FACTS ON THE NORTH AMERICAN HORTICULTURAL PEAT INDUSTRY AND ITS SUSTAINABILITY

This document is part of a series providing information about the North American Horticultural Peat Industry and, more specifically, the Canadian Peat Extraction Industry, its environmental footprint, the responsible management of peatlands and the wise use of horticultural peat as an unequaled growing media component. Four facts sheets are presented in the series i.e., Peatland Science and Bog Restoration; Greenhouse Gas Emissions from Peat Extraction; Veriflora® Responsibly Managed Peatlands Certification; and Alternative Materials and the Wise Use of Peat. Last revision: June 2023.

PART 1 - PEATLAND SCIENCE AND BOG RESTORATION

Key Facts:

- **Restoration Approach**: The Moss Layer Transfer Technique (MLTT) is a successful post-extraction peatland ecological restoration method developed by top independent scientific researchers through 30 years of partnership with the Canadian Horticultural Peat Industry.

- **Return of the Biodiversity**: Using the MLTT, typical peatland plant communities re-establish within 3 to 5 years. These support the return of animal, insect and bird communities found in undisturbed similar environments. The creation of ponds in restoration projects increases the biodiversity by providing a variety of microhabitats.

- **Return of the Carbon Sink Function**: Peatlands resume being carbon sinks within one to two decades after restoration.

- **Restoring the Canadian Peatlands:** 67% of the Horticultural Peat Industry post-production areas have been restored or reclaimed as of 2021. Through its National Peatland Restoration Initiative, the industry has set ambitious restoration goals - and successfully reaches them.

- **Inspiring other Industries, globally**: The MLTT is not only used on Canadian peatlands but is also applied around the globe. The method is recognized as a novel, efficient approach to ecological restoration that benefits not only the peat industry but several other activities that impact peatlands.

Industry-Science Collaboration

The Canadian Peat Industry has been collaborating for decades with the academic science community. Since 1996, the Canadian Sphagnum Peat Moss Association (CSPMA) has made possible over $20M worth of research projects, not a small amount for a small industry. An important part of the research conducted focused on the development of Best Management Practices, especially ecological restoration techniques for post-extraction peatlands.

Through a partnership between the Peatland Ecology Research Group (PERG)[1], the CSPMA, along with Canadian federal and provincial agencies, **research has been ongoing for 30 years regarding the ecological restoration and integrated responsible management of Canadian peatlands**. Since its inception in 1992, the PERG research team, headed by Dr. Line Rochefort of Université Laval (Québec, Canada) in collaboration with several other research teams across the country, has led many projects in partnership with CSPMA, including topics such as:

- Development of restoration techniques for post-extraction peatlands;
- Peatland biodiversity (plants, arthropods, amphibians, and birds);
- Carbon sequestration and greenhouse gases balance;
- Hydrology, geochemistry, and microbiology of pristine, under extraction, pre-restored, and restored peatlands.

As a result, the PERG research team has developed an incomparable and internationally recognized expertise in peatlands biology and ecological restoration approaches[2].

The Moss Layer Transfer Technique: A Restoration Method for Post-Extraction Peatlands

The knowledge developed by PERG on the biology of *Sphagnum* mosses and the research on peatland restoration led to the development of the Moss Layer Transfer Technique (MLTT). **The goal of this ecological restoration method is to restore peat extraction sites to ensure the return of the peatland ecosystems' ecological functions, including biodiversity, hydrology, and carbon sequestration**. The restoration technique re-establishes self-regulatory mechanisms that will bring back naturally functioning peat accumulating ecosystems. This science-based and operationally efficient large-scale restoration technique is based on two main actions[3]:

1) the **rewetting** of the site, which is achieved by blocking the drainage ditches that were dug to allow the extraction of peat, to raise the water level.

2) the **reintroduction of peatland plants** on the surface of the site. These plants are usually collected in a nearby peatland, called a donor site.

The different steps of the MLTT, including how to plan the restoration work, the surface preparation, the donor site management, vegetation collection, how to spread, fertilize and protect the plants as well as the best ways to control water levels, have been described in the Peatland Restoration Guide[4] [17].

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[1] Peatland Ecology Research Group (PERG) website: www.gret-perg.ulaval.ca

[2] List of 300+ PERG publications: www.gret-perg.ulaval.ca/fileadmin/Fichiers/centre_recherche/PERG_Publications_1992-2021.pdf

[3] Video showcasing peatland restoration in Northern Québec: www.youtube.com/watch?v=Vyhfz39d4uw.

