Agriculture Research and Development

Biomass Production and Phosphorus Availability from Dairy Manure in Silage Corn

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Project Objectives

- Evaluate the performance of silage corn genotypes for biomass production and phosphorous acquisition following dairy manure and inorganic phosphorous application;
- Determine the role of root architecture and root exudates in phosphorous uptake of silage corn genotypes; and
- Assess the crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), non-structural carbohydrates (NSC), total digestible nutrients (TDN), and ash contents of five corn silage genotypes.

Abstract

Expansion of the dairy industry in Newfoundland and Labrador has increased the livestock feed requirements and availability of dairy manure. Corn silage hybrids with higher biomass production, optimum root architecture, and maximum phosphorous acquisition can help meet industry feed requirements. A field experiment was conducted in western Newfoundland during 2016 and 2017 to determine biomass variability, phosphorous acquisition, and quality traits of five corn silage genotypes using four phosphorous sources. Preliminary results indicate Yukon-R and DKC 26-28 produce higher biomass versus other genotypes.

Background

Newfoundland and Labrador's dairy and livestock industries face challenges of insufficient forage production and depends on imports from other provinces. Growing local corn silage with maximum productivity might bridge the gap between production and consumption. Corn requires substantial inputs of plant nutrients for maximum biomass production which can be cost prohibitive. Dairy farms across Newfoundland and Labrador produce a large quantity of manure, which is an inexpensive and abundant nutrient source. Dairy manure application can also increase soil phosphatase activity (SPA) and stimulate microbial populations that decompose organic matter through the production of extracellular enzymes - increasing available phosphorous through mineralization. Furthermore, dairy manure

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application improves phosphorous use efficiency, phosphorous uptake by the crop, and final dry matter production. However, excessive manure application is a waste of resources with potential to cause deficiency or toxicity of other plant nutrients or pollute water resources. Therefore, judicious use of manure could be the most cost-effective, productive, and sustainable method of utilizing this resource.

Technical Details

Field experiments were conducted to determine biomass and quality of five low CHU corn silage genotypes (Fusion RR, Yukon R, A4177G3, DKC-2317 RIB and DKC 26-28 RIB) using four different phosphorous sources [P0: control (no phosporous); P_1: manure with high phosphorous concentration (0.6 kg P_2O_5/1000 L^{-1}); P_2: manure with low phosphorous concentration (0.3 kg P_2O_5/1000 L^{-1}); and P_3 as an inorganic phosphorous (0-45-0)]. Dairy manure was applied and incorporated according to local farmers' practice at 30,000 litres/hectare and inorganic phosphorous at 110 kilograms/hectare before seeding.

Corn was seeded the last week of May 2016 and 2017 at a rate of 89980 seeds/hectare. The seeder places a permeable layer of plastic over the soil to provide extra heat during the first few weeks of growth. The crop was harvested in the second week of October in both years. Soil, plant, and root exudate samples were collected at six-leaf, 12-leaf, tasseling, and black layer crop stages. Plant physiological attributes including leaf area, leaf chlorophyll contents, net photosynthesis, stomatal conductance, transpiration rate, and water use efficiency were also recorded. At harvest, plant height and total biomass was recorded. Plant samples collected at harvest were analysed for qualitative traits,

Preliminary Results

Results indicated Yukon-R and DKC 26-28 produced the highest biomass at 16 tonnes/hectare. Also, the high phosphorous manure increased available phosphorous by 37.54% and average crop dry matter by 21.95% compared to the control, emphasizing the importance of phorphorous for crop growth.

Agriculture Industry Benefits

We anticipate that local corn silage acreage will increase in the future and help achieve feed self-sufficiency in the province. This can improve the profitability and economy of individual farms and the provincial dairy and livestock industries overall.

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