Effect on rice cultivars (*Oryza sativa* L. var. Thihtatyin, Kone Myint2)

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

Crop: Rice (*Oryza sativa* L. var. Thihtatyin, Kone Myint2)
Stress 1: Flooding (till plant maturity; intermittent, permanently)
Stress 2: *Meloidogyne graminicola*
Stage of plant: 3 day old seedling

The table shows the impact of nematode and flooding alone and in combination on growth and yield of rice plants.

			Plant response to stress (reduction over control %) Type A parameters*				
	Soil	**Treatment**	**Plant height**	**Fresh root weight**	**No. of tillers/ plant**	**No. of panicles /plant**	**No. of filled grains /panicle**
Thihtatyin	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	-16.2↑	50.9↓	33.3↓	55.6↓	2.9↓
		Intermittent flooding (till plant maturity)	-21.0↑	19.2↓	-23.8↑	-20.1↑	3.2↓
		Permanent flooding (till plant maturity)	-15.6↑	-17.2↑	4.8↓	-5.6↑	-30.3↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	-17.1↑	49.5↓	33.3↓	25.7↓	4.0↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	-10.1↑	5.5↓	-4.8↑	-23.6↑	1.1↓

	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	22.8↓	68.0↓	63.6↓	86.4↓	86.8↓
		Intermittent flooding (till plant maturity)	-12.8↑	14.6↓	22.7↓	-14.6↑	-15.6↑
		Permanent flooding (till plant maturity)	-27.5↑	-53.9↑	-4.5↑	-103.9↑	5.3↓
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	-15.7↑	58.7↓	63.6↓	39.8↓	2.6↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	-19.1↑	-56.3↑	9.1↓	-53.4↑	0.3↓
Kone Myint2	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	10.7↓	40.3↓	18.2↓	40.0↓	33.7↓
		Intermittent flooding (till plant maturity)	0.7↓	-14.9↑	-18.2↑	-8.7↑	-11.6↑
		Permanent flooding (till plant maturity)	-5.0↑	-23.0↑	-9.1↑	3.8↓	-27.5↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	2.6↓	27.8↓	-18.2↑	17.5↓	0.0

		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	7.0↓	10.9↓	-27.3↑	-18.8↑	7.4↓
	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	40.8↓	29.1↓	0.0	65.3↓	72.1↓
		Intermittent flooding (till plant maturity)	-7.3↑	-66.1↑	-33.3↑	12.5↓	-28.6↑
		Permanent flooding (till plant maturity)	-4.6↑	-114.2↑	-33.3↑	-13.9↑	-44.8↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	16.1↓	14.2↓	33.3↓	22.2↓	44.1↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	-3.6↑	-65.4↑	-33.3↑	-22.2↑	-14.1↑

			Plant response to stress (reduction over control %) Type A parameters*			
	Soil	**Treatment**	**Filled grains/ plant ** (%)**	**Filled grain weight /plant**	**1000 filled grains weight**	**Yield**
Thihtatyin	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	76.6	21.5↓	-3.3↑	24.1↓
		Intermittent flooding (till plant maturity)	62.1	-48.1↑	-6.5↑	-10.3↑

		Permanent flooding (till plant maturity)	76.4	-64.6↑	-11.4↑	-62.1↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	66.6	13.9↓	4.9↓	13.8↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	58.8	-39.2↑	-2.7↑	-27.6↑
	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	13.9	97.4↓	79.4↓	98.5↓
		Intermittent flooding (till plant maturity)	76.8	-28.6↑	-8.0↑	-40.7↑
		Permanent flooding (till plant maturity)	60.5	-41.6↑	-2.3↑	-55.6↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	53.8	42.9↓	4.0↓	59.3↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	60.8	-32.5↑	-3.4↑	-11.1↑
Kone Myint2	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	60.3	52.5↓	-10.3↑	57.9↓
		Intermittent flooding (till plant maturity)	86.5	-32.2↑	-10.3↑	-63.2↑
		Permanent flooding (till plant maturity)	81.6	-35.6↑	-8.9↑	-57.9↑

