Research Findings and Recommendation to

Canadian Hail Association Loss Adjustment Committee

Lentil Research Results

Submitted by National Crop Insurance Services:

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Executive Summary

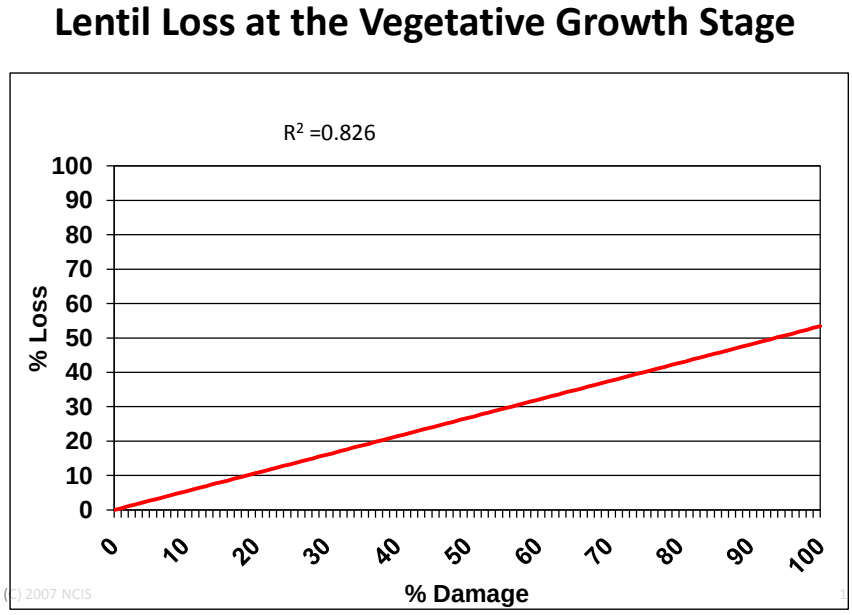
Research was conducted by the University of Saskatchewan during the years 2006 through 2008 on the effects of simulated hail on the recoverability of lentils. This research was conducted at two locations in Saskatchewan on two varieties, CDC Blaze – a small red variety; and on CDC Sedley - a medium to large green variety. The lentils were flailed at four different levels of damage ~ 0, 30, 60, and 90% and at four different stages of growth: vegetative (prior to any flower formation/blooms), early/first flower (when the plant started with the first flowers), mid-pod fill (when the pods were starting to fill the pods, and at mature pod fill (pods were filled but plant was not combine ready). The plots were desiccated and then were harvested with a small plot combine. The samples were dried and then cleaned and weighed to provide the final yields. The percent loss was obtained by taking the plot weights for the various treatments and dividing that by the weight of the control plots in the appropriate replication. The yields and percent loss were analyzed in a combined analysis, with locations and years used as random effects. The yields and percent loss were then regressed against the levels of damage applied to obtain the response curves for linear, quadratic and cubic. Only statistical differences will be discussed.

