Effect on potato cultivars (*Solanum tuber*)

A. The net impact of individual and combined stress on the plant

Stress 1: *Colletotrichum coccodes*
Stress 2: *Verticillium dahliae*
Stage of plant: Plantlet

The table shows the impact of individual and combined stress on plant height and shoot weight of potato cultivars

Cultivar	Treatment	Response under combined stress (Type A parameters*) reduction over control (%)	
		Plant height	Shoot weight
Nicola	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	46.26 ↓	72.72 ↓
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	33.73 ↓	59.09 ↓
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	32.33 ↓	59.09 ↓
	C. coccodes (10^2 conidia/mL)	-1.75 ↑	22.72 ↓
	C. coccodes (10^3 conidia/mL)	1.5 ↓	-18.18 ↑
	C. coccodes (10^4 conidia/mL)	1.95 ↓	45.45 ↓
	V. dahliae (10^2 conidia/mL)	1.5 ↓	13.63 ↓
	V. dahliae (10^3 conidia/mL)	1.75 ↓	18.18 ↓
	V. dahliae (10^4 conidia/mL)	3.39 ↓	40.90 ↓
Desiree	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	35.18 ↓	61.53 ↓
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	29.89 ↓	69.23 ↓
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	56.30 ↓	76.92 ↓
	C. coccodes (10^2 conidia/mL)	58.86 ↓	76.92 ↓
	C. coccodes (10^3 conidia/mL)	53.25 ↓	76.92 ↓
	C. coccodes (10^4 conidia/mL)	54.77 ↓	69.23 ↓
	V. dahliae (10^2 conidia/mL)	28.67 ↓	30.76 ↓
	V. dahliae (10^3 conidia/mL)	8.79 ↓	61.53 ↓
	V. dahliae (10^4 conidia/mL)	41.27 ↓	38.46 ↓
Alpha	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	30.51 ↓	36 ↓
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	53.80 ↓	52 ↓
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	25.08 ↓	44 ↓
	C. coccodes (10^2 conidia/mL)	28.17 ↓	52 ↓

	C. coccodes (10^3 conidia/mL)	16.83 ⬇	44 ⬇
	C. coccodes (10^4 conidia/mL)	32.30 ⬇	56 ⬇
	V. dahliae (10^2 conidia/mL)	30.58 ⬇	44 ⬇
	V. dahliae (10^3 conidia/mL)	14.43 ⬇	36 ⬇
	V. dahliae (10^4 conidia/mL)	34.36 ⬇	68 ⬇
Cara	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	9.70 ⬇	38.09 ⬇
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	9.17 ⬇	38.09 ⬇
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	11.86 ⬇	85.71 ⬇
	C. coccodes (10^2 conidia/mL)	16.41 ⬇	42.85 ⬇
	C. coccodes (10^3 conidia/mL)	7.46 ⬇	38.09 ⬇
	C. coccodes (10^4 conidia/mL)	12.76 ⬇	42.85 ⬇
	V. dahliae (10^2 conidia/mL)	27.23 ⬇	66.67 ⬇
	V. dahliae (10^3 conidia/mL)	41.71 ⬇	28.57 ⬇
	V. dahliae (10^4 conidia/mL)	24.55 ⬇	52.38 ⬇

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

$$\textit{Reduction over control (\%)} = \frac{(\textit{Value}_{\textit{Control}} - \textit{Value}_{\textit{Stress}})}{\textit{Value}_{\textit{Control}}} \; x100$$

1) ⬇'- indicates plant parameter is more affected by stress that leads 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)

B. The interaction between the fungal pathogens under the combined stress treatment at plant interphase

The table shows the interaction between fungus *C. coccodes* and *V. dahliae* on disease symptoms, crown rot, sclerotia, and stem colonization in potato cultivars

Cultivar	**Treatment**	**Response under combined stress (Type B parameters*)**				
		Disease symptoms	**Crown rot**	***C. coccodes* sclerotia**	**Stem colonization**	
					C. coccodes	***V. dahliae***
Nicola	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	3.35	1.8	4.1	3.59	4.7