[4] Peatland Restoration Guide (Quinty and Rochefort, 2003) and its updated chapters about the restoration steps (Quinty, LeBlanc and Rochefort, 2020): Planning Restoration Projects; Site Preparation and Rewetting; Plan Material Collecting and Donor Site Management; Spreading Plant Material, Mulch and Fertilizer.

Peatland Restoration Outcomes

Peatland restoration is a gradual process. Its success is measured by studying the establishment and growth of vegetation communities and other factors that affect the ecosystem, such as hydrology and carbon balance. For that reason, the CSPMA not only supports research to restore peatlands, but also to monitor restored sites. Over the years, PERG has created and maintained an unequaled long-term monitoring database of ecologic characteristics about each large-scale restored site across the country. This database has an extraordinary scientific value and is the starting points of numerous research projects and collaborations. The main outcomes from peatland restoration using the MLTT include:

Vegetation: Ombrotrophic peatland (bog) plant communities are typically composed of *Sphagnum* mosses, which are the foundation of these unique ecosystems, as well as ericaceous shrubs, carnivorous plants, and a variety of shrubs.

- Once the restoration method is applied, a plant cover composed of typical bog species and dominated by *Sphagnum* mosses establishes within 3 to 5 years. [4, 7, 8, 15, 18]
- Most species present in the donor sites establish successfully in the restored sites (transfer rates: 82% of vascular plants, 69% of moss species, which are considered an excellent rate compared to other ecosystems). [3, 9]
- 8 years after restoration, productivity rates and accumulation of organic matter are comparable to those measured in undisturbed peatlands. [1, 12]
- 10 years after restoration, *Sphagnum*-dominated plant communities have proven to resist and be resilient to wildfires. [2]
- The donor sites' moss layer recovers within 10 years and can be used more than once. [9]

Hydrology: Since the peatland surface is drained for the peat to be extracted, restoration operations focus on rewetting the peatland by blocking the drainage ditches, which supports the re-establishment of the plant communities and the return of natural processes such as peat accumulation.

- The water table level quickly rises after ditch blocking, leading to significantly improved hydrological conditions. [11, 16, 20]
- The water table fluctuates more in restored sites than in natural peatlands. However, models suggest that hydrological conditions self-regulate around 17 years post-restoration, once a functional acrotelm (surface layer of living plants where the water table naturally fluctuates) establishes. [12]
- Not only the post-extraction peatland surfaces are restored: methods have recently been developed to enhance the eco-hydrological connectivity between the restored sites and the surrounding natural landscape. [19]

Carbon Sequestration: The return of peat vegetation and hydrology contribute to the return of an important ecological function of peatlands: its ability to sequester carbon.

- One to two decades following restoration, the annual carbon balance of a restored bog returns to values comparable to a natural environment. This means peatlands quickly become carbon sinks ecosystems once restored. [13, 14]

- Restoring quickly after peat extraction is an important Best Practice to limit the impact on GHG. Immediate active restoration achieved a neutral climate impact 155 years earlier than does a 20-year delay in restoration. [14]
- See the [Fact Sheet from this series entitled Greenhouse Gas Emission from Peat Extraction]() for more information.

Fauna Biodiversity: In restored peatlands, the fast return of the plant biodiversity supports the return of animal, insect and bird communities found in undisturbed similar environments. The creation of ponds increases the biodiversity by providing different microhabitats.

- Entomofauna: The addition of ponds successfully supports aquatic species such as diving beetles and the introduction of fast-growing plant species provides habitat, cover and the microclimatic conditions necessary for peatland spiders. [6]
- Avifauna: According to bird counts conducted between 1993 and 2019, bird species assemblages and diversity are similar in restored and undisturbed peatlands, while lower in unrestored sites. Restoration also provides novel habitats for some regionally declining species. [5]

Other Restoration Options

Not all extraction sites require the application of the MLTT: because of their ecological characteristics, some sites will benefit from active rewetting techniques without the reintroduction of plant material, while others require specific operations to re-establish particular species or communities. The PERG team is conducting research projects to adapt the restoration techniques to a wide range of post-extraction sites conditions.