Results

Cultivars/Varieties

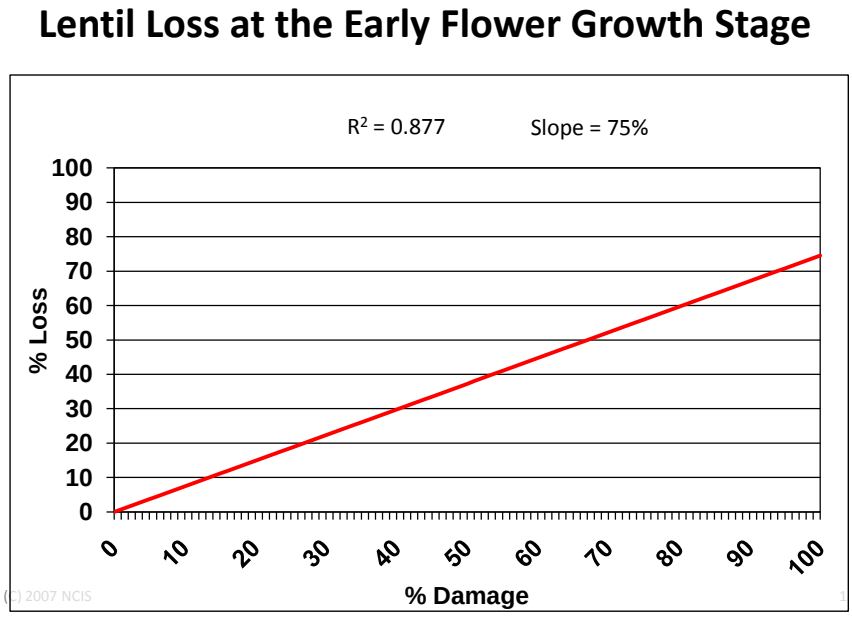
The analysis of the three years of data indicates that there were no differences in the way that the two cultivars/varieties of lentils (CDC Blaze and CDC Sedley) responded to the simulated hail. This allowed the data to be combined so that the regressions that follow are done over both varieties.

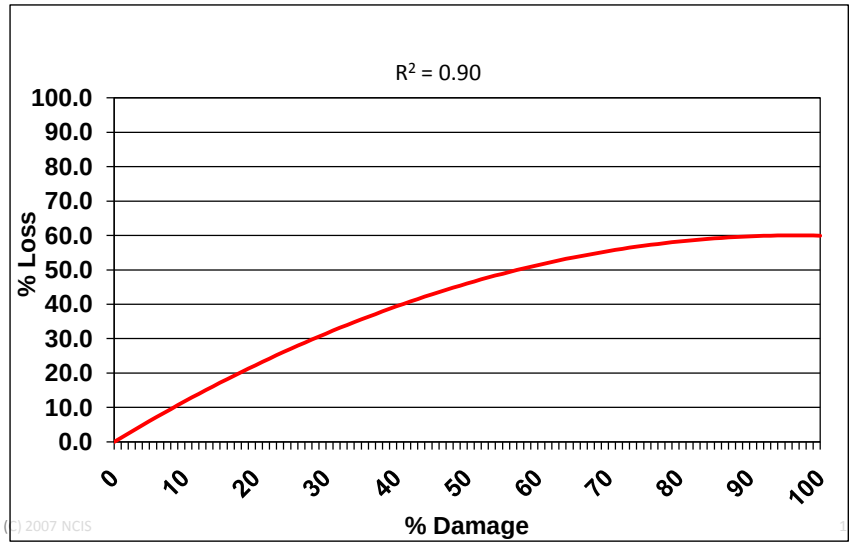
Growth Stages – Vegetative Stage



The analysis of regression for the percent loss versus the amount of applied damage was only statistically significant for the linear regression. The result is that the "factor" associated with this growth stage of damage is 0.53. The current Canadian hail procedures have the factor for this stage of development at 0.50. **The recommendation is that there is no need to change the factor associated with the vegetative stages – continue to use the 0.5 factor.**

