

Germination of Several Lettuce Cultivars With High Temperature and Salt

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INTRODUCTION

High temperatures can reduce germination and result in poor stands for lettuce growers during early fall plantings in Arizona. During this time, soil temperatures near the seeds often exceed 35°C but may be as high as 40-45°C. Optimum temperatures for lettuce germination range from 15 to 22°C, and maximum germination temperatures range from 26 to 33°C. To help alleviate the high temperature inhibition of germination, growers frequently keep the seed beds wet, which lowers soil temperatures by evaporative cooling. Even with wet soils, temperatures may exceed 27°C. In addition, this practice has the potential to cause other problems from high salt and low oxygen. The purpose of our study was to screen several commercial lettuce cultivars for tolerance to high temperature and salt during this sensitive germination stage.

PROCEDURES

Several cultivars of lettuce (*Lactuca sativa* L.), normally planted at different times, were selected to determine if those planted earlier when soil temperatures are higher would have more resistance to high temperature and salt than those planted later. Cultivars chosen were Empire, Great Lakes 659-700, Mesa 659, Climax, Red Coach 74, Salinas, Wintersupreme, Coolguard, Vanguard 75 (all crispheads), and Grand Rapids (leaf).

Fifty seeds were placed in petri dishes lined with filter paper which was moistened with 5 ml of solution at 0, -0.3, -0.6, -0.9, -1.2, and -1.5 MPa NaCl (1 MPa \approx 12000 ppm NaCl). Most irrigation water in Arizona is in the range of 0 to -0.3 MPa, although some is as high as -0.6 MPa.

The dishes were placed inside clear plastic containers and put into growth chambers in the light. Temperatures were 20, 25, 30, and 35°C. Each combination of treatments was replicated three times, with two dishes per replication. Germinated seeds were counted every 2-3 days for 14 days. Seeds were considered germinated when one mm of radicle was visible. Germination percentages were calculated.

RESULTS

Results are shown in a series of bar graphs with each graph representing percentage germination at one salinity level and all four temperatures. With 0 MPa (no salt), germination was greater than 95% for all cultivars at the three lower temperatures. However, at 35°C germination decreased to less than 10% for all cultivars except Empire, Red Coach, and Coolguard. These three cultivars normally are planted at widely different times over the season, suggesting little correlation between planting date and tolerance to high temperature at germination.

With -0.3 MPa NaCl, germination dropped to nearly zero for all cultivars at 35°C. At 30°C, where germination was greater than 95% with no salt, noticeable decreases in germination were observed for some cultivars, i.e. Great Lakes, Mesa, Salinas, and Wintersupreme. Again, these represent cultivars from widely different planting times. At 25 and 20°C, germination was still very high for all cultivars.

With -0.6 MPa NaCl, all cultivars showed significant decreases in germination at 30°C, although Empire and Coolguard still had greater than or equal to 80% germination. These cultivars represented both early and late planting dates. Germination dropped to less than 10% at 30°C for some cultivars, i.e. Great Lakes and Mesa. Both of these cultivars were normally planted early in the season. At 25 and 20°C, germination was still very high for all cultivars.

With -0.9 MPa NaCl, all cultivars showed less than 10% germination at 30°C except for Coolguard, which still had 24% germination. At 25°C, where germination was still very high at -0.6 MPa, significant decreases in germination were seen for many, but not all cultivars. At 20°C, germination was still very high for all cultivars.

With -1.2 MPa NaCl, germination dropped to zero for all cultivars at 30°C. At 25°C germination dropped to less than 10% for all cultivars except Coolguard and Vanguard which still had 20-25% germination. Both of these cultivars are planted later during the season. At 20°C germination showed major decreases, which were not seen at this temperature at -0.9 MPa. The germination ranged from 0 to almost 85%, suggesting a wide spread in cultivar responses.

With -1.5 MPa NaCl, germination dropped to nearly zero for all cultivars. This salinity is roughly equivalent to 50% that of seawater.