		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	79.3	20.3↓	0.5↓	10.5↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	79.8	-13.6↑	-5.6↑	-36.8↑
	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	26.7	97.6↓	68.7↓	95.3↓
		Intermittent flooding (till plant maturity)	81.2	-40.5↑	-13.4↑	-60.0↑
		Permanent flooding (till plant maturity)	87.9	-85.7↑	-12.4↑	-106.7↑
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	54.2	26.2↓	11.9↓	60.0↓
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	72.5	-28.6↑	-13.4↑	-26.7↑

Reference - Win PP, Kyi PP, Maung ZTZ, Myint YY, Waele DD (2015) Effect of different water regimes on nematode reproduction, root galling, plant growth and yield of lowland and upland Asian rice varieties grown in two soil types infested by the rice root-knot nematode *Meloidogyne graminicola*. Russian Journal of Nematology 23(2): 99 – 112.

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 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) "0.0" value indicates plant parameter behaved similarly under control and stress condition (no damage).

'' - For more information on parameter classification, please refer to the 'methodology' tab.*
*'**' - Values are presented as it is from the source article without subjecting to the calculation.*

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

The table shows the effect of nematode and flooding on nematode population, root gall index and multiplication factor under combined stress treatment

			Response to combined stress** **Type B parameters***			
	Soil	**Treatment**	**No. of J2/ g root**	**No. of eggs/ g root**	**Root galling index**	**Multiplication factor**
Thihtatyin	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	11457	5430	8	44
		Intermittent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Permanent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	12060	15929	5	57
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	9039	17674	4	97
	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	28560	14260	9	71
		Intermittent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Permanent flooding (till plant maturity)	N/A	N/A	N/A	N/A

		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	8058	5831	7	20
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	11761	10915	4	137
Kone Myint2	Clay Loam	*Meloidogyne graminicola*(3000 J2/ pot)	6720	12513	7	31
		Intermittent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Permanent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	5718	12825	7	34
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	5500	9605	3	44
	Sandy loam	*Meloidogyne graminicola*(3000 J2/ pot)	11013	19597	8	33
		Intermittent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Permanent flooding (till plant maturity)	N/A	N/A	N/A	N/A
		Meloidogyne graminicola(3000 J2/ pot) + Intermittent flooding (till plant maturity) 6 days later (Sequential stress)	6378	8257	7	17
		Meloidogyne graminicola(3000 J2/ pot) + Permanent flooding (till plant maturity) 6 days later (Sequential stress)	2336	13436	2	12

Root galling index according to 0 = no swellings or galls, 1 = 10% galls, 2 = 20% galls, 3 = 30% galls, 4 = 40% galls, 5 = 50% galls, 6 = 60% galls, 7 = 70% galls, 8 = 80% galls, 9 = 90% galls and 10 = all roots of the root system galled.

Reference - Win PP, Kyi PP, Maung ZTZ, Myint YY, Waele DD (2015) Effect of different water regimes on nematode reproduction, root galling, plant growth and yield of lowland and upland Asian rice varieties grown in two soil types infested by the rice root-knot nematode *Meloidogyne graminicola*. Russian Journal of Nematology 23(2): 99 – 112.

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 the 'methodology' tab.*

Inference From the study: Win et al. studied the interaction of *Meloidogyne graminicola* and two flooding regimes; intermittent and permanent flooding in two rice cultivars Thihtatyin and Kone Myint2. Rice was grown in two soil types; clay loam and sandy loam. Stress was given singly and sequentially. Parameters like fresh root weight, no. of tillers per plant, no. of panicles per plant, filled grain weight per plant, and yield did not show an additive reduction under combined stress compared to individual stresses. Plant height increased under combined stress. The number of filled grains per panicle decreased additively with intermittent flooding under combined stress in clay loam soil but not in sandy loam soil for cultivar Thihtatyin but not for Kone Myint2. Filled grains per plant was reduced in both soil types but not synergistically under combined stress. Overall, cultivar Kone Myint2 was affected more under stress compared to thihtatyin. Nematode population and eggs were high in clay loam soil, multiplication factor was less in clay loam soil. Root galling index was high in sandy loam soil. **This stress combination does not reduce rice growth and yield synergistically and is not detrimental to the plant.**