Screening for genotypic heat tolerance in lentil

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Heat waves pose a risk to lentil production, with the frequency and severity expected to increase.

Lentil are one of the most susceptible cool season pulses to heat waves (yield reduction between 30 & 35 °C).

Particularly sensitive at the reproductive phase.

Heat stress in lentil
Heat stress in Lentil

2009 – HEAT WAVE

PROFITABLE CROP

70% YIELD REDUCTION
Aim: maximize genetic potential

Germplasm included over two consecutive years

- 81 genotypes
- 33 countries
Field-based screening for Heat Tolerance

**Shade Effect**
- Radiant temp. reduced by 38%
- Absolute temp. reduced by 2.5°C
- Grain yield 57% higher
Experimental Heat Traces

- 0700 – 1700 hrs post shade installation

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Yield</th>
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<tbody>
<tr>
<td>2014</td>
<td>1.1 g/m</td>
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<tr>
<td>2015</td>
<td>1.4 g/m</td>
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<td>3.8 g/m</td>
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<td>11.2 g/m</td>
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Cumulative Heat > 32°C (hrs)

- Shade
- No shade

Flowering

- 2014
- 2015

Time (weeks)
Screening results

Unshaded (heat) yield relative to Shade (control)
Commercial cultivars

Moderate tolerance, high GY.

High tolerance, adequate GY.

2014 Trial

Unshaded (heat) yield relative to Shade (control)
2015 Trial

Unshaded (heat) yield relative to Shade (control)

Absolute yield of control plots (g/m)
Heat tolerance

Seed size & Grain number

Unshaded (heat) yield relative to shade (control)

Grain number

Seed size

R² = 0.06

R² = 0.8
Verification of Results - Field Work

- Rapid development under higher temperature/longer days.
- In-season field trials
- Purpose built heat chambers used to apply heat.
Verification of Results - Glasshouse

- Controlled screening to confirm results.
- Investigating potential fast-throughput screening methods.
- Electrolyte leakage – potential heat tolerance indicator?
Conclusion

• Field-based late sowing is a successful screening method to identify genetic potential to improve adaptation to heat stress.
• The genotypes with improved tolerance were from regions in Jordan, India, Pakistan and Bangladesh.
• Two lines, 71457 (Jordan) and 72578 (India) had consistent yield stability under high temperature over two years.
• Most tolerant commercial cultivar, PBA Bolt
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