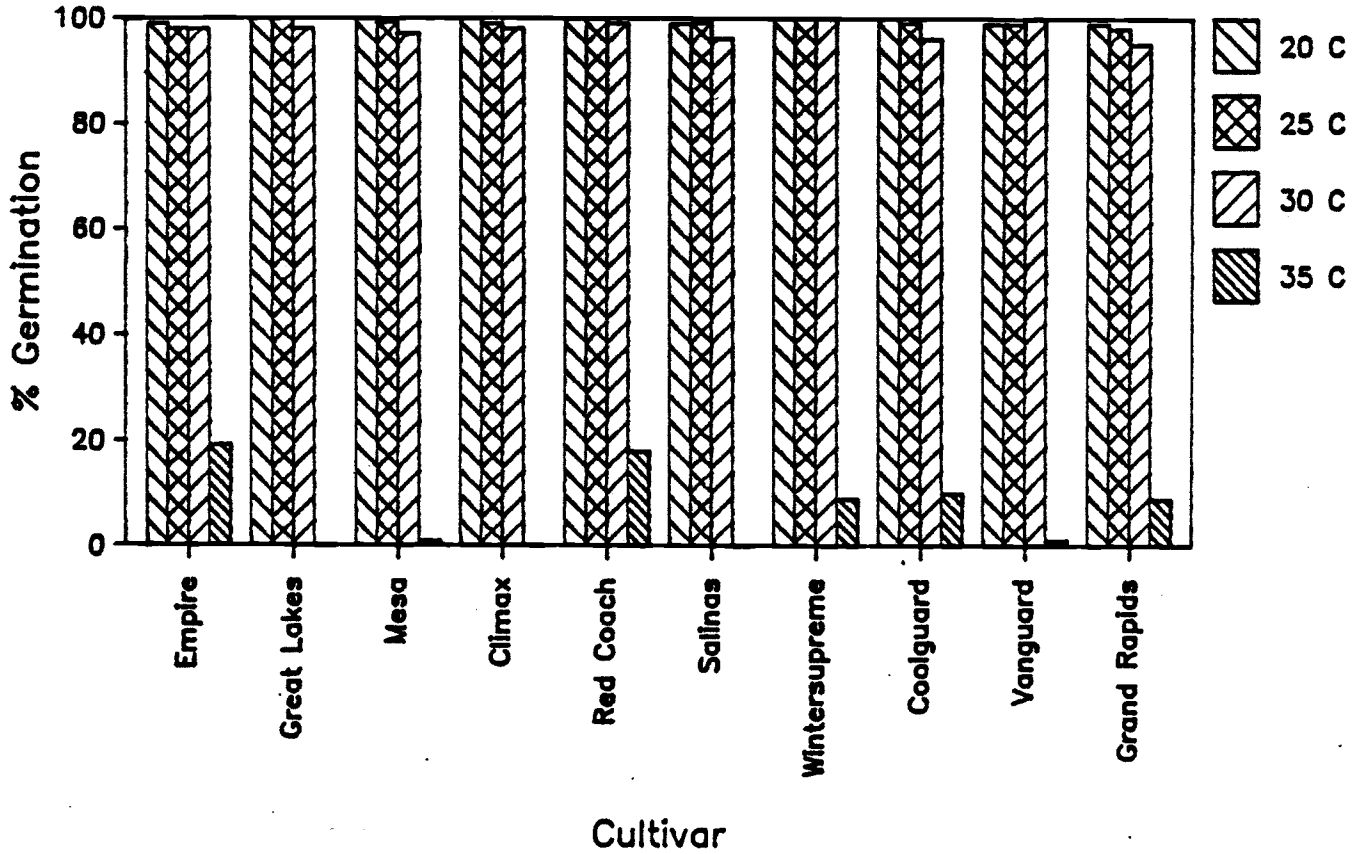
DISCUSSION

Results show that germination was inhibited greatly at 35°C for all cultivars when no salt was present. However, this inhibitory germination temperature was lowered as salt was increased, suggesting that salt increases the high temperature inhibition of germination. The inhibitory germination temperature dropped to 30°C for all but one cultivar when salt was increased to -0.9 MPa. This temperature dropped to 25°C for all but two cultivars when salt was increased to -1.2 MPa.

