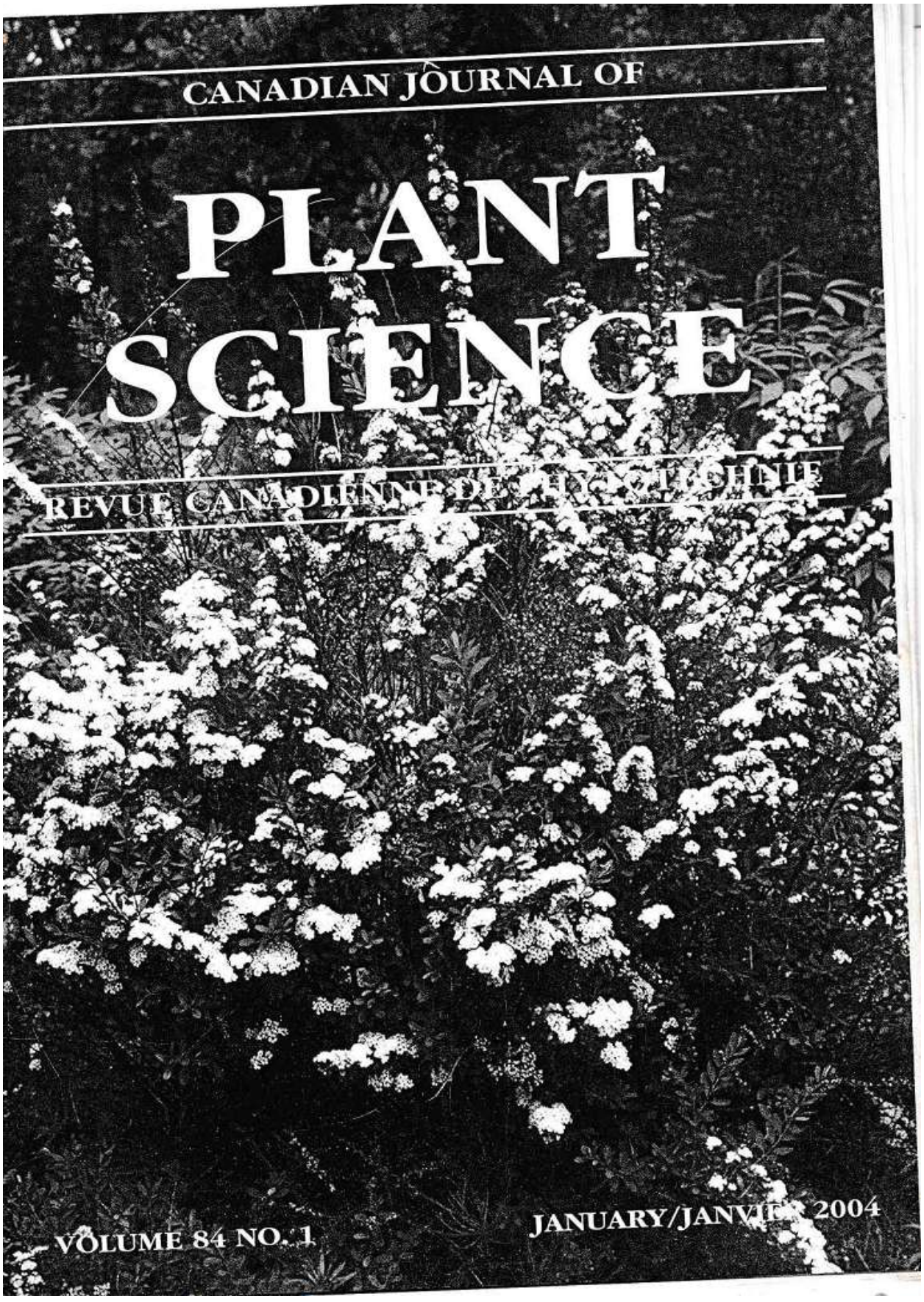
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Cover: *Spiraea* Snowmound. See the paper by C. Richer et al. on p. 265 of this issue.

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Effect of medium nitrogen level on potato microtuber protein concentrations. Estela Ortiz-Medina and Danielle J. Donnelly. McGill University, Ste-Anne-de-Bellevue, Québec (eortiz2@po-box.mcgill.ca).

