



## Effect on sugarbeet cultivars (*Beta vulgaris* cv. Alyssa, Calida, Sanetta)

### 1. The net impact of individual and combined stress on plant growth

Crop: Sugarbeet (*Beta vulgaris* cv. Alyssa, Calida, Sanetta)  
 Stress 1: *Heterodera schachtii*  
 Stress 2: *Rhizoctonia solani*  
 Stage of plant: 4 weeks after sowing

The table shows the impact of nematode and fungus alone and in combination on leaf weight, root weight, beet weight, root length of sugarbeet plants.

	Treatment	Plant response to stress (reduction over control %) Type A parameters*			
		Leaf weight	Root weight	Beet weight	Root length
Alyssa	<i>Heterodera schachtii</i> (1000 J2/pot)	-4.1 ↑	-31.8 ↑	19.5 ↓	8.7 ↓
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	57.1 ↓	21.2 ↓	55.0 ↓	78.6 ↓
	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	98.5 ↓	93.9 ↓	96.0 ↓	99.5 ↓
	<i>Rhizoctonia solani</i> (5mm mycelium disc)+ <i>Heterodera schachtii</i> (1000 J2/pot) 2 weeks later (Sequential stress)	40.1 ↓	29.2 ↓	51.3 ↓	N/A
Calida	<i>Heterodera schachtii</i> (1000 J2/pot)	-13.4 ↑	-14.6 ↑	4.3 ↓	-1.0 ↑
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	69.0 ↓	42.7 ↓	78.3 ↓	69.5 ↓
	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	80.2 ↓	86.6 ↓	83.2 ↓	85.8 ↓

Sanetta	<i>Heterodera schachtii</i> (1000 J2/pot)	-3.8 ↑	-10.0 ↑	-3.0 ↑	21.5 ↓
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	62.7 ↓	61.4 ↓	56.7 ↓	82.1 ↓
	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	37.3 ↓	14.3 ↓	44.8 ↓	45.5 ↓

**Note:** Values presented in the table were calculated using the formula described below.

$$\text{Reduction over control (\%)} = \frac{(\text{Value Control} - \text{Value Stress})}{\text{Value Control}} \times 100$$

1) '↓' - indicates plant parameters affected by stress that lead to high susceptibility (higher the value more the damage).

2) '↑' - indicates plant parameters less/not affected by stress leading to improved resistance (higher the value lesser the damage).

3) N/A- Not Available

'\*' - For more information on parameters classification, please refer to 'methodology' tab.

## 2. The interaction between nematode and fungal pathogen under combined stress at plant interface

The table shows the effect of the fungal pathogen on nematode population and effect of nematode on fungus induced crown and root-rot index under combined stress treatment

	Treatment	Response to combined stress** Type B parameters*	
		Nematode population (J2/plant)	Rhizoctonia crown and root rot
Alyssa	<i>Heterodera schachtii</i> (1000 J2/pot)	6120	N/A
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	N/A	5.5

	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	342	6
	<i>Rhizoctonia solani</i> (5mm mycelium disc)+ <i>Heterodera schachtii</i> (1000 J2/pot) 2 weeks later (Sequential stress)	662	3.6
Calida	<i>Heterodera schachtii</i> (1000 J2/pot)	3560	N/A
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	N/A	5.3
	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	482	5.5
Sanetta	<i>Heterodera schachtii</i> (1000 J2/pot)	69	N/A
	<i>Rhizoctonia solani</i> (5mm mycelium disc)	N/A	4.6
	<i>Heterodera schachtii</i> (1000 J2/pot) + <i>Rhizoctonia solani</i> (5mm mycelium disc) (Simultaneous stress)	48	3

For raw data – Click here (.xlsx file)

Reference - Hillnhütter C, Sikora R, Oerke E-C (2011a) Influence of different levels of resistance or tolerance in sugar beet cultivars on complex interactions between *Heterodera schachtii* and *Rhizoctonia solani*. *Nematology* 13: 319-332

**Note:**

‘\*\*\*’ - Values are presented as it is from the source article without subjecting to the calculation.

‘\*’ - For more information on parameters classification, please refer to ‘methodology’ tab.

**Inference From the study:** Hillnhütter C et al. 2011a studied the interaction of *Heterodera schachtii* and *Rhizoctonia solani* in three sugarbeet cultivar alyssa, calida and sanetta. Pathogens were inoculated singly, sequentially, and simultaneously. Plants were then analyzed for their leaf

weight, root weight, root length, and beet weight. Simultaneous inoculation resulted in the synergistic reduction of beet weight and other plant growth parameters in cultivars alyssa and calida but not in cultivar sanetta. The sequential inoculation of pathogens did not result in a synergistic reduction of growth parameters in cultivar alyssa. Similarly, the nematode population was least, and fungus induced crown and root-rot were high under simultaneous combined stress conditions in cultivar alyssa and calida. Cultivar saneets showed the least root-rot index. **Thus, sugarbeet cultivar alyssa and calida are susceptible and show a synergistic reduction in plant growth parameters under simultaneous combined stress treatment.**