Growth Stages – Early Flower

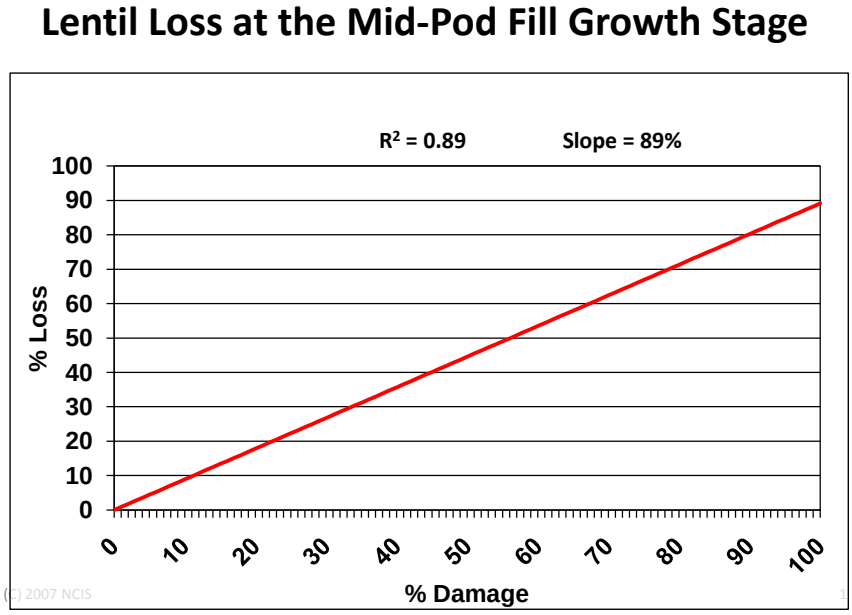


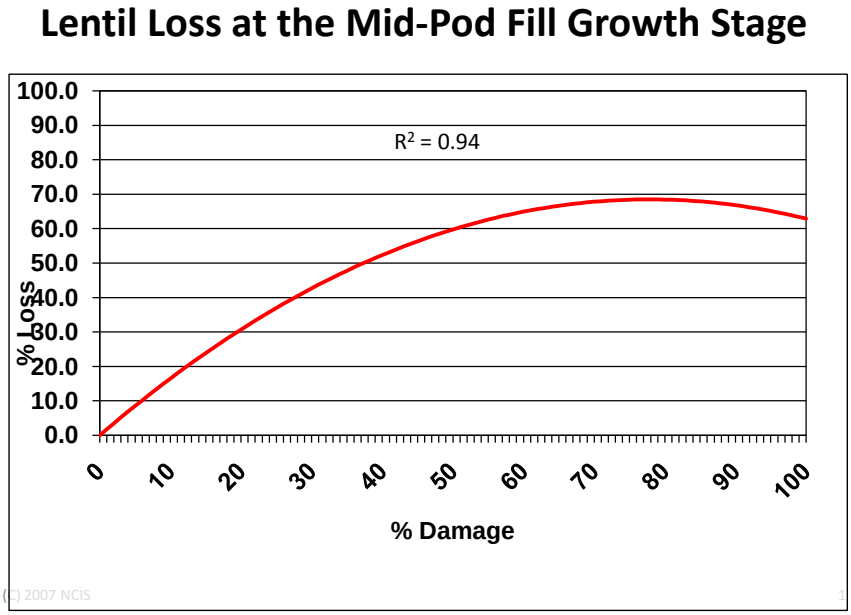


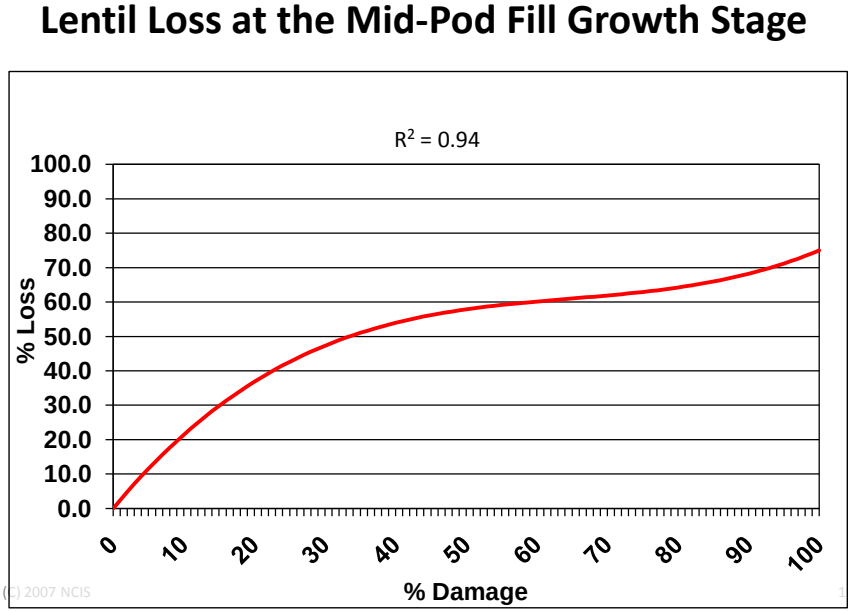
The analysis of the regression for the Early Flower stage of growth resulted in statistically significance for both linear and the quadratic equations. The slope for the linear regression is 0.75 with a R^2 of 0.88 – this means that 88% of the variability within the data set is explained by the regression line. The result of the quadratic equation has an R^2 of 0.90 – approximately 2.3% better than the linear response. The result of

