Screening lentil accessions for lodging tolerance

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Lodging in lentil crops is a major economic problem for modern mechanized agriculture systems (1). Lodging can result in increased disease incidence, reduced yields (1, 5), and lower quality of harvested crops. Lodging occurs when plants with a normally upright growth habit have been flattened so that they lean close to the ground.

Lodging is highly influenced by the environment in which plants are grown. Conditions such as high seeding rates, excessive nutrients (6), and adverse weather conditions may all contribute to the occurrence of lodging in lentils (3). There is also evidence to suggest that different lentil genotypes will differ in lodging susceptibility (3, 4, 2), although the exact extent of genetic control is difficult to measure as it is often influenced by environmental conditions. Lodging is often correlated with other physiological factors such as plant height and stem thickness (1, 3). In the absence of the specific environmental conditions that cause lodging, it is difficult to select for lodging tolerance.

Currently there is no protocol that has been developed to screen lentil genotypes for lodging tolerance. Such a protocol would prove useful in screening breeding lines during years when environmental conditions are not conducive to lodging in lentils (5). Therefore, the objectives of this project are to develop a lodging protocol for screening lentil breeding material, focusing on when to apply the artificial lodging treatment, and the optimum seeding rate for inducing stem lodging in lentil stands. This project will also seek to determine the effect of stem fiber content on lodging in lentil plants.

This project consists of two experiments conducted at two sites for two years. The first experiment is a two factorial split block design, with the factors consisting of rolling stages (7, 10, 14 nodes, mid pod fill, and non-rolled) and cultivars (CDC Redberry, CDC Rouleau, CDC Imperial, CDC Sovereign, CDC Sedley, and CDC Plato). The second experiment is a three factorial split plot RCBD. The factors in the second experiment include seeding rate (30, 60, 120, 180, 210 plants m^{-2}) cultivars (CDC Redberry, CDC Imperial, CDC Sovereign, and CDC Plato) and a lodging treatment (rolled or non-rolled). Measurements in both experiments consisted of lodging recovery, seed yield, and stem fiber content. Plots were rolled to artificially simulate lodging using a water-filled turf roller commonly used for landscaping. Lodging recovery was evaluated by measuring the angle of the main stem with a protractor starting immediately after plots were artificially lodged and continuing to plant maturity at selected intervals. Acid detergent fiber (ADF) content was measured in the first eight above-ground nodes of lentil stems collected from the two experiments described above.

The following results are from the first year (2006) of the project. From the first experiment it appears that the ideal timing to artificially induce lodging in the lentil plots to express lodging tolerance is the 14 node stage which coincides with the onset of flowering. When artificially lodged at earlier stages, lentil plants were able to fully recover by maturity, while later artificial lodging events caused severe lodging from which plants were unable to recover. The 14 node stage shows the best expression of variability for lodging tolerance between cultivars. Yield differences were found to be significant between cultivars and rolling stages, but the interaction between cultivar and rolling stage was not significant.

The second experiment was conducted to determine the effect of seeding rate on lodging. Unfortunately the rolling stage chosen for this experiment was the mid pod-fill stage which is unsuitable for lodging recovery measurements as demonstrated in the first experiment. Yield data for the second experiment showed significant differences between cultivars, rolling and seeding rates. In 2007 the 14 node rolling stage was chosen to better express lodging tolerance. No conclusions have been drawn regarding what seeding rate to use when inducing lodging in lentil plots.

Analysis of ADF content in lentil stems in 2006 showed significant differences between cultivars and between the growth stages at which plants were artificially lodged in the first experiment. Significantly different ADF

content was also found between seeding rate treatments in the second experiment as well as between the artificially lodged and untreated plots.

Preliminary results show that artificially lodging lentil plots at the 14 node growth stage does lead to expression of variability for lodging tolerance. From this we can conclude that selection for lodging tolerance can be improved, resulting in the selection of cultivars with higher agronomic performance. Additional work needs to be conducted to explore the relationship between ADF content of lentil stems and lodging tolerance.

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