	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	3.4	2.1	4.5	3.47	5.13
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	3.47	1.9	4.2	4.08	4.96
	C. coccodes (10^2 conidia/mL)	1.2	0.35	0.55	2.75	N/A
	C. coccodes (10^3 conidia/mL)	2	0.6	1.9	2.79	N/A
	C. coccodes (10^4 conidia/mL)	2.56	0.67	2.11	2.89	N/A
	V. dahliae (10^2 conidia/mL)	1.5	0.4	N/A	N/A	5.04
	V. dahliae (10^3 conidia/mL)	1.7	0.3	N/A	N/A	5.06
	V. dahliae (10^4 conidia/mL)	2.65	1.5	N/A	N/A	5.21
Desiree	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	2	2.13	4	3.1	5
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	3.57	2.71	4.86	4.34	5.9
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	3	2.25	4.75	3.7	5.64
	C. coccodes (10^2 conidia/mL)	2.17	2.33	4.22	4.62	N/A
	C. coccodes (10^3 conidia/mL)	3.15	2.4	4.3	4.5	N/A
	C. coccodes (10^4 conidia/mL)	2.27	2.04	3.43	4.23	NA
	V. dahliae (10^2 conidia/mL)	1.38	1.13	N/A	N/A	6.09
	V. dahliae (10^3 conidia/mL)	3.05	2.4	N/A	N/A	6.54
	V. dahliae (10^4 conidia/mL)	1.9	1.2	N/A	N/A	5.99
Alpha	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	0.5	0.33	1.89	3.36	0
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	2.1	1.4	3.35	3.6	5.18
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	2.15	1.9	3.25	3.05	3.4
	C. coccodes (10^2 conidia/mL)	1.45	0.95	1.9	4.08	N/A
	C. coccodes (10^3 conidia/mL)	1.1	1.05	3.4	4.21	N/A
	C. coccodes (10^4 conidia/mL)	2	1.6	3.6	3.92	N/A
	V. dahliae (10^2 conidia/mL)	2	0.7	N/A	N/A	4.55
	V. dahliae (10^3 conidia/mL)	2.05	0.4	N/A	N/A	4.27
	V. dahliae (10^4 conidia/mL)	2.6	1.6	N/A	N/A	5.02

Cara	*C. coccodes* (10^2 conidia/mL) + *V. dahliae* (10^2 conidia/mL) (Simultaneous stress)	2.55	1.1	1.45	2.25	4.52
	C. coccodes (10^3 conidia/mL) + *V. dahliae* (10^3 conidia/mL) (Simultaneous stress)	1.61	1.11	1.39	2.33	3.47
	C. coccodes (10^4 conidia/mL) + *V. dahliae* (10^4 conidia/mL) (Simultaneous stress)	3.31	1.18	1.75	0	4.37
	C. coccodes (10^2 conidia/mL)	3.25	2.1	0.8	2.36	N/A
	C. coccodes (10^3 conidia/mL)	2.55	1.2	1.2	3.03	N/A
	C. coccodes (10^4 conidia/mL)	3.06	2	1.62	2.53	N/A
	V. dahliae (10^2 conidia/mL)	2.31	2.38	N/A	N/A	5.6
	V. dahliae (10^3 conidia/mL)	3	2.25	N/A	N/A	5.96
	V. dahliae (10^4 conidia/mL)	3.56	2	N/A	N/A	5.75

(*N/A-Not available; Disease scale of 0 to 5, 0=no symptoms, 1=chlorosis of lower leaves, 2=moderate (30-50% of leaves) wilt with severe chlorosis, 3=moderate wilt and necrosis, 4=severe (more than 50% of leaves) wilt and necrosis, and 5=death of the plant. Crown rot on a scale of 0 to 3, 0=healthy crown, 1=scattered brown lesions, 2=brown lesions on most of the crown surface, 3=rotted crown. C. coccodes sclerotia on the roots on a scale of 0 to 5, 0=no sclerotia, 1 =several sclerotia, 2=up to 25% of roots covered with sclerotia, 3=up to 50% of roots covered with sclerotia, 4=50-70% of roots covered with sclerotia, and 5=≥70% of roots covered with sclerotia*)

For raw data – Click here (.xlsx file)

Reference- Tsror (Lahkim) L, Hazanovsky M, (2001) Effect of co-inoculation by *Verticillium dahliae* and *Colletotrichum coccodes* on disease symptoms and fungal colonization in four potato cultivars. Plant Pathol. **50:** 438-488

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*

The inference from the study: Lakhim and Hazanovsky, 2001 study aims to understand the interaction between the fungal pathogens *V. dahliae* and *C. coccodes* (the causal agents of potato early dying syndrome) on four potato cultivars Nicola (resistant to *C. coccodes* and susceptible to *V. dahliae*), Desiree (susceptible to *C. coccodes* and resistant to *V. dahliae*), Alpha (susceptible to *C. coccodes* and resistant to *V. dahliae*) and Cara (resistant to both the pathogens). The simultaneous inoculation of both the pathogens caused significant reduction in plant height and shoot weight of cv. Nicola in comparison with the single inoculation of either pathogen. The percentage reduction in plant height and shoot weight were not additive in cv. Desiree. The simultaneous and single inoculation of pathogens caused a similar level of reduction in plant height and shoot weight of cv. Alpha; whereas, in cv. Cara the percentage reduction caused by the inoculation of both the pathogens were less than the reduction caused by either pathogen alone. **The overall observations indicate that the simultaneous inoculation of both the pathogens affecting the plant height and shoot weight was cultivar-dependant response to pathogens.**