioassays

The efficacy of the resistance trait was further validated during a greenhouse trial carried out by Wageningen University Research (NL). **Multiplication level** on the resistant hybrid was less than 0.2% of the multiplication level of a conventional (susceptible) sugar beet variety.

Fig. 4: Comparing a sensitive (source Misr Holland company) vs a resistant sugar beet variety (source SESVanderHave)

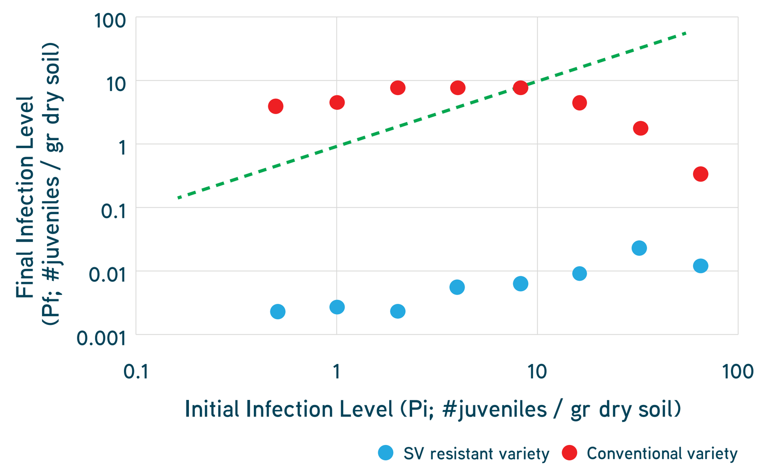

Fig. 5: Relative susceptibility of root-knot resistant and conventional sugar beet (Wageningen University)

PEST SYMPTOMS AND ECONOMIC DAMAGE

Above ground symptoms on sensitive crops are often absent. In case of severe infections, wilting, stunting or chlorosis may occur. Below ground, root-knot nematode is confirmed by the **presence of knots on roots and tubers**. The extent of the damage depends on cultivar, nematode population density, temperature, and growing season length. Reduction of yield is rarely observed. **Detection in basic plant material (plant passport refusal) or visual damage to commercial crops can lead however to high economic losses.**

Figure 2: Root-knot nematode galls on potatoes and carrots, (Wesemael, ILVO)

VALIDATION OF THE ABILITY OF RESISTANT BEET GENETIC TO PROTECT SENSITIVE CROPS GROWN IN THE SAME ROTATION

During field seasons 2019 and 2020, a field trial under natural *M. chitwoodi* infection, located in Vredepeel, The Netherlands, was set up to compare SESVanderHave's root-knot nematode resistant sugar beet variety with a conventional sugar beet variety. Japanese oat, known for its strong *M. chitwoodi* multiplication and black fallow were included as references. The trial was aiming to **test if a well-placed resistant variety in the rotation can effectively help to protect sensitive crops that are grown in the same rotation.**

Initial (Pi) and final (Pf) infection levels were measured during the 2019 growing season. In 2020, a highly susceptible potato variety (Hansa) was grown. The final root-knot nematode damage was expressed using the Tuber Knot Index (TKI).

	Pi		Pf1		Pf2		TKI	
Black fallow	386	a	1	a . . .	2	a . . .	10.3	a .
Japanese oat	523	a	13181	. . . d	4077	. . . d	34.5	. b
Conventional beet	427	a	499	. . c .	123	. . c .	32.6	. b
Resistant beet	618	a	10	. b . .	8	. b . .	16.5	a .

Table 1. Initial and final infection levels of M. chitwoodi (N/100 ml soil) (Pi: March 2019; Pf1: November 2019; Pf2: March 2020) and potato tuber knot index (TKI), (Wageningen University)

SESVanderHave's **resistant sugar beet hybrid reduces the root-knot nematode populations** to similar levels of what can be reached with black fallow (i.e., the current standard control option).

CONCLUSION

SESVanderHave breeding efforts have resulted in:

- An innovative genetic solution helping to keep multiple species of root-knot nematodes under control without use of chemicals or disadvantages of current control methods.
- New perspectives for growers of sensitive crops who will be able to grow resistant sugar beet as a 'break crop' to greatly reduce the risk of loss of quality, yield, and potential regulatory issues.
- A contribution to sustain farmers' crop rotations, and to preserve income.

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