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## EFFECTS OF AMMONIUM:NITRATE RATIO ON SALINITY TOLERANCE IN TWO LAWN GENERA



*Poa pratensis* L. 'Barimpala'

*Lolium perenne* L. 'Bartwingo'

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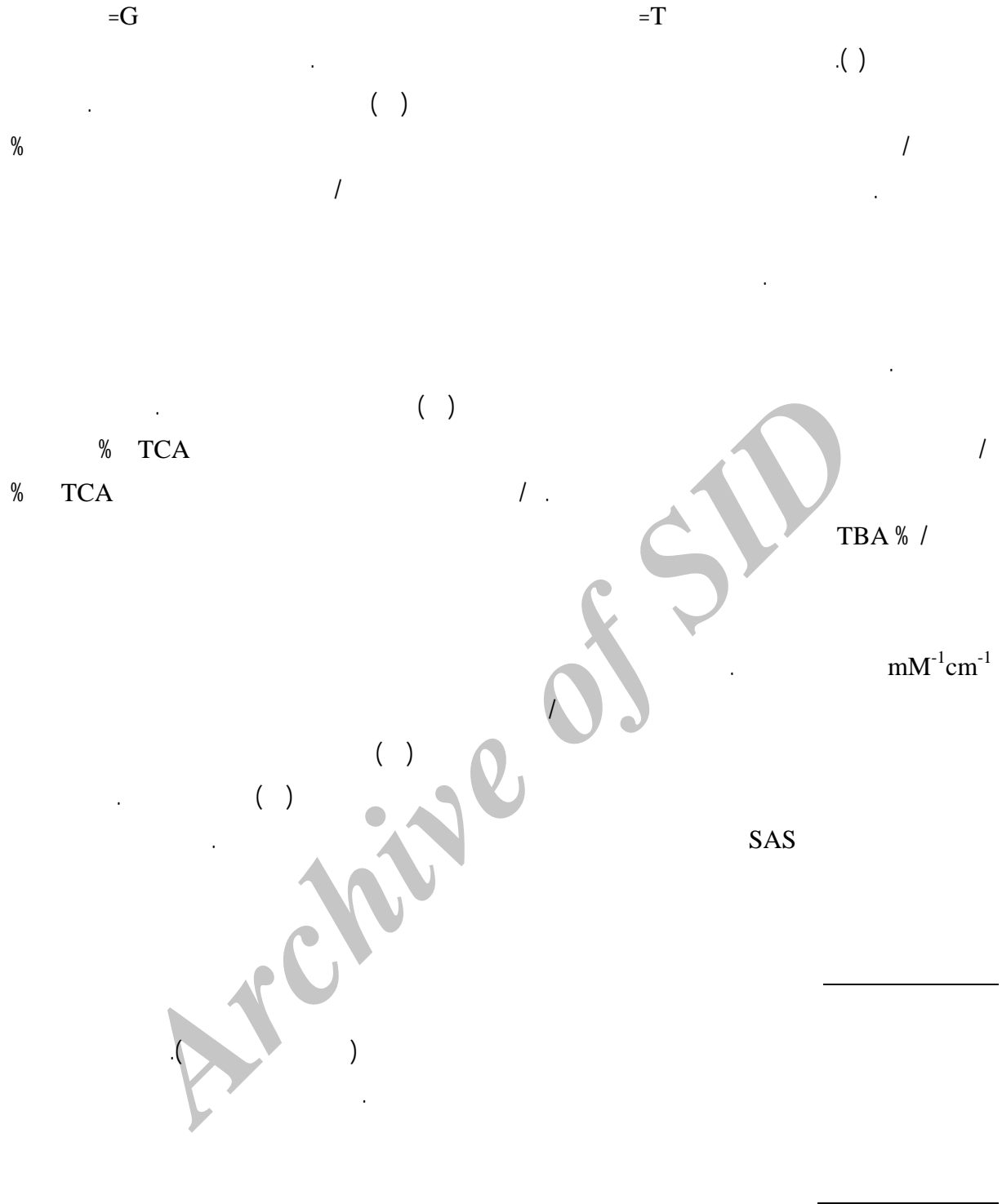
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2-Thiobarbituric acid

Trichloroacetic acid

جدول ۱- اثر شوری بر درصد و سرعت تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدهاید و کلروفیل شاخساره چمن لولیوم پرنه.

