# RESEARCH FACTS

UNIVERSITY OF SASKATCHEWAN
Livestock and Forage Centre of Excellence
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## IN PROGRESS

# Inducing higher germination in Cicer milkvetch

## PROJECT TITLE

Optimization of a novel catalytic seed treatment inducing higher germination rates and nodulation in a Cicer milkvetch cultivar

**In progress:**

*Results expected in March 2021*

## RESEARCHERS

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### Background:

Greater germination and germination under the cool temperature conditions of spring, greater emergence, root and shoot growth as well as nodulation induction by the seed treatment are important responses for all legumes and will be extremely useful particularly in crops such as Cicer milkvetch (Astragalus cicer) for which no current inoculants are available.

The only previous study on Cicer milkvetch was a part of a larger project (ADF project 20130253) on 30 different crops and cultivars. Thus, while the data on Cicer milkvetch 'Oxley' is promising, the study was relatively limited. This project both expands the investigation of the catalytic seed treatment application and examines a wider range of cultivars under controlled environments. Since translation of the catalytic seed technology to the field will be investigated for the first time in forages, we will focus on one cultivar and expand the number of concentrations.

The concept for the development of the CATTM reaction is based on chemical principles of catalysis associated with catalytic properties of transition metals. In principle, the chemistry of catalytic processes exploited for the purpose of the present study is basically described as a combination of at least two reactions i.e. Fenton reaction and Haber-Weiss reaction. The key chemical aspect of the catalytic reaction-based procedure exploited here includes use and generation of oxygen and synthesis of reactive oxygen species (ROS), which are naturally associated with seed germination and mediates signalling in most major

plant growth and development stages (Barba-Espin et al., 2010; Bethke and Jones, 2001; Kimura et al., 2012; Kobayashi et al., 2007; Miller et al., 2009; Mittler, 2017; Queval et al., 2007). $H_2O_2$ is a relatively long lived ROS. It is believed that the abundance of oxygen and ROS generated during the treatment of seeds with the catalytic reaction play key roles in stimulation of germination. ROS is a known common signalling factor involved in abiotic and biotic stresses, including nodulation (Mittler, 2017; Richards et al., 2015; Tadeo et al., 2019). Our CATTM results show consistently improved total germination, even of old seed, and it increases lateral rooting. A recent Nature article (Yamada et al., 2020) also indicates that ROS mediates upstream signalling, increasing the root stem cell niche with potential impact on increasing lateral rooting.

## Objectives:

1. Determine germination effect and optimize dose (soaking) of the catalytic seed treatment on 'Oxley II' under the 10°C temperatures typical at planting (May 15).

2. Using the optimized soaking doses for each cultivar and temperature of Objective 1, evaluate plant growth and developmental responses including nodulation in soilless mix in pots at 10C and further optimize as needed.

3. Evaluate field responses using a replicated field plot trial based on methodology optimized in Objective 2) for one cultivar, 'Oxley II'.

## What They Will Do:

**Under controlled environment conditions: determine optimum soaking dose concentration across three cultivars**

'Oxley II' will be soaked for one hour at 0, 12.5%, 25%, 50% and 100% CATTM and grown under 10°C controlled environment conditions. Seeds will be soaked and then dried for two days before germination tests are initiated. Germination time and total germination will be examined in petri plates. Then, the optimized dose will be tested in soilless mix in pots at 10°C with time to emergence, shoot and root biomass and nodulation examined after one month after emergence in both cultivars.

**Under field conditions: evaluate responses to catalytic seed soaking treatment in 'Oxley II'**

In 'Oxley II', the following traits in Cicer milkvetch 'Oxley II' will be examined using the optimum dose found in the controlled environment and a series of three higher concentrations (0, 1X, 2X, 3X, 4X). Early spring emergence, seedling root and shoot growth, nodulation and yield of CATTM treated and non-treated seeds will be examined. Seeds will be soaked and then dried for two days before planting.

In conjunction with the forage breeding program under Dr. Bill Biligetu, forage crop responses will be evaluated through the assistance of field crews (land preparation at the LFCE, planting, maintenance and yield) and a technician hired on this project, Rensong Liu, will gather the data in the field. This will enable determination if the seed treatment effect can be translated to the field.

One cultivar 'Oxley II' x 5 treatments (treated at 5 concentrations) x 1 seeding date (standard) x 6 replications = 30 field plots in a Randomized Complete Block Design. Each plot is 1.2 x 6.0 m with 30 cm row spacing, 4 rows per plot.

## Implications:

This project will deliver optimized concentration, growth and development responses in controlled environment and field, of Oxley II to the catalytic seed treatment.

Proudly funded by:

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