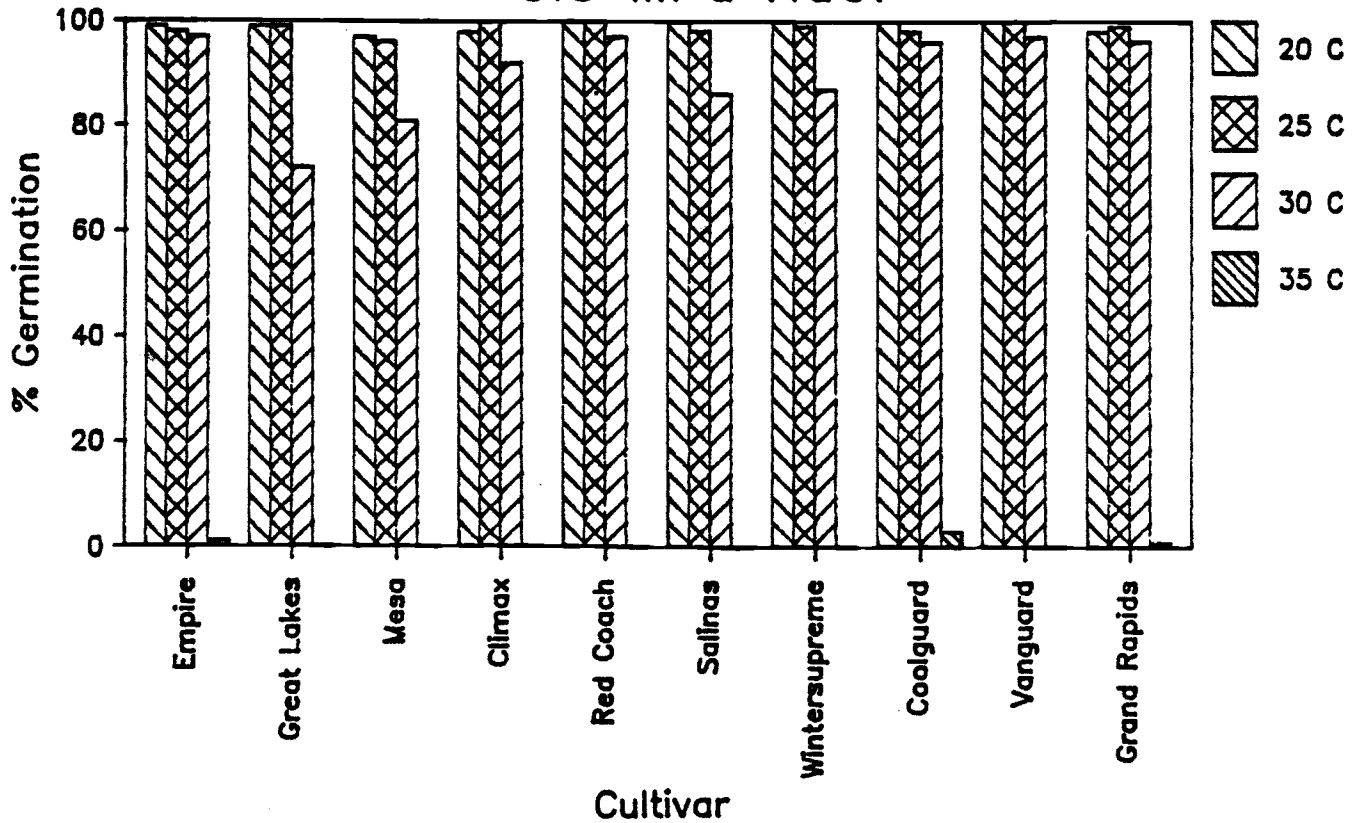
Differences observed between cultivars were greater in response to salt than to high temperature, as demonstrated by few cultivar differences with zero MPa NaCl. Also, no consistent correlations were apparent between cultivar planting times and cultivar sensitivity to high temperature and salt.

