



Stress Combination and their Interaction in Plants (SCIP) Database

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Effect on barley genotypes (*Hordeum vulgare* L.)

The interaction between the fungal pathogens under combined stress treatment at the plant interface

Stress 1: *Puccinia hordei*
Stress 2: *Erysiphe graminis*
Stage of plant: First seedling leaf

The table shows the effect of *P. hordei* on *E. graminis* and vice-versa on the number of rust pustules, rust pustule size, uredospores germination, number of mildew colony, mildew area and productivity in barley cultivars

| The development of <i>P. hordei</i> on seedling barley previously inoculated with <i>E. graminis</i> | | | |
|--|--|--|---|
| Cultivar | Treatment | Response under combined stress (Type B parameter*) | |
| | | Mean number rust pustules/leaf | Mean rust pustule size (mm ²) on leaves |
| Midas | <i>E. graminis</i> +2hr. interval + <i>P. hordei</i> (Sequential stress) | 246 | 0.09 |
| | <i>P. hordei</i> | 249 | 0.12 |
| | <i>E. graminis</i> +1-day interval + <i>P. hordei</i> (Sequential stress) | 39 | 0.07 |
| | <i>P. hordei</i> | 27 | 0.1 |
| | <i>E. graminis</i> + 2-day interval + <i>P. hordei</i> (Sequential stress) | 66 | 0.09 |
| | <i>P. hordei</i> | 51 | 0.11 |
| | <i>E. graminis</i> + 4-day interval + <i>P. hordei</i> (Sequential stress) | 64 | 0.05 |
| | <i>P. hordei</i> | 144 | 0.07 |
| | <i>E. graminis</i> + 6-day interval + <i>P. hordei</i> (Sequential stress) | 15 | 0.04 |
| | <i>P. hordei</i> | 106 | 0.09 |
| Zephyr | <i>E. graminis</i> +2hr. interval + <i>P. hordei</i> (Sequential stress) | 201 | 0.09 |
| | <i>P. hordei</i> | 228 | 0.11 |
| | <i>E. graminis</i> +1day interval + <i>P. hordei</i> (Sequential stress) | 94 | 0.1 |
| | <i>P. hordei</i> | 58 | 0.1 |
| | <i>E. graminis</i> +2-day interval + <i>P. hordei</i> (Sequential stress) | 58 | 0.08 |
| | <i>P. hordei</i> | 89 | 0.12 |
| | <i>E. graminis</i> + 4-day interval + <i>P. hordei</i> (Sequential stress) | 112 | 0.05 |
| | <i>P. hordei</i> | 138 | 0.08 |
| | <i>E. graminis</i> + 6-day interval + <i>P. hordei</i> (Sequential stress) | 0 | 0.06 |

| | | | |
|---------|--|-----|------|
| | <i>P. hordei</i> | 94 | 0.07 |
| Julia | <i>E. graminis</i> +2hr. interval + <i>P. hordei</i> (Sequential stress) | 247 | 0.11 |
| | <i>P. hordei</i> | 220 | 0.09 |
| | <i>E. graminis</i> +1day interval + <i>P. hordei</i> (Sequential stress) | 67 | 0.05 |
| | <i>P. hordei</i> | 96 | 0.08 |
| | <i>E. graminis</i> + 2-day interval + <i>P. hordei</i> (Sequential stress) | 58 | 0.05 |
| | <i>P. hordei</i> | 145 | 0.13 |
| | <i>E. graminis</i> + 4-day interval + <i>P. hordei</i> (Sequential stress) | 100 | 0.05 |
| | <i>P. hordei</i> | 154 | 0.07 |
| | <i>E. graminis</i> + 6-day interval + <i>P. hordei</i> (Sequential stress) | 3 | 0.03 |
| | <i>P. hordei</i> | 85 | 0.07 |
| Mazurka | <i>E. graminis</i> +2hr. interval + <i>P. hordei</i> (Sequential stress) | 162 | 0.08 |
| | <i>P. hordei</i> | 253 | 0.11 |
| | <i>E. graminis</i> +1day interval + <i>P. hordei</i> (Sequential stress) | 128 | 0.06 |
| | <i>P. hordei</i> | 122 | 0.07 |
| | <i>E. graminis</i> + 2-day interval + <i>P. hordei</i> (Sequential stress) | 52 | 0.07 |
| | <i>P. hordei</i> | 81 | 0.08 |
| | <i>E. graminis</i> + 4-day interval + <i>P. hordei</i> (Sequential stress) | 97 | 0.06 |
| | <i>P. hordei</i> | 187 | 0.09 |
| | <i>E. graminis</i> + 6-day interval + <i>P. hordei</i> (Sequential stress) | 25 | 0.06 |
| | <i>P. hordei</i> | 85 | 0.08 |

Development of rust on the adaxial leaf surfaces of seedling barley pre-inoculated with *E. graminis*

| Cultivar | Treatment | Mean germination uredospores (%) | Mean no. rust pustule/leaf | Mean area of rust pustules (mm ²) |
|----------|---|----------------------------------|----------------------------|---|
| Zephyr | <i>E. graminis</i> (on abaxial surface) incubated for 24 hr.+ <i>P. hordei</i> (on adaxial surface) (Sequential stress) | 34.2 | 116.5 | 0.175 |
| | <i>E. graminis</i> (on adaxial surface) incubated for 24 hr.+ <i>P. hordei</i> (on adaxial surface) (Sequential stress) | 30.3 | 35.8 | 0.149 |
| | <i>P. hordei</i> (on adaxial surface) | 34.9 | 116 | 0.194 |