Restoration in Canada

In 2021, the total Canadian Peat Industry footprint (all areas opened for peat extraction since the beginning of industrial operations, around 1930) covers 35,300 ha. **That area represents 0.03% of Canada's overall peatland area[5]**. As of 2021, 60% of the industry footprint is in production and 40% is in post-production, which includes 26% restored or reclaimed and 14% either converted to other land-use (like agriculture) or waiting to be restored (Figure 1). **That means 67% of the post-production areas have been restored or reclaimed already.**

The ecologically restored surfaces account for 8,150 ha, which includes restoration through MLTT (1,950 ha), active rewetting (1,500 ha) and naturally revegetated (4,700 ha) areas[6].

[5] Peatland area in Canada is estimated at 119.4 million hectares [21].
[6] Canadian Peat Industry Statistics: https://peatmoss.com/statistics/

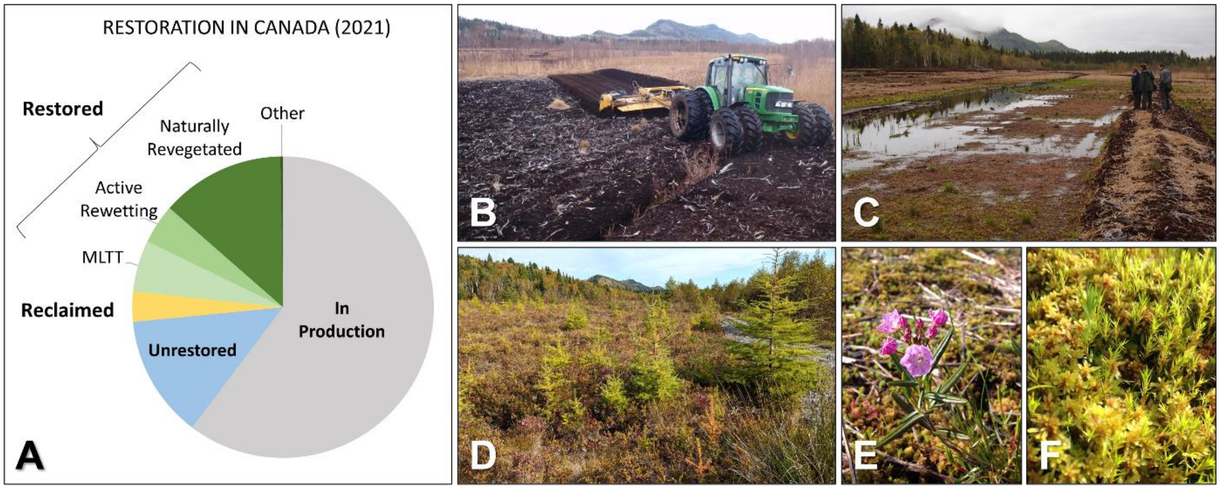

Figure 1: A) Portrait of Canadian Horticultural Peat managed areas, in 2021. B) Peatland restoration in Saint-Fabien-sur-Mer, Québec, Canada, using the MLTT. Pre-restoration conditions. C) 3 years after the restoration. D) 11 years after restoration, E) and F) Well established typical peatland plant communities.

National Peatland Restoration Initiative

The Canadian Peat Industry committed in 2016 to an ambitious National Peatland Restoration Initiative (NPRI). One of the goals is to restore not only its actual post-production footprint, but also all historical sites that have been extracted and closed without restoration actions within 15 years. **In 2021, the CSPMA's national survey of managed peatlands revealed a 37% reduction of these areas within the first five years of the NPRI.**

Furthermore, the CSPMA partners with the Government of Canada under the Environment and Climate Change Canada *Nature Smart Climate Solutions Fund: Placed-based Actions* program. This program aims to restore and secure high carbon ecosystems across Canada. **The project is valued at $6.7 M over 5 years (2022-2027) and aims at restoring numerous unrestored peatlands across the country**.

International Recognition and Other Industrial Applications

The MLTT can be applied to any *Sphagnum*-dominated peatland in the world, and it is now used on a large-scale basis in several countries including the USA, Chile, Australia, Denmark, The Netherlands, Poland, Lithuania, Latvia, and Estonia. The work that the PERG has been doing for years is thus recognized at the international level. **The strong partnership between the science community and the Horticultural Peat Industry, where the peat producers have become restoration leaders, is seen as a model throughout the globe.** In addition, this expertise in peatland restoration has inspired other parties looking for ways to restore disturbed peatlands, including governments, conservation organizations and other industries. As an example of the later, adapted versions of the MLTT have been applied by the oil and gas, the mining and the hydropower sectors to restore oil pads and seismic lines, infrastructure and access roads, and to ensure the return of vegetation following pollutant spills and surface clearing.