Table 1. Effects of salinity on germination percentage and rate, root and shoot length, shoot proline, malondealdehyde and chlorophyll content of *Lolium perenne* L.

| شوری                  | درصد تندش بذور                 | میانگین زمان تندش بذور<br>(روز) | طول ریشه            | طول شاخساره          | پرولین                                      | مالون دی آلدهاید                | کلروفیل                   |
|-----------------------|--------------------------------|---------------------------------|---------------------|----------------------|---|---------------------------------|---------------------------|
| Salinity<br>(mM NaCl) | Seed germination<br>percentage | Mean germination<br>time (day)  | Root length<br>(cm) | Shoot length<br>(cm) | Proline<br>( $\mu\text{mol} / \text{gFW}$ ) | Malondealdehyde<br>(nmol / gFW) | chlorophyll<br>(mg / gFW) |
| 0                     | 94.25a †                       | 2.73e                           | 7.32a               | 12.58a               | 2.40e                                       | 15.29e                          | 1.58a                     |
| 20                    | 93.42a                         | 2.93d                           | 7.27a               | 12.66a               | 5.47d                                       | 15.76d                          | 1.55a                     |
| 40                    | 82.58b                         | 3.39c                           | 6.39b               | 10.58b               | 6.76c                                       | 18.25c                          | 1.34b                     |
| 60                    | 64.00c                         | 3.83b                           | 5.05c               | 9.37c                | 7.71b                                       | 20.52b                          | 1.27b                     |
| 80                    | 61.08d                         | 4.19a                           | 3.94d               | 6.98d                | 9.17a                                       | 23.00a                          | 1.02c                     |

Means in each column are not significantly different at the 1% level of probability using DMRT. †

در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ آزمون چند دامنه ای دانکن ندارند. †

جدول ۲- اثر شوری بر درصد و سرعت تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدهاید و کلروفیل شاخساره چمن پوآ پراتنسیس.

Table 2. Effects of salinity on germination percentage and rate, root and shoot length, shoot proline, malonaldehyde and chlorophyll content of *poa pratensis* L.

| شوری<br>Salinity<br>(mM NaCl) | درصد تندش بذور<br>Seed germination<br>percentage | میانگین زمان تندش بذور (روز)<br>Mean germination time<br>(day) | طول ریشه<br>Root length<br>(cm) | طول شاخساره<br>Shoot length<br>(cm) | پرولین<br>Proline<br>( $\mu$ mol/gFW) | مالون دی آلدهاید<br>Malonaldehyde<br>(nmol/gFW) | کلروفیل<br>chlorophyll<br>(mg/gFW) |
|-------------------------------|--|--|---------------------------------|-------------------------------------|---------------------------------------|---|------------------------------------|
| 0                             | 92.50a †   | 6.74e  | 5.55a                           | 8.85a                               | 2.58e                                 | 25.55e  | 1.49a                              |
| 20                            | 65.70b   | 7.79d  | 4.31b                           | 7.51b                               | 6.60d                                 | 35.29d  | 1.33b                              |
| 40                            | 48.67c   | 8.55c  | 3.43c                           | 6.52c                               | 10.54c                                | 47.79c  | 1.16c                              |
| 60                            | 32.75d   | 9.36b  | 2.60d                           | 5.36d                               | 14.02b                                | 57.39b  | 1.05d                              |
| 80                            | 25.83e   | 10.13a   | 1.72e                           | 4.05e                               | 17.62a                                | 67.99a  | 0.72e                              |

Means in each column are not significantly different at the 1% level of probability using DMRT. †

در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ آزمون چند دامنه ای دانکن ندارند. †

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جدول ۳- اثر میزان آمونیوم بر سرعت تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدهاید و کلروفیل شاخساره چمن لولیوم پرنه.

