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Development of *Heterodera schachtii* in sugar beet genotypes with varying levels of resistance

Johannes Roeb[1,2], Florian M. W. Grundler[2], Johannes Hallmann[1]

[1]Julius Kühn Institute, Institute for Epidemiology und Pathogen Diagnostics, Messeweg 11/12, 38104 Braunschweig, Germany
[2]University of Bonn, INRES, Molecular Phytomedicine, Karlrobert-Kreiten-Straße 13, 53115 Bonn, Germany

Introduction

According to their interaction with the beet cyst nematode *Heterodera schachtii* current sugar beet genotypes are categorized as either susceptible, resistant or tolerant. Last-mentioned also show some quantitative resistance, which effectively decreases the nematode reproduction in the field. However, the underlying resistance mechanism so far are poorly understood.

Materials and methods

A series of climate chamber experiments was conducted to investigate the penetration, development and reproduction of *H. schachtii* on a **susceptible (S)**, a **resistant (R)** and **4 tolerant sugar beet genotypes (T1-T4)**. Seedlings were grown in 100-ml-containers with sand and inoculated with 500 2nd-stage juveniles of *H. schachtii* in the 2-leaf stage of sugar beets (Fig. 1). Penetration and development within the root were evaluated at weekly intervals using acid fuchsin staining and microscopic identification. Additionally the nematode stages in the soil and those detached during the staining process were determined. About 7 weeks after inoculation (465 °Cd to base of 8°C) numbers of cysts and content of newly formed eggs and juveniles were counted in 6 distinct experiments.

Fig. 1: Sugar beet seedlings in small containers.

Results and discussion

Penetration rates of *H. schachtii* into the root did not contrast between sugar beet genotypes. While in susceptible sugar beet genotypes nematodes developed normal, in resistant plants many remained in juvenile stages and almost none developed into adult females (Fig. 2). Previous findings suggest that an early collapse of the nematode-induced feeding site is responsible for this effect. Quantitative resistance of tolerant sugar beet genotypes resulted from (1) a shift in sex ratio in favour of males, (2) a slower development of females and (3) a smaller production of eggs and juveniles per female. These observations indicate a reduced nutrient availability to *H. schachtii* in tolerant compared to susceptible sugar beet genotypes. Due to variability in plant growth, penetration rates and cyst numbers differences between individual tolerant sugar beet genotypes which match previous findings from field and greenhouse experiments were only found when comparing average content of eggs and juveniles per cyst (Tab. 1).

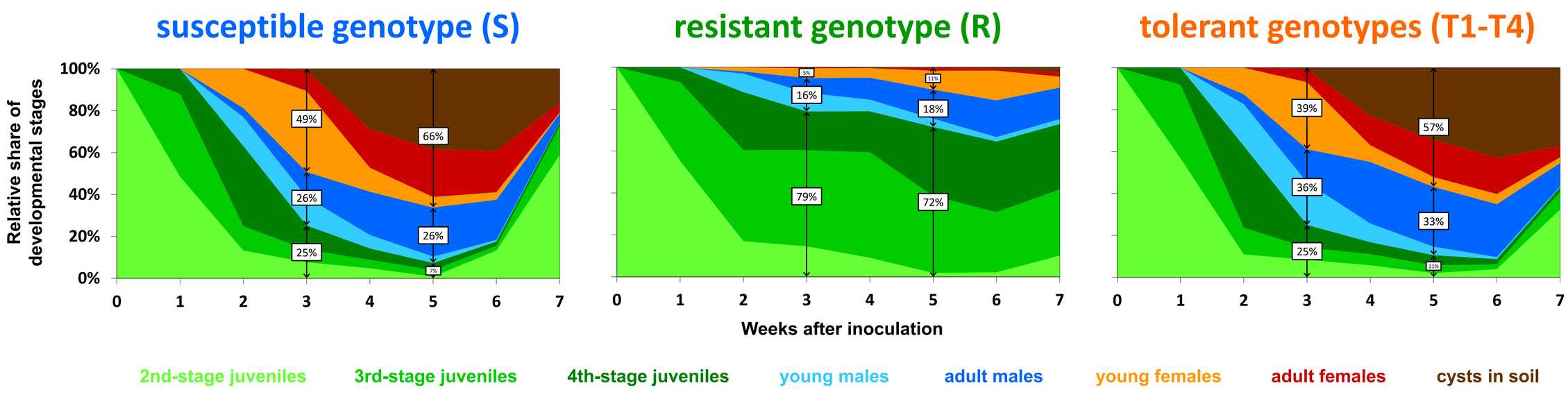

Fig. 2: Relative share of developmental stages of Heterodera schachtii after inoculation of susceptible, resistant or tolerant sugar beet genotypes. Results from the third climate chamber experiment including stages in the root and adult males and cysts extracted from the substrate. Increasing percentage of juveniles at 6-7 weeks after inoculation result from the second nematode generation.

Conclusions

Results support the assumption, that nutrient availability is the main factor influencing nematode reproduction on sugar beets. To better understand the cellular interaction between *H. schachtii* and quantitative resistant sugar beets higher resolution microscopic methods would needed to be applied.

	Climate chamber experiment												
sugar beet genotype	1st	2nd	3rd	4th	5th	6th		1st	2nd	3rd	4th	5th	6th	
	Cysts / plant							Eggs + juveniles / cyst						
S	36	39	61	279	126	89	A	196	206	313	329	325	257	A
R	3	3	1	4	4	3	D	97	108	155	117	40	53	D
T1	40	22	44	187	118	69	B	172	147	212	240	203	126	C
T2	25	20	33	162	72	71	C	174	162	256	296	239	190	B
T3	34	27	34	209	106	69	B	131	146	188	219	173	110	C
T4	30	23	41	152	104	80	BC	167	167	253	264	254	174	B

Tab. 1: Cysts and average cyst content on susceptible, resistant or tolerant sugar beet genotypes after inoculation with Heterodera schachtii. Letters indicate significant differences (Tukey's test, α = 0.05).

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