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About the CSPMA: The Canadian Sphagnum Peat Moss Association (CSPMA) is an association of Canadian Horticultural Peat producers responsible for approximately 90% of the yearly extracted peat across Canada. The 14 CSPMA producer members are devoted to promoting the responsible management of Canadian peatlands and the wise use of Peat. For more information about our association and our actions, visit www.peatmoss.com.

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PART 2 - GREENHOUSE GAS EMISSIONS (GHG) FROM PEAT EXTRACTION

Key Facts:

- **20 years of research on GHG**: The horticultural peat industry has been working for more than 20 years with researchers to improve knowledge about GHG in peatlands and from peat use. The results inform how to reduce these impacts and develop solutions.

- **Carbon sink function return confirmed**: Peatlands restored using ecological practices (e.g. Moss Layer Transfer Technique) have their GHG sequestration function returned to that of undisturbed peatlands within one to two decades.

- **Small disturbance relative to other activities**: Horticultural peat extraction accounts for 1% of the peatland area disturbed by anthropic activities in Canada. Other disturbances include agriculture (63%), mining (18%), hydropower reservoirs (12%) and forestry (3%).

- **GHG attributable to peat extraction**: GHG attributable to the sector represent 1.5 Mt CO_2 equivalent annually or 0.2% of total Canadian GHG emissions.

Peatland GHG 101

Peat is a natural resource that accumulates in peatlands, which are important ecosystems when talking about GHG because of their functions on **carbon fluxes** (more specifically carbon sequestration) and **carbon store**.

In pristine peatlands, year-round water-logged conditions slow plant decomposition to such an extent that dead plants accumulate to form peat. This stores the carbon the plants absorbed from the atmosphere within the peat deposit, providing a global net-cooling effect.

Peat extraction impacts carbon fluxes and storage. Since vegetation is removed, no new carbon is absorbed by plants. Also, extraction methods involve draining the surface of the peat deposit. As the conditions are no longer water-logged, peat oxidation occurs which causes the drained peatlands to emit carbon into the atmosphere. In addition, the extracted peat is removed from the deposit for use and disposal elsewhere, where it can also emit carbon.

The horticultural peat industry recognizes these impacts and has been working for more than 20 years with various researchers to improve knowledge about GHG balance in peatlands and from peat, reduce these impacts and develop solutions.

Research on GHG in Peatlands Used by the Horticultural Peat Industry

The study of GHG has always been an important focus of the industry's research program. **As early as 1999, researchers began measuring carbon fluxes as part of an ecosystem-wide peatland restoration project.** The Bois-des-Bel (Québec, Canada) peatland then served as an open-air laboratory for researchers to measure carbon fluxes before and at different time periods after restoration. Other study sites and specific projects have been added over the years, which led to a better understanding of GHG in natural, under extraction, post-extraction but unrestored, and restored peatlands.

The researchers the industry partners with are internationally recognized experts in the field, including Dr. Nigel Roulet (McGill University), Dr. Maria Strack (University of Waterloo) and Dr. Ian Strachan (formerly at McGill University, now at Queen's University). These researchers and their teams have complementary expertise ranging from field assessment of carbon fluxes using chambers (localized, point-in-time measurements that provide a better understanding of the factors at play), to Eddy covariance tower measurements (ecosystem-level measurements that provide a more global picture), to modelling for long-term simulation scenarios.

National GHG Inventories

Countries who ratified the United Nations Framework Convention on Climate Change (UNFCCC)[1] must submit a national inventory of GHG sources and sinks to the UNFCCC annually. To do so, they need to comply with the requirements outlined in the guidelines provided by the Intergovernmental Panel on Climate Change (IPCC)[2]. The GHG inventory includes emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and other gases, from the following five sectors: Energy; Industrial Processes and Product Use; Agriculture; Waste; and Land Use, Land-Use Change and Forestry (LULUCF). Peatland use is accounted for under this last sector.

When countries are reporting, they can either use tier 1, tier 2 or tier 3 methodology, each tier representing an added level of methodological complexity. Tier 1 is the basic method and uses emission factors (EFs) compiled at the international level. Tier 2 (intermediate) and Tier 3 (the most demanding in terms of complexity and data requirements) are more accurate and countries are encouraged to develop higher tier methodology.

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[1] https://unfccc.int/resource/docs/convkp/conveng.pdf

[2] IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006): www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/ and IPCC Wetlands Supplement (IPCC, 2014): www.ipcc.ch/publication/2013-supplement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories-wetlands/.