| آمونیم<br>Ammonium<br>(meq / L) | میانگین زمان تندش بذور<br>(روز)<br>Mean germination<br>time (day) | طول ریشه<br>Root<br>length<br>(cm) | طول<br>شاخساره<br>Shoot<br>length<br>(cm) | پرولین<br>Proline<br>( $\mu$ mol /<br>gFW) | مالون دی آلدهاید<br>Malondealdehy<br>de<br>(nmol / gFW) | کلروفیل<br>chlorophyl<br>l<br>(mg /<br>gFW) |
|---------------------------------|---|------------------------------------|---|--|---|---|
| 0.00                            | 3.34b†  | 6.11a                              | 10.29b                                    | 6.25b                                      | 18.53b  | 1.38a                                       |
| 0.25                            | 3.37b   | 6.09a                              | 10.41b                                    | 6.27b                                      | 18.52b  | 1.37a                                       |
| 0.50                            | 3.43ab  | 6.98a                              | 10.50b                                    | 6.28b                                      | 18.54b  | 1.36ab                                      |
| 1.00                            | 3.50a   | 5.80b                              | 10.75a                                    | 6.39a                                      | 18.66a  | 1.30b                                       |

Table 3. Effects of ammonium concentrations on germination rate, root and shoot length, shoot proline, malondealdehyde and chlorophyll content of *Lolium perenne* L.

† Means in each column are not significantly different at the 1% level of probability using DMRT.

† در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ آزمون چند دامنه ای دانکن ندارند.



جدول ۴- اثر میزان آمونیوم بر سرعت تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدهاید و کلروفیل شاخساره چمن پوآپراتنسیس.

Table 4. Effects of ammonium concentrations on germination rate, root and shoot length, shoot proline, malondealdehyde and

| آمونیم<br>Ammonium<br>(meq / L) | میانگین زمان تندش بذور<br>(روز)<br>Mean germination<br>time (day) | طول ریشه<br>Root<br>length<br>(cm) | طول<br>شاخساره<br>Shoot<br>length<br>(cm) | پرولین<br>Proline<br>( $\mu\text{mol} /$<br>gFW) | مالون دی آلدهاید<br>Malondealdehy<br>de<br>(nmol / gFW) | کلروفیل<br>chlorophyl<br>l<br>(mg /<br>gFW) |
|---------------------------------|---|------------------------------------|---|--|---|---|
| 0.00                            | 8.26c†  | 3.64a                              | 6.58a                                     | 10.04c   | 46.02d  | 1.19a                                       |
| 0.25                            | 8.38c   | 3.59ab                             | 6.51a                                     | 10.16bc  | 46.52c  | 1.18ab                                      |
| 0.50                            | 8.61b   | 3.45bc                             | 6.44ab                                    | 10.28b   | 46.93b  | 1.15b                                       |
| 1.00                            | 8.81a   | 3.41c                              | 6.31b                                     | 10.61a   | 47.74a  | 1.07c                                       |

chlorophyll content of *poa pratensis*

† Means in each column are not significantly different at the 1% level of probability using DMRT.

† در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ آزمون چند دامنه ای دانکن ندارند.

جدول ۵- برهمکنش شوری و میزان آمونیوم بر میانگین زمان تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدهاید و کلروفیل شاخساره چمن لولیم پرنه.

Table 5. Intraction of salinity and ammonium concentrations on mean germination time, root and shoot length, shoot proline, malondealdehyde and chlorophyll content of *Lolium perenne* L.