Further studies are being conducted to plant these same cultivars in the field at Yuma, Arizona during August and September to determine how well findings in the laboratory correlate with the ability of cultivars to establish a stand in the field. Further studies are also being conducted to evaluate salt tolerance of some of these cultivars at later developmental stages.

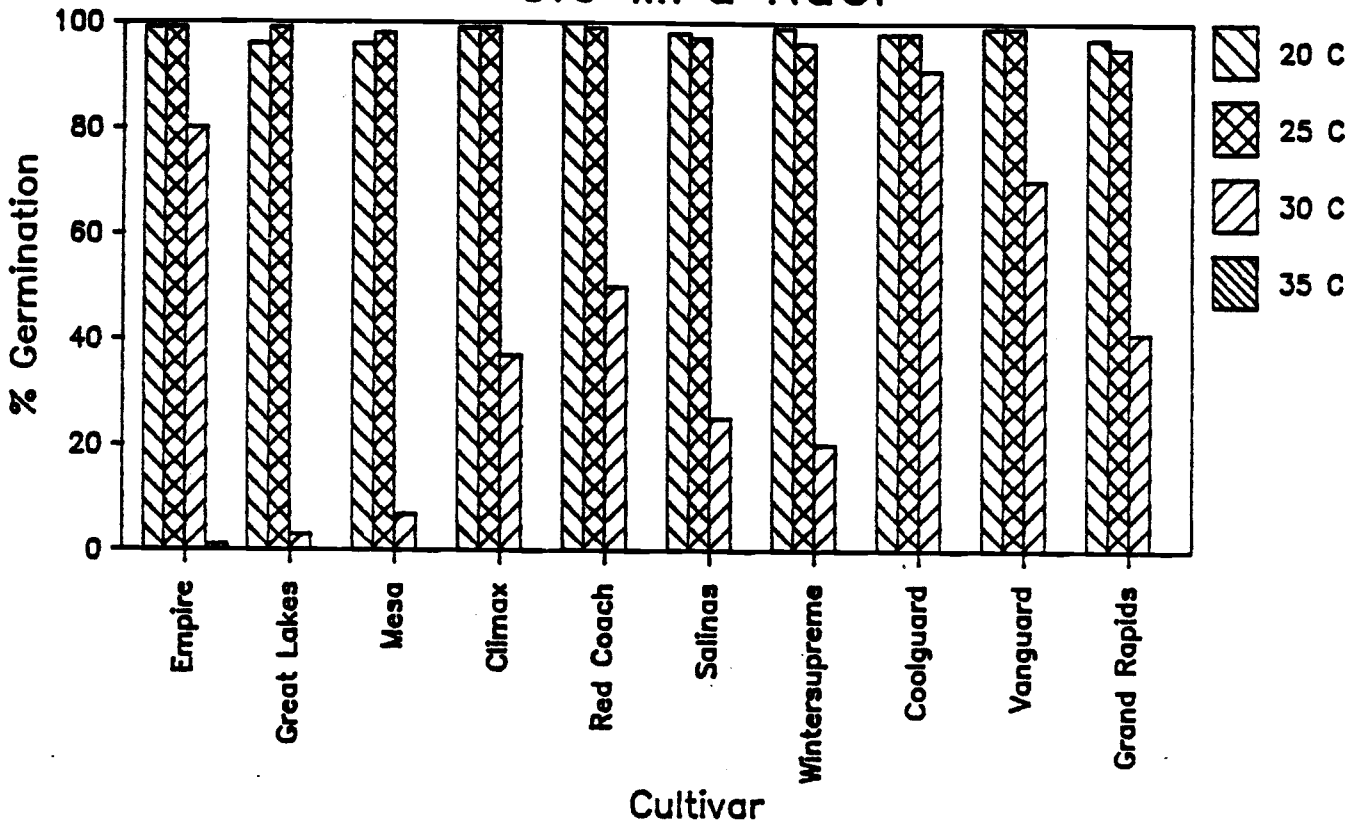
