



Effect on alfalfa cultivars (*Medicago sativa* cv. Apollo II, Nevada Synthetic XXX, Deseret)

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

Crop: Alfalfa (*Medicago sativa* cv. Apollo II, Nevada Synthetic XXX, Deseret)
 Stress 1: *Meloidogyne hapla*
 Stress 2: *Phytophthora megasperma* f.sp. *medicaginis*
 Stage of plant: At sowing

The table shows the impact of nematode and oomycete alone and in combination on shoot weight, root weight, and plant survival after 7 weeks post-inoculation in alfalfa plants.

	Treatment	Plant response to stress (reduction over control %)		
		Type A parameters*		
		Plant survival after 7 weeks	Shoot weight	Root weight
Apollo II	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	32.4 ↓	22.2 ↓	2.6 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	9.2 ↓	63.7 ↓	63.0 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	36.2 ↓	91.2 ↓	81.7 ↓
Nevada Synthetic XXX	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	44.7 ↓	61.7 ↓	53.3 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	1.1 ↓	44.2 ↓	49.1 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	21.1 ↓	73.4 ↓	71.0 ↓

Deseret	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	77.1 ↓	73.2 ↓	68.0 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	22.9 ↓	96.6 ↓	84.5 ↓
	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	44.1 ↓	99 ↓	91.5 ↓

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

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

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

'*' - For more information on parameter classification, please refer to the 'methodology' tab.

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

The table shows the effect of the oomycete pathogen on nematode induced root gall rating and effect of the nematode on oomycete induced root-rot rating, percent of infected roots and nodules under combined stress treatment

	Treatment	Response to combined stress**			
		Type B parameters*			
		% nodules infected with <i>Phytophthora</i>	% roots infected with <i>Phytophthora</i>	Root-rot rating	Root Gall rating
Apollo II	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	0	10.3	1.6	N/A
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	N/A	N/A	N/A	4.4

	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	13.3	25.3	2.1	3.8
Nevada Synthetic XXX	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	0	11.3	1.7	N/A
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	N/A	N/A	N/A	2.1
	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	0	10.3	1.6	1.4
Deseret	<i>Phytophthora megasperma</i> (0.1g/ 1g of seed)	2.3	25.3	2.5	N/A
	<i>Meloidogyne hapla</i> (2000 eggs/seed)	N/A	N/A	N/A	4.4
	<i>Meloidogyne hapla</i> (2000 eggs/seed) + <i>Phytophthora megasperma</i> (0.1g/ 1g of seed) (simultaneous stress)	17.3	61.3	2.6	3.7

For raw data – Click here (.xlsx file)

Reference - Gray FA, Griffin GD, Johnson DA, Eckert JW, Kazimir JE (1990) Interrelationship between *Meloidogyne hapla* and *Phytophthora megasperma* f. sp. *medicaginis* in seedling damping-off and root infection of alfalfa. *Phytopathology* 80:228-232

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: Gray FA (1990) studied the interaction of *Meloidogyne hapla* with *Phytophthora megasperma* in three alfalfa cultivars Apollo II, Nevada Synthetic XXX, Deseret. Pathogens were inoculated singly and simultaneously. Plants were then analyzed for their shoot weight, root weight, and the number of live plants after seven weeks. All growth parameters showed additive reduction under simultaneous inoculation in all three cultivars. However, Deseret cultivar was more susceptible to this pathogen combination. Root rot rating and percent infection with oomycete were high under simultaneous stress index, whereas gall rating was low under combined stress. Cultivar Deseret showed a maximum root rot rating. **Thus, this**

pathogen combination acts synergistically to reduce plant growth and forms a complex disease phenotype in all alfalfa cultivars.