| شوری<br>Salinity<br>(mM NaCl) | امونیوم<br>Ammonium<br>(meq / L) | میانگین زمان تندش بذور<br>(روز)<br>Mean germination<br>time (day) | طول ریشه<br>Root<br>length<br>(cm) | طول شاخساره<br>Shoot length<br>(cm) | پرولین<br>Proline<br>( $\mu$ mol /<br>gFW) | مالون دی آلدهاید<br>Malondealdehy<br>de<br>(nmol / gFW) | کلروفیل<br>chlorophyl<br>l<br>(mg /<br>gFW) |
|-------------------------------|----------------------------------|---|------------------------------------|-------------------------------------|--|---|---|
| 0                             | 0.00                             | 2.71h †   | 7.17a                              | 12.27c                              | 2.53k                                      | 15.32g  | 1.59a                                       |
|                               | 0.25                             | 2.75h   | 7.23a                              | 12.53bc                             | 2.37k                                      | 15.28g  | 1.56a                                       |
|                               | 0.50                             | 2.72 h  | 7.33a                              | 12.90b                              | 2.42k                                      | 15.30g  | 1.56a                                       |
|                               | 1.00                             | 2.74h   | 7.53a                              | 13.70a                              | 2.46k                                      | 15.25g  | 1.62 a                                      |
| 20                            | 0.00                             | 2.93g   | 7.10a                              | 12.13c                              | 5.63h                                      | 15.82f  | 1.53a                                       |
|                               | 0.25                             | 2.92g   | 7.23a                              | 12.37bc                             | 5.58hi                                     | 15.77f  | 1.57a                                       |
|                               | 0.50                             | 2.96g   | 7.33a                              | 12.63bc                             | 5.39ij                                     | 15.70f  | 1.60a                                       |
|                               | 1.00                             | 2.92g   | 7.43a                              | 13.50a                              | 5.26j                                      | 15.73f  | 1.51a                                       |
| 40                            | 0.00                             | 3.33f   | 6.50b                              | 10.10e                              | 6.98e                                      | 18.28e  | 1.34b                                       |
|                               | 0.25                             | 3.36f   | 6.40b                              | 10.37e                              | 6.80ef                                     | 18.26e  | 1.35b                                       |
|                               | 0.50                             | 3.39f   | 6.30b                              | 10.63e                              | 6.72fg                                     | 18.23e  | 1.36b                                       |
|                               | 1.00                             | 3.47f   | 6.37b                              | 11.23d                              | 6.54g                                      | 18.24e  | 1.32bc                                      |
| 60                            | 0.00                             | 3.73e   | 5.50c                              | 9.43f                               | 7.64d                                      | 20.49d  | 1.32bc                                      |
|                               | 0.25                             | 3.77e   | 5.37cd                             | 9.43f                               | 7.72d                                      | 20.52d  | 1.30bc                                      |
|                               | 0.50                             | 3.87de  | 5.00d                              | 9.37f                               | 7.70d                                      | 20.54d  | 1.27bc                                      |
|                               | 1.00                             | 3.95cd  | 4.33e                              | 9.23f                               | 7.77d                                      | 20.52d  | 1.20cd                                      |
| 80                            | 0.00                             | 4.02cd  | 4.30e                              | 7.50g                               | 8.72c                                      | 22.73c  | 1.12de                                      |
|                               | 0.25                             | 4.06c   | 4.23e                              | 7.33g                               | 8.89c                                      | 22.77bc   | 1.09de                                      |
|                               | 0.50                             | 4.23b   | 3.93e                              | 7.00g                               | 9.19b                                      | 22.96b  | 1.03e                                       |
|                               | 1.00                             | 4.44a   | 3.30f                              | 6.10h                               | 9.90a                                      | 23.55a  | 0.85f                                       |

†Means in each column are not significantly different at the 1% level(5% for chlorophyll and mean germination time) of DMRT. probability using

† در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ (در مورد کلروفیل و میانگین زمان تندش بذور در سطح ۵٪) آزمون چند دامنه ای دانکن ندارند.

جدول ۶- برهمکنش شوری و میزان آمونیوم بر میانگین زمان تندش بذور، طول ریشه و شاخساره، میزان پرولین، مالون دی آلدیاید و کلروفیل شاخساره چمن پوآ پراتنسیس.