0 MPa NaCl



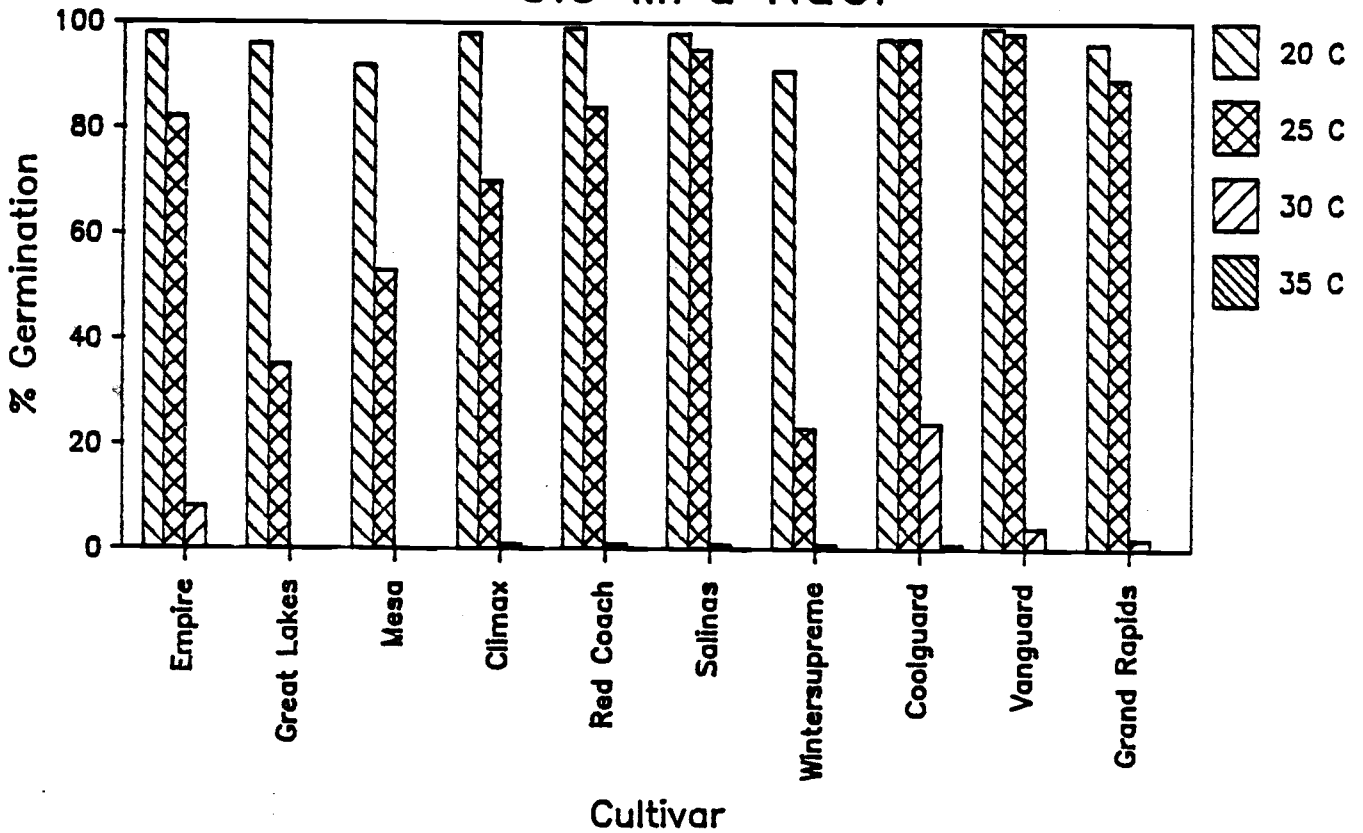
-0.3 MPa NaCl



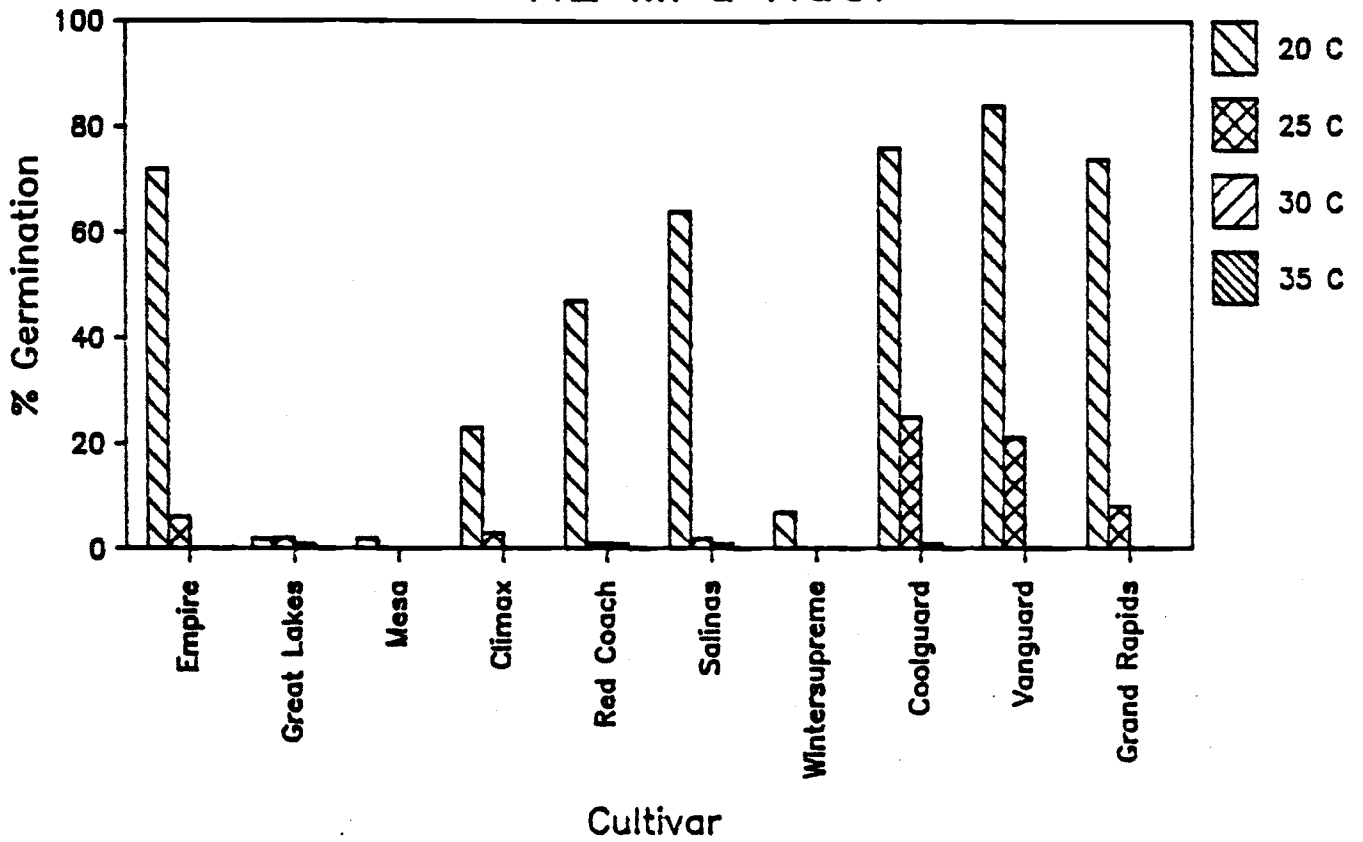
-0.6 MPa NaCl



-0.9 MPa NaCl



-1.2 MPa NaCl



-1.5 MPa NaCl