Reduction of rust on leaves pre-inoculated with *E. graminis* 4 days earlier

| Cultivar | Treatment | Mean number rust pustules/leaf |
|----------|---|--------------------------------|
| Zephyr | <i>E. graminis</i> + 4 days interval + <i>P. hordei</i> (Sequential stress) | 13.4 |
| | <i>P. hordei</i> | 42.9 |

Mean no. rust pustules per leaf on leaves of cultivar Mazurka seedling barley pre-inoculated with *E. graminis*

| Cultivar | Treatment | Mean no. rust pustules/leaf |
|----------|---|-----------------------------|
| Mazurka | <i>E. graminis</i> + 2hr. interval + <i>P. hordei</i> (Sequential stress) | 255 |

| | | |
|--|--|-----|
| | <i>P. hordei</i> | 183 |
| | <i>E. graminis</i> +1-day interval + <i>P. hordei</i> (Sequential stress) | 70 |
| | <i>P. hordei</i> | 117 |
| | <i>E. graminis</i> + 4-day interval + <i>P. hordei</i> (Sequential stress) | 82 |
| | <i>P. hordei</i> | 155 |
| | <i>E. graminis</i> + 6-day interval + <i>P. hordei</i> (Sequential stress) | 48 |
| | <i>P. hordei</i> | 82 |

Effect on mildew of pre-inoculating different parts of seedling barley leaves with *P. hordei*

| Cultivar | Treatment | Mean no. mildew colonies |
|----------|--|--------------------------|
| Zephyr | <i>P. hordei</i> on basal third leaf + 4-day interval + <i>E. graminis</i> uniform inoculation (Sequential stress) | 39.4 |
| | <i>P. hordei</i> on central third leaf + 4-day interval + <i>E. graminis</i> uniform inoculation (Sequential stress) | 74 |
| | <i>P. hordei</i> on distal third leaf+ 4-day interval + <i>E. graminis</i> uniform inoculation (Sequential stress) | 71.1 |
| | <i>E. graminis</i> uniform inoculation | 83.2 |

Effects on mildew development of pre-inoculating seedling barley leaf with a central band of *P. hordei*

| Cultivar | Treatment | Mean rust colony size (mm ²) | | | | | | | | | | Mean no. rust conidiophores/mm ² | | | | | | | | |
|----------|---|--|------|------|------|------|------|------|------|-----------|------------|---|------|-----|-----|-----|-----|-----|-----------|--|
| | | Distance from center of leaf (cm) | | | | | | | | | | Distance from center of leaf (cm) | | | | | | | | |
| | | 2.5 (Base) | 2 | 1.5 | 1 | 0 | 1 | 1.5 | 2 | 2.5 (Tip) | 2.5 (Base) | 2 | 1.5 | 1 | 0 | 1 | 1.5 | 2 | 2.5 (Tip) | |
| Zephyr | <i>Ph</i> + <i>Eg</i> (Sequential stress) | 1.88 | 1.38 | 1.34 | 0.55 | 0.28 | 0.95 | 1.18 | 1.54 | 1.24 | 1443 | 1259 | 1037 | 671 | 306 | 861 | 714 | 939 | 945 | |

Further to check effects on mildew development of pre-inoculating seedling barley leaves with *P. hordei*

| Cultivar | Treatment | Mean germination of mildew conidia (%) | | Mean formation of mildew appressoria (%) | | Mean establishment of mildew colonies (%) | Mean area of mildew colonies (mm ²) | Mean number conidiophores (mm ²) | Productivity of conidia |
|----------|---|--|-------|--|-------|---|---|--|-------------------------|
| | | Day 1 | Day 3 | Day 1 | Day 3 | Day 3 | | | |
| Zephyr | <i>Ph</i> + <i>Eg</i> (Sequential stress) | 20.2 | 16.2 | 72 | 69.7 | 54 | 1.59 | 512 | 3.3 |
| | <i>E. graminis</i> | 15.2 | 18.1 | 64 | 81.7 | 53.9 | 2.33 | 1071 | 5.7 |

(*Ph*- *Puccinia hordei*; *Eg*- *Erysiphe graminis*)

For raw data – Click here (.xlsx file)

Reference– Round PA, Wheeler BEJ (1978) Interactions of *Puccinia hordei* and *Erysiphe graminis* on seedling barley. Ann. appl. Biol. **89**:21-35

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: Round and Wheeler, 1978 studied the interaction between *P. hordei* (causal agent of rust) and *E. graminis* (causal agent of mildew) on barley cultivars Midas, Zephyr, Julia and Mazurka grown to first seedling leaf. The pre-inoculation of *E. graminis* on leaves decreased the number of rust pustules in comparison with the single inoculation *P. hordei*. Similarly, the pre-inoculation of *P. hordei* on leaves reduced the size and number of mildew colonies in comparison with the single inoculation of *E. graminis*. **Therefore, these observations revealed the antagonistic interaction among both the pathogens.**