Nitrogen is an essential nutrient for plant growth. In potato crops grown in the field, optimum nitrogen fertilization is important to maximizing yield. However, it is not known to what extent nitrogen availability affects protein concentration of tuber tissues. This is more readily evaluated in a tissue culture system than in the field. Nitrogen level was varied in Murashige and Skoog medium to determine its effect on the total protein content of microtubers of four potato cultivars with a range of seasonalities. These included Norland, Shepody, Green Mountain, and Russet Burbank. Microtubers were generated from layered micropropagated plantlets using a two-step method. For all cultivars, both the mean number and size of microtubers per container were greater when medium nitrogen levels were increased. However, there were no clear trends relating medium nitrogen level to microtuber tissue protein concentration. Low medium nitrogen level tended to reduce the protein concentration in cultivars Shepody and Norland while high medium nitrogen level tended to increase the protein concentration only in Russet Burbank. These results confirm that nitrogen fertilization can promote tuber yield but suggest that tissue protein concentrations are genetically determined.

Crops and agricultural practices for biomass/bio-fuel production and greenhouse gas mitigation in eastern Canada. Juan Almaraz, Xiaomin Zhou, and Donald Smith. McGill University, Ste-Anne-de-Bellevue, Québec (jalmar1@po-box.mcgill.ca).

Crops can help to reduce the greenhouse effect because they have the capability to remove CO_2 from the atmosphere through photosynthesis to produce biomass that can be used for biofuels. Lipo-chitooligosaccharides (LCOs), compounds produced by rhizobia in their interactions with legume roots, can increase photosynthesis. The use of these compounds in combination with tillage practices such as no-till could be useful for both biomass production and soil carbon sequestration. The objective of the research was to determine the optimum balance between biomass production, carbon sequestration, and N_2O emission for a range of crops (corn, sorghum, soybean, and switchgrass). The treatments were tillage system (no-till in comparison with conventional tillage), nitrogen fertilization rates (0, 1/2 and full rates), and LCOs. Soil and plant variables were evaluated during the season. In 2001, crops were strongly affected by drought and the effect of treatments was small; the highest N rate was sometimes excessive. In 2002, corn responded more to nitrogen fertilization than the other crops. Sorghum grew well in all three nitrogen fertility levels. No-till plots had dry weight values lower than conventional tillage plots; those differences diminished and were not significant by the season's end. LCO application caused increased soybean biomass at mid-season, but dry conditions resulted in no difference by the end of the season. Sorghum produced the most biomass, at around 1.5 kg m^{-2}. The optimum management for greenhouse gas reduction (biomass produced vs. greenhouse gases produced during crop production) is discussed.

Modifying the dietary cation-anion difference of timothy using fertilization. Sophie Pelletier[1], Gilles Bélanger[2], Gaëtan F. Tremblay[2], Réal Michaud[2], Annie Brégard[1], and Guy Allard[1]. [1]Université Laval, Sainte-Foy, Québec; [2]Agriculture and Agri-Food Canada, Sainte-Foy, Québec (pelletiers@agr.gc.ca).

Decreasing the dietary cation-anion difference (DCAD) in forages may help to prevent milk fever of postpartum cows. A split-split-plot greenhouse experiment was conducted to establish fertilization treatments that may decrease the DCAD of timothy. We evaluated soil type (loam and clay), N fertilization (65 and 130 kg N ha^{-1}), and Cl and S fertilization (NH_4Cl at 50 and 100 kg Cl ha^{-1}; $(NH_4)_2SO_4$ at 35 and 70 kg S ha^{-1}). Timothy concentrations of K, Ca, Mg, Na, P, Cl, and S were determined. Concentrations of Ca, P and Mg were respectively 45, 40, and 15% higher in plants grown on loam than on clay soil, while the K concentration was 19% higher in timothy grown on clay soil. Soil type did not affect Cl and S concentrations but DM yield was higher on loam than on clay soil. Nitrogen fertilization did not affect DM yield and any of the elements used in the calculation of DCAD. Concentrations of Cl and Ca were respectively 90 and 13% higher in timothy fertilized with NH_4Cl than with $(NH_4)_2SO_4$. The Cl concentration was 55% higher in plants fertilized with 50 kg Cl ha^{-1} of NH_4Cl than with 100 kg Cl ha^{-1}. Timothy fertilized with $(NH_4)_2SO_4$ had a 12% greater DM yield than when fertilized with NH_4Cl. Our results indicate that soil type and Cl fertilization affect some of the elements used to calculate the DCAD.

