Effect on alfalfa genotypes (*Medicago sativa* L. cv. Ranger, Lahontan, Moapa69)

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

Crop: Alfalfa (*Medicago sativa* L. cv. Ranger, Lahontan, Moapa69)
Stress 1: *Ditylenchus dipsaci*
Stress 2: *Fusarium oxysporum*
Stage of plant: At sowing

The table shows the impact of nematode and fungus alone and in combination on shoot weight, root weight, plant persistence and yield of alfalfa genotypes

	Treatment	Plant response to stress (reduction over control %) Type A parameters*					
		High soil moisture shoot weight	Low soil moisture shoot weight	High soil moisture root weight	Low soil moisture root weight	High soil moisture-Plant persistance** %	Low soil moisture-Plant persistance** %
Lahontan	*Ditylenchus dipsaci(100 nema/plant)*	4.5 ↓	3.8 ↓	26.4 ↓	-6.2 ↑	87↓	97↓
	Fusarium oxysporum (12X10^7 microconidia/ plant)	19.0 ↓	14.4 ↓	37.3 ↓	-3.8 ↑	75↓	79↓
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X107 microconidia/plant) (simultaneous stress)	28.6 ↓	26.1 ↓	39.6 ↓	13.9 ↓	67↓	73↓
Moapa	*Ditylenchus dipsaci (100 nema/plant)*	45.5 ↓	3.5 ↓	34.8 ↓	1.4↓	68 ↓	95↓
	Fusarium oxysporum (12X10^7 microconidia/ plant)	11.0↓	0.8 ↓	15.2 ↓	-3.8 ↑	89 ↓	93↓

69	*Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X107 microconidia/plant)(simultaneous stress)*	60.2 ↓	10.2 ↓	43.6 ↓	-0.5 ↑	64 ↓	84↓
Ranger	*Ditylenchus dipsaci(100 nema/plant)*	47.1 ↓	2.8 ↓	36.8 ↓	-2.4 ↑	73 ↓	95↓
	Fusarium oxysporum (12X10^7 microconidia/plant)	22.6 ↓	8.3 ↓	31.8 ↓	-4.3 ↑	76↓	77↓
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)	62.3 ↓	25.4 ↓	58.7 ↓	17.1 ↓	46↓	74↓

	Treatment	**Plant response to stress (reduction over control %) Type A parameters***			
		Early irrigation- Yield (tonnes per hectare)	**Late irrigation- Yield (tonnes per hectare)**	**Early irrigation- Plant persistence** %**	**Late irrigation- Plant persistence** %**
Lahontan	*Ditylenchus dipsaci(100 nema /plant)*	6.4 ↓	3.4 ↓	93 ↓	97 ↓
	Fusarium oxysporum (12X10^7 microconidia/plant)	24.5 ↓	19.1 ↓	83 ↓	84 ↓
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)	43.6 ↓	28.1 ↓	67 ↓	83 ↓
Mo	*Ditylenchus dipsaci (100 nema/ plant)*	48.3 ↓	11.5 ↓	63 ↓	95 ↓

apa 69	*Fusarium oxysporum (12X10^7 microconidia/plant)*	9.0 ↓	4.6 ↓	91 ↓	93 ↓
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)	65.2 ↓	5.7 ↓	37 ↓	91 ↓
Ranger	*Ditylenchus dipsaci (100 nema/plant)*	48.9 ↓	8.9 ↓	67 ↓	94 ↓
	Fusarium oxysporum (12X10^7 microconidia/plant)	21.6 ↓	21.1 ↓	80 ↓	82 ↓
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)	61.4 ↓	31.1 ↓	43 ↓	80 ↓

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).
2) '↑'- indicates plant parameters less/not affected by stress leading to improved resistance (higher the value lesser the damage).
'' - For more information on parameters classification, please refer to 'methodology' tab.*
'**' - *Values are presented as it is from the source article without subjecting to the calculation.*

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-induced nodules per plant and and the effect of the nematode on fungus induced percent wilt under combined stress treatment

	Treatment	Response to combined stress** Type B parameters*			
		High soil moisture-Rhizobium nodules/plant	**Low soil moisture-Rhizobium nodules/plant**	**High soil moisture-%Fusarium wilt**	**Low soil moisture-%Fusarium wilt**
Lahontan	*Ditylenchus dipsaci (100 nema/plant)*	36	44	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	28	41	41	15
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X107 microconidia/plant) (simultaneous stress)	30	44	46	21
Moapa 69	*Ditylenchus dipsaci (100 nema/plant)*	27	45	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	40	44	24	13
	Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X107 microconidia/plant) (simultaneous stress)	24	45	30	14
Range	*Ditylenchus dipsaci (100 nema/plant)*	24	42	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	25	38	49	18

r	*Ditylenchus dipsaci (100 nema/ plant) + Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)*	23	43	63	20

	Treatment	**Response to combined stress**** **Type B parameters***			
		Early irrigation- Rhizobium nodules/plant	**Late irrigation- Rhizobium nodules/plant**	**Early irrigation- % Fusarium wilt**	**Late irrigation- % Fusarium wilt**
Lahontan	*Ditylenchus dipsaci(100 nema/plant)*	60	68	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	53	68	31	15
	Ditylenchus dipsaci (100 nema/ plant) + *Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)*	48	65	56	21
Moapa 69	*Ditylenchus dipsaci* *(100 nema/plant)*	30	65	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	64	72	24	13
	Ditylenchus dipsaci (100 nema/ plant) + *Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)*	27	63	30	14

Ranger	*Ditylenchus dipsaci* *(100 nema/plant)*	34	63	0	0
	Fusarium oxysporum (12X10^7 microconidia/plant)	52	62	39	18
	Ditylenchus dipsaci (100 nema/ plant) + *Fusarium oxysporum (12X10^7 microconidia/plant) (simultaneous stress)*	31	60	63	20

For raw data – Click here (.xlsx file)
Reference- Griffin GD (1992) Stem Nematode-Fusarium Wilt Complex in Alfalfa as Related to Irrigation Management at Harvest Time Journal of Nematology 24: 315-320

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: Griffin GD (1992) studied the interaction between *Ditylenchus dipsaci* and *Fusarium oxysporum f. sp. medicaginis* in three alfalfa cultivars. Simultaneous inoculation of both pathogens led to an additive reduction in shoot weight, root weight, and yield compared to single pathogen inoculation in all cultivars. This reduction was high in high soil moisture and in early irrigation conditions. Wilt percentage was also high in simultaneous inoculation in high soil moisture and early irrigation condition in cultivar ranger only. Other two cultivars did not show much wilt reduction under combined stress treatment. **Thus, this stress combination is effective under high soil and early irrigation conditions reducing growth and yield of alfalfa plants.**