Canada is using a Tier 2 methodology for reporting about GHG emissions and removals in peatlands drained for peat extraction. The approach is based on domestic science and land management practices specific to peat extraction in Canada. Emission estimates for "drained" (under extraction) and "rewetted" (restored) sites include on-site CO_2, CH_4 and N_2O emissions and off-site CO_2 emissions from waterborne C losses and from the decay of extracted peat. Domestic EFs were derived from flux measurements reported by multiple research studies. It is important to note that these EFs are no longer up to date in view of the new scientific research that have been published in recent years. CSPMA and the research partners will work in a near future with Environment and Climate Change Canada (ECCC) to update these EFs.

Peatland Area Involved in Peat Extraction in Canada

In order to calculate GHG generated by a sector, EFs for different land-use categories, as well as the area covered by each of these categories, are needed.

- Total undisturbed peatland area in Canada: 119,377,000 ha [10]
- Area affected by horticultural peat extraction in Canada (2021) [1]:
    - Under extraction: 21,330 ha
    - Restored and reclaimed post-extraction area: 9,320 ha
    - Unrestored post-extraction area: 4,650 ha
    - **Total footprint 35,300 ha**
    - **Total net footprint (under extraction and unrestored area): 25,980 ha**
- Area of peatland disturbance by other land-use changes: Total peatland loss is poorly known but estimated to be ~1,220,000 ha [3]. The current annual land-use conversion for Canadian peatlands is ~120,000 ha.
- According to UNEP, **the Horticultural Peat industry represents 1% of the peatland area disturbed by anthropic activities in Canada. Other industries include agriculture (63%), mining (18%), Hydropower reservoirs (12%) and forestry (3%).** [10]
- Peat extraction over time has affected 0.03% of all Canadian peatlands, of which 0.008% have been restored or reclaimed.

GHG from Peat Extraction due to Peat extraction and the Associated Land-Use Changes

GHG calculations are complex, but based on the area mentioned above, the GHG emissions (CO_2-C: Carbon under its CO_2 form) due to peat extraction and the associated land-use change can be estimated as follows:

- IPCC Tier 1 default values:
    - Peatlands under extraction: 2.8 tonnes CO_2-C ha^{-1} annually [7]
    - For Canada: 59,700 tonnes CO_2-C annually
- ECCC GHG National Inventory Report (Tier 2 Canadian values):
    - Peatlands under extraction: 2.3 – 3.1 tonnes CO_2-C ha^{-1} annually [2]
    - For Canada: 49,100 – 66,100 tonnes CO_2-C annually
- Latest estimate from recent McGill University GHG modelling (Tier 3):
    - Peatlands under extraction: 1.51 ± 0.2 tonnes CO_2-C ha^{-1} annually [5, 6]
    - For Canada: 27,300 – 37,100 tonnes CO_2-C annually

The Tier 1 values are based on approximately 10 studies of observed fluxes from peatlands under extraction and unrestored post-extraction peatlands in Europe and North America. The ECCC (Tier 2) numbers are based on Canada's emissions from extracted and unrestored peatlands. The modelling numbers (Tier 3), derived from simulation using CoupModel [5, 6], are different because they include the entire year and the inter-annual variability among years. Tier 1 and Tier 2 values are based primarily on the warm season observations; hence they are larger than simulated Tier 3 annual values. The Tier 3 model numbers match the observed fluxes closely from the summer months, but are lower in the spring, fall and winter because the temperatures are lower, or the peat is frozen. The simulations were done for eastern Canadian bogs.

GHG Emissions from Restored Peatlands in Canada

The GHG balance from restored peatland has been the focus of CSPMA-supported research for 20 years. The results suggest that peatlands restored using ecological practices (e.g. Moss Layer Transfer Technique) have their **GHG sequestration function returned to that of undisturbed peatlands within one to two decades** [8].

- Emissions from latest estimates, based on number of years after restoration (Tier 2):
  - Unrestored (2 to 14 years post-extraction): emitting ~2.3 – 4 tonnes CO_2-C ha^{-1} annually
  - Restored 2 years: still emitting ~2.8 tonnes CO_2-C ha^{-1} annually
  - Restored >12 years: sequestering ~0.9 tonnes CO_2-C ha^{-1} annually
- Reference undisturbed natural peatlands: sequestering on average 0.9 tonnes CO_2-C ha^{-1} annually [4].