Adaptation of eastern Canadian crops and cropping systems to climate change. Juan Almaraz, Xiaomin Zhou, and Donald Smith. McGill University, Ste-Anne-de-Bellevue, Québec (jalmar1@po-box.mcgill.ca).

In the Province of Quebec, the last 2 yr were both unusually dry and hot, and probably represent the sort of climate change conditions that will be much more common in the future. Our objective was to examine the yields of several full season crops, and key elements of crop production systems for suitability to climate change conditions. Four crops were grown in the field: soybean, corn, sorghum, and switchgrass. All crops, except soybean, were fertilized with nitrogen at 0, 1/2 and the full rate, and under till and no-till conditions. Yield and/or biomass data were collected in 2001 and 2002. Additionally, data of yield for the same crops grown in Montreal and data of precipitation, evaporation and temperature were collected from the statistical records over the last 20 yr. Yield in the experiments was low, and this was associated with low precipitation during the second half of the season in both years. Yield for corn and soybean were reduced in both years. Sorghum and switchgrass are warm season crops and grew well in dry and hot conditions obtained in those years. It seems that some of the crops used were more affected by low precipitation than others. Analysis of yield data records indicated that the yield of major crops declined in the last 2 yr because of drought. Climate change conditions may make no-till systems more appropriate and lead to reductions in N fertilizer applications.

Lipo-chitooligosaccharide: handling and storage. Supanjani Supanjani, Alfred Souleimanov, and Donald L. Smith. McGill University, Ste-Anne-de-Bellevue, Québec (ssupan@po-box.mcgill.ca).

Lipo-chitooligosaccharides (LCOs or Nod factors) produced by rhizobia are not only important for the establishment of legume-rhizobia symbiosis, but also have a potential to improve somatic embryogenesis, seed germination, and plant growth and development of some important crops. We evaluated different methods of handling and storage of Nod Bj-V($C_{18:1}$ MeFuc), the major Nod factor produced by *Bradyrhizobium japonicum*, on its recovery and biological activity. During freeze drying to purify LCO solution obtained through HPLC isolation, approximately 10% of the LCO

was lost, regardless of whether polypropylene or glass material was used as the container. For sterilization, filter materials affected the amount of LCO loss, being in order: polyestersulfone (32.3%), cellulose acetate (55.1%), nylon (51.9%), polytetrafluoroethylene (62.0%) and mixed cellulose ester (68.2%). Autoclaving LCO can be used as an alternative to filtering to sterilize LCO solution; around 70% of the LCO was recovered after autoclaving for durations of 15 to 30 minutes. Storage temperature affected LCO degradation. LCO degraded faster when stored at 23 ± 2°C (room temperature) than at 4 ± 1°C (refrigerator); after a duration of 16 mo, 74% of the LCO was recovered following room temperature storage and 84% following fridge storage. When tested at the same concentration (10^{-7} M), the biological activity (root hair deformation and seed germination in soybean) of LCO obtained from autoclaved and stored samples were similar to that of freshly prepared LCO.

Enhancement of calcium uptake into soybean by nod factor. Supanjani Supanjani, Ahsan Habib, Danielle Donnelly, and Donald. L. Smith. McGill University, Ste-Anne-de-Bellevue, Québec (ssupan@po-box.mcgill.ca).