Table 6. Interaction of salinity and ammonium concentrations on mean germination time, root and shoot length, shoot proline, malondealdehyde and chlorophyll content of *poa pratensis* L.

| شوری<br>Salinity<br>(mM<br>NaCl) | امونیوم<br>Ammonium<br>(meq / L) | میانگین زمان تندش<br>بذور (روز)<br>Mean germination<br>time (day) | طول ریشه<br>Root<br>length<br>(cm) | طول شاخساره<br>Shoot length<br>(cm) | پرولین<br>Proline<br>( $\mu$ mol /<br>gFW) | مالون دی آلدیاید<br>Malondealdehyde<br>(nmol / gFW) | کلروفیل<br>chlorophyll<br>(mg /<br>gFW) |
|----------------------------------|----------------------------------|---|------------------------------------|-------------------------------------|--|---|---|
| 0                                | 0.00                             | 6.75k †   | 5.57a                              | 8.60b                               | 2.50j                                      | 25.52i  | 1.46a                                   |
|                                  | 0.25                             | 6.70k   | 5.57a                              | 8.40b                               | 2.70j                                      | 25.59i  | 1.50a                                   |
|                                  | 0.50                             | 6.77k   | 5.40a                              | 9.10a                               | 2.61j                                      | 25.56i  | 1.51a                                   |
|                                  | 1.00                             | 6.73k   | 5.67a                              | 9.30a                               | 2.52j                                      | 25.54i  | 1.47a                                   |
| 20                               | 0.00                             | 7.41j   | 4.03c                              | 7.30d                               | 6.61i                                      | 35.22k  | 1.36b                                   |
|                                  | 0.25                             | 7.63j   | 4.27bc                             | 7.40d                               | 6.57i                                      | 35.38k  | 1.35b                                   |
|                                  | 0.50                             | 7.93i   | 4.44bc                             | 7.45d                               | 6.60i                                      | 35.30k  | 1.32b                                   |
|                                  | 1.00                             | 8.20hi  | 4.53b                              | 7.90c                               | 6.62i                                      | 35.28k  | 1.29b                                   |
| 40                               | 0.00                             | 8.31h   | 3.43d                              | 6.60e                               | 10.23h                                     | 46.69j  | 1.19c                                   |
|                                  | 0.25                             | 8.39gh  | 3.40d                              | 6.67e                               | 10.43h                                     | 47.52j  | 1.18c                                   |
|                                  | 0.50                             | 8.61g   | 3.37d                              | 6.43e                               | 10.51h                                     | 47.86i  | 1.15c                                   |
|                                  | 1.00                             | 8.91f   | 3.53d                              | 6.40e                               | 10.99g                                     | 49.08h  | 1.13cd                                  |
| 60                               | 0.00                             | 9.00ef  | 2.97e                              | 6.00 f                              | 13.64f                                     | 56.25g  | 1.12cd                                  |
|                                  | 0.25                             | 9.23de  | 2.70ef                             | 5.80f                               | 13.75ef                                    | 56.66fg   | 1.10cd                                  |
|                                  | 0.50                             | 9.50cd  | 2.53fg                             | 5.20g                               | 14.00e                                     | 57.24f  | 1.05d                                   |
|                                  | 1.00                             | 9.73bc  | 2.20gh                             | 4.43h                               | 14.71d                                     | 59.41e  | 0.92e                                   |
| 80                               | 0.00                             | 9.81b   | 2.20gh                             | 4.40h                               | 17.23c                                     | 66.42d  | 0.82f                                   |
|                                  | 0.25                             | 9.53b   | 2.03h                              | 4.30hi                              | 17.35c                                     | 67.45c  | 0.79f                                   |
|                                  | 0.50                             | 10.24a  | 1.53i                              | 4.00i                               | 17.68 b                                    | 68.69 b   | 0.70 g                                  |
|                                  | 1.00                             | 10.5a   | 1.10j                              | 3.50j                               | 18.21 a                                    | 69.39 a   | 0.55 h                                  |

† Means in each column are not significantly different at the 1% (5% for chlorophyll) level of probability using DMRT.

† در هر ستون میانگین های با حروف مشابه اختلاف معنی دار در سطح ۱٪ (در مورد کلروفیل در سطح ۵٪) آزمون چند دامنه ای دانکن ندارند.

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