These fluxes are “age-dependent” because the peatlands continue to emit GHG the 2 to 3 first years following restoration while the vegetation is establishing. Thus, a more complex tool is required to calculate the emissions from these surfaces according to their different post-restoration "ages” or vegetation communities. Since unrestored post-extraction peatlands likely emit the same level of GHG as actively extracted peatlands, the best practice is to initiate restoration immediately after extraction is completed [8].

GHG Emissions from Peat Use in Horticulture

As it stands now, the ECCC GHG National Inventory Report is based on EFs times the area in production and restored. It is also considered that 5% of the extracted peat volume (in the form of CO_2) is returned to the atmosphere within the first year [8]. It is not clear, however, what is assumed for subsequent years in terms of emissions, both for peat use or after it has been used.

For its part, the IPPC guidelines assumes 100% of the peat extracted is emitted (in the form of CO_2) in the year it is extracted [4, 6]. This is an important overestimation, it may be valid for peat used for energy production (which isn’t happening in Canada), but not for peat used for horticulture. **For the Horticultural Peat sector, current research suggests ~5 to 6% of peat is lost (in the form of CO_2) in the first year of use, then progressively less each subsequent years.**

Total Emissions from the Canadian Horticultural Peat Industry

The ECCC National GHG Inventory Report 1990-2020 estimates that overall emissions from peat extraction were 1.9 M tonnes CO_2 equivalent[3] in 2020. This includes factors or processes mentioned above (land-use changes associated with extraction and restoration, decay of extracted peat) but also other factors or processes such as land-use changes associated with peatland opening or post-production options other than restoration, off-site CO_2 emissions from waterborne C loss, peat stockpiles, and inclusion of other GHG (CH_4, N_20). With ongoing research projects, we will be able to better inform the authorities to incorporate more realistic emission factors. We believe that the GHG estimates for the horticultural peat sector will be revised downwards **to approximately 1.5 Mt CO_2 eq annually or 0.2% of total Canadian GHG emissions.**

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This Fact Sheet was prepared in collaboration with Dr Nigel Roulet, McGill University (Montréal, Canada).

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[3] Carbon dioxide equivalent (CO_2e or CO_2eq or CO_2-e) is calculated from the Global warming potential (GWP). For any gas, it is the mass of CO_2 that would warm the earth as much as the mass of that gas. It provides a common scale for measuring the climate effect of different gases. It is calculated as GWP times mass of the other gas.

FACTS ON THE NORTH AMERICAN HORTICULTURAL PEAT INDUSTRY AND ITS SUSTAINABILITY

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PART 3 - THE VERIFLORA® RESPONSIBLY MANAGED PEATLANDS CERTIFICATION

Key Facts:

- **Independent certification**: The Veriflora® Certification for Responsible Horticultural Peat Moss Production is an independent program attesting that peat is extracted from peatlands managed in an environmentally and socially responsible manner and meets the highest product quality standards.

- **SCS Global stringent conditions**: The certification requirements go further than many regulatory requirements from various levels of governments.

- **Best Management Practices developed and applied**: For the Horticultural Peat industry, the Certification standards not only represent guidelines to reach, but also foster the development of Best Management Practices and innovative tools such as a Greenhouse gas calculator for the peat producers.

- **Certification support by the producers**: As of 2021, approx. 80% of the Canadian peat production is certified under the Veriflora® Program.

The Responsibly Managed Peatlands Standard

The Veriflora® Responsibly Managed Peatlands program is an independent Certification for Responsible Horticultural Peat Moss Production established by SCS Global Services[1]. Developed in 2012, the certification program is detailed in a Standard, which lists requirements peat producers must comply to (Table 1). **The scope of the Standard covers all stages of peat harvesting, including peatland opening, extraction, and restoration or rehabilitation activities that occur after cessation of harvesting activities.**

[1] https://www.scsglobalservices.com/services/responsibly-managed-peatlands

While the companies and the Associations are developing and applying Best Managements, the Veriflora® Responsibly Managed Peatlands Program is **a third-party certification that ensures the specific elements detailed in the Standard are all respected, through audits and reporting.**

Table 1: Summary of criteria included in the Responsibly Managed Peatlands Standard[2]

General	▪ Legal Compliance ▪ Administrative Requirements ▪ Traceability/Chain of Custody
Responsible Peat Moss Production	▪ Responsible Peatland Management ▪ Agrochemical Inputs ▪ Restoration and Rehabilitation
Ecosystem Management and Protection	▪ Ecosystem Monitoring ▪ Ecosystem Protection
Resource Conservation and Energy Efficiency	▪ Energy