Nod factors or lipo-chitooligosaccharides (LCOs) produced by rhizobia during legume-rhizobia symbiosis are known to cause transient increases in cytosolic calcium concentration in the root hairs of legumes. Soybean seedlings at the V1 stage were placed in treatment solutions containing LCO, rhizobial innoculum, or various other compounds. Seedlings were then transferred into test solution containing Murashige and Skoog basal salt medium and the radiotracer $^{45}CaCl_2$ to examine Ca uptake. Twenty-four hours following the addition of the radiotracer, trifoliolate leaf samples were harvested and $^{45}Ca^{2+}$ measured by liquid scintillation counting. Incubation with NodBj-V($C_{18:1}$ MeFuc) prior to testing increased the $^{45}Ca^{2+}$ uptake into seedling leaves in a concentration-dependent manner. Similarly, incubation with *Bradyrhizobium japonicum* strains 532C and USDA3 also increased $^{45}Ca^{2+}$ uptake into trifoliolate leaves. No increased $^{45}Ca^{2+}$ uptake occurred into seedling leaves following incubation with strain Bj-168, a nodC-mutant incompetent to produce LCO or either *Rhizobium leguminosarum* and *Sinorhizobium meliloti*, two Rhizobia that do not normally nodulate soybean. The tetramer or pentamer of chitosan and lumichrome also did not affect $^{45}Ca^{2+}$ uptake. This work suggests that rhizobial symbiosis, in addition to its known role in provision of nitrogen, also improves calcium uptake into soybean plants.

Farmer-directed on-farm experimentation examining the impact of companion planting barley and oats on timothy-alfalfa forage establishment in central Newfoundland. Dean Spaner[1] and Alexander Todd[2]. [1]University of Alberta, Edmonton, Alberta; [2]Agriculture and Agri-Food Canada, St. John's, Newfoundland (dean.spaner@ualberta.ca).

Growing barley or oats in the year of forage establishment is a common agronomic practice in marginal growing regions, but is not often recommended to growers. We worked with a dairy farmer in central Newfoundland in a 4-yr study to address his question of what the best cereal species and seeding rate were for use in companion cropping during forage establishment. Our treatments consisted of barley planted at three seeding rates together with a forage companion crop of timothy (*Phleum pratense* L.) and alfalfa (*Medicago sativa* L.), and oats planted similarly. The alfalfa-timothy mixture companion planted with barley yielded 11% more forage dry matter than with oats in the year of planting, but the two species did not differ for any other forage quality trait, or yield. Increasing seeding rate from 22.5 to 67.5 kg ha^{-1} resulted in a linear increase in forage dry matter yield in the year of planting of 32%, and linear decreases in percentage crude protein of 20%, P of 12% and Ca of 35% in the harvested forage. Companion planting oats or barley at rates increasing from 45 to 67.5 kg ha^{-1} in the planting year resulted in a 9% increase in timothy-alfalfa in the second-year forage harvest, but did not alter any other forage quality trait. The decision process for the choice of cereal species, and the seeding rate of the companion planted cereal, will involve a producer-inferred balance between higher yields at higher seeding rates, with an inevitable forage quality decline as yields increase in the year of seeding.

Surface-banding with assisted infiltration—New low disturbance technique for applying slurry on land. Shabtai Bittman[1], Laurens Van Vliet[1], Grant Kowalenko[1], and Sean McGinn[2]. [1]Agriculture and Agri-Food Canada, Agassiz, British Columbia; [2]Agriculture and Agri-Food Canada, Lethbridge, Alberta (bittmans@agr.gc.ca).

Manure nutrients are required for crops but applying manure onto land can lead to environmental concerns. Some of these risks can be reduced by injecting manure into soil or quickly incorporating the manure after application. However, injection and incorporation may cause excessive soil disturbance, so less disruptive systems are required. This study compared effects of applying dairy slurry on a perennial grass sward by broadcasting or banding on the soil surface, with a new technique designed for rapid infiltration with low soil disturbance. The new applicator, called AERWAY SSD (Holland Equipment, Norwich, ON), creates vertical aeration slots then bands manure over the slots. Results from 2 yr of testing in south coastal BC show that the new applicator delivers manure uniformly and does not damage existing crops. The method slightly improves crop response (yield and N offtake) to manure and reduces ammonia volatilization by over 40% and odour emission by 35% compared to surface broadcasting. There is also indication that the system will reduce surface runoff, although it does not reduce emission of nitrous oxide compared to surface broadcasting. The applicators, which are available in 2.5- to 10-m widths, have proven through extensive farm use all over North America to be robust, rapid and relatively low cost.