the response curve would suggest that the factor for low levels of damage would be approximately a factor of 1, so that for 10% damage there would be a loss of 10%. This would continue to approximately 40% damage, where the curve would start flattening out and reaching a plateau of about 60% loss at 100% applied damage. The use of the quadratic equation may be more statistically correct, however for practical purposes there is not enough precision gained from a quadratic response equation (88 to 90% for the R^2). The current factor for the reproductive stages of growth is 1.

Growth Stage – Mid-Pod Fill Stage



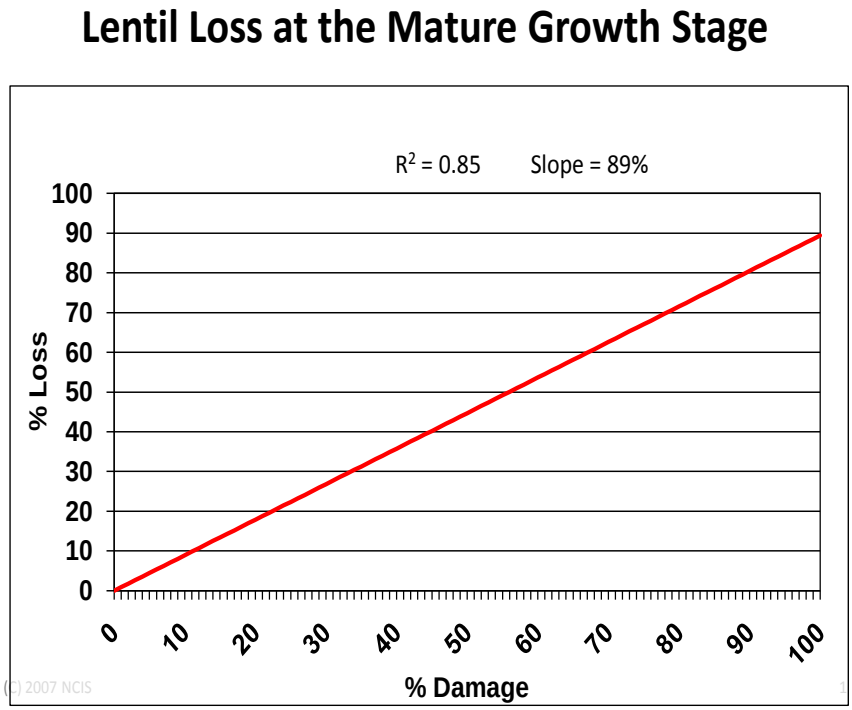




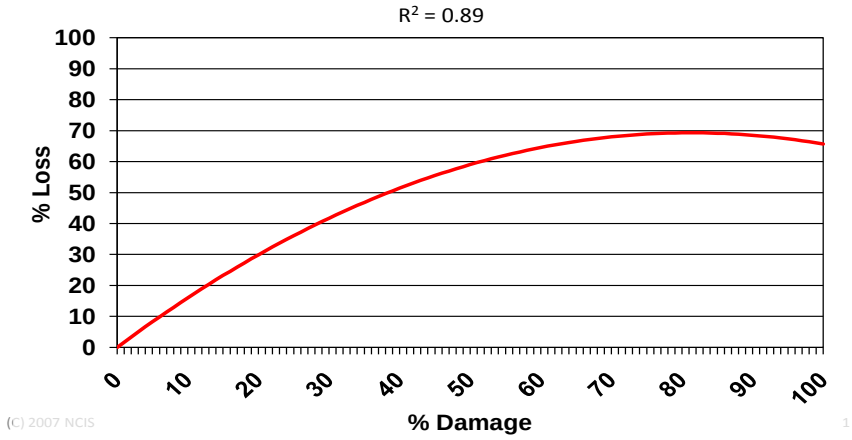
The statistical analysis for the Mid-Pod fill growth stage resulted in significance for the linear, quadratic and cubic curve responses. The R^2 for the quadratic and cubic response curve was 0.94, while it was 0.89 for the linear equation. The cubic equation shows a steeper slope with lower levels of damage (~ a factor of 2 up to 20% damage inflicted), then a moderate level at the medium levels of damage (~ a factor of 1.5 from 30 to 50% damage), a leveling off at 60% damage applied and then a slight rise to a loss of 75% where there is 100% damage occurring. This would compare to a factor of

