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Correcting chloride deficiency in annual canarygrass

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At chloride-responsive sites, Cl^- fertilization increased annual canarygrass yield by 70%. However, without Cl^- fertilizer, the application of other macro- and micro-nutrients did not provide a yield response at these sites. Additionally, soil testing did not adequately predict Cl^- fertilizer response, indicating that Cl- fertilizer should be applied to all canarygrass fields on the Prairies.

Annual canarygrass responds well to chloride Cl^- fertilization on fields where it is deficient. However, there was a lack of information on how Cl^- interacted with macro and micronutrients. The objectives of this study were to determine the effect of macro- and micro-nutrients on the development and grain yield of canarygrass, if Cl^- interacts with other nutrients in canarygrass, the effectiveness of side banded versus surface spread Cl^- in canarygrass, and the level of residual Cl^- in the soil at which the grain yield will no longer respond to the addition of Cl^- fertilizer.

Research was conducted at Indian Head, Swift Current, Melfort, Scott, Redvers, and Yorkton, Saskatchewan over four years from 2014 to 2017 providing 21 site-years of data.

In these field trials, the macro-nutrients studied were nitrogen (N), phosphorus (P), potassium (K), sulphur (S). Micro-nutrients studied were Cl^-, copper (Cu), zinc (Zn), manganese (Mn), and boron (B).

Thirteen fertility treatments were compared in the study.

Treatment	N kg ha^{-1}	P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}	Cl kg ha^{-1}	S kg ha^{-1}	Copper kg ha^{-1}	Zinc kg ha^{-1}	Combination of Micros Cu, Zn, Mn, B kg ha^{-1}
1	0	0	0	0	0	0	0	N (0, 0, 0, 0)
2	15	0	24	18.1	0	0	0	N
3	30	0	24	18.1	0	0	0	N
4	30	30	24	18.1	0	0	0	N
5	30	30	24	18.1	15	0	0	N
6	60	30	24	18.1	15	0	0	N
7	60	30	0	0	15	0	0	N
8	60	30	24	18.1	15	3	0	N
9	60	30	24	18.1	15	0	3	N
10	60	30	24	18.1	15	0	0	Y (3 , 3, 3, 1.5)
11	90	30	24	18.1	15	0	0	Y
12	60	30	24**	18.1**	15	0	0	N
13	60	30	0	18.1***	15	0	0	N

** KCl broadcast on soil surface *before* seeding; N, P_2O_5 sideband *at* seeding

***$CaCl_2$ broadcast on soil surface *before* seeding; N, P_2O_5 sideband *at* seeding

Source: May and MacGregor, 2021.

CDC Calvi canarygrass was no-till seeded with all nutrients side-banded during seeding. The exceptions were treatments 12 and 13. In these treatments, the Cl^- was applied to the soil surface before seeding. In treatment 12 KCl fertilizer was applied, and in treatment 13 the Cl- fertilizer used was $CaCl_2$. Treatments 12 and 13 were added in 2015 and used to separate the effects of K and Cl^-.

Soil sampling was conducted for treatments 1 and 7, for multiple nutrients at most sites in most years. Plant and panicle density, plant height, lodging, maturity, kernel weight, seeds per panicle, grain yield and test weight were measured.

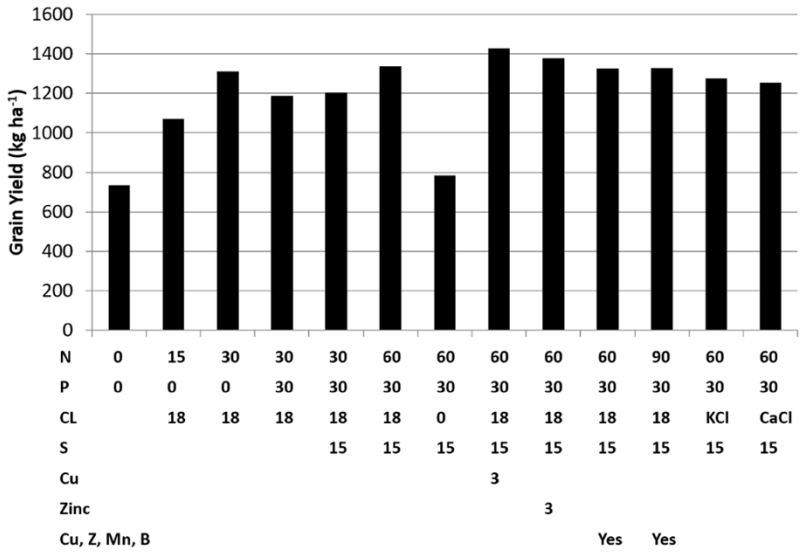
Data analysis split the results into Cl^- responsive and non-responsive sites. Based on grain yield, a strong chloride response was seen at 7 of 21 site years at Indian Head, Swift Current and Yorkton in 2014, Melfort and Scott in 2015 and 2017.

However, the Cl^- soil test levels were similar between the responsive and non-responsive sites, which makes soil testing an unreliable method to accurately predict a Cl^- response prior to seeding. As a result, the researchers recommend apply Cl^- fertilizer to all fields where canaryseed is grown.

Chloride fertility must be addressed to improve response to other nutrients

At the responsive sites, application of other nutrients, including N, did not improve yield without the addition of Cl^- fertilizer. When Cl^- fertilizer was applied at the responsive sites, grain yield increase significantly by 70% or 489 lbs/ac (550 kg/ha). At the non-responsive sites, yield was maximized without the addition of Cl^- fertilizer.

The effect of nutrients on the grain yield of canarygrass at sites responsive to chloride fertilizer



Source: May and MacGregor, 2021.

At the responsive sites, Cl^- fertilizer also significantly increased seeds per panicle, seed weight, height, and test weight.

The greatest yield benefit came from the addition of N and Cl^- fertilizer on the responsive sites. The addition of P and S fertilizer had little impact on growth and yield.

There were no differences in crop response between placement of Cl^- fertilizer on the soil surface or side-banded. In addition, canarygrass responded equally to both forms of surface applied chloride fertilizer KCl and $CaCl_2$. The researchers indicated that this means that any form of soluble

Cl^- fertilizer should work as a surface application and that K was not contributing to the observed grain yield response.

Little response to micronutrients

Application of micronutrients provided little crop response. There was no response to the addition of Cu, and Zn only increased panicle density at the non-responsive sites. Applying all 4 micronutrients did not impact crop development or yield at Cl^- responsive or non-responsive sites, indicating that these micronutrients did not impact Cl^- deficiency in canarygrass.

Overall, the research found that N and Cl^- fertilization is necessary to maximize yield. Canarygrass was relative non-responsive to P, K, S, Zn, Cu, Mn and B.

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Mr. William Earl May and Mr. Michael MacGregor. Interaction between chloride and both macro and micro nutrients in annual canarygrass. *Canadian Journal of Plant Science*. **Just-IN** https://doi.org/10.1139/CJPS-2021-0157