0.89 for the linear response (a 44.5% loss for damage of 50% and 89% loss for damage of 100%).

Growth Stage: Mature



Lentil Loss at the Mature Growth Stage



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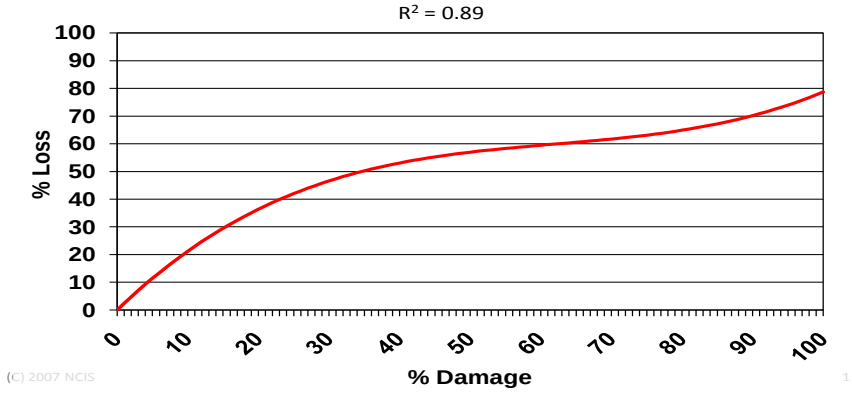

The statistical analysis for the Mature Growth Stage again resulted in the linear, quadratic and cubic response curves all being significant. The R^2 was the same for each one of the responses, 0.89. The slope for the linear response was the same as obtained for the Mid-Pod stage, while the quadratic and cubic equations would be almost exactly the same for the mature stage, with the result that % loss would be the same for the two stages.

The factor currently used in the Canadian Loss Guide is 1.0. This is the factor used for all reproductive stages of growth.

Recommendations:

Vegetative Stage: The recommendation for factors associated with lentil losses is to keep the current factors. The factor obtained by this research project for the vegetative stage is almost identical to the current factor used (0.53 to 0.5).

Reproductive Stages: The factors for the various reproductive stages of growth show some variability. The statistical analysis suggests that the response is more complex than a simple linear effect – quadratic for the early flower stage and cubic for the mid-pod and mature stages of development. The models would suggest that there is a greater rate of loss associated with a lower level of damage applied to the plant and that this rate of loss lessens as the amount of damage increases. Generally, from research on other crops, we see the percent loss gradually – lower rate of loss, and then increase at a more rapid rate with increased damage. This is often due to the plant having to expend more energy to recover from the higher levels of damage.

A second point is that the amount of variation that can be attributed to the response curve is shown by the R^2 value. The closer the value gets to 1, the better the "fit" of the data to the model. The R^2 values for the linear and quadratic models, for the early flower stage, and for the linear, quadratic and cubic models for the mid-pod filling and mature stages are very close to each other and with the example for the mature stage, are the same.

The factors obtained from this research project suggest factors of 0.75 for the early flower stage and 0.89 for the mid-pod and mature stage; however it is believed that the current factor of 1.0 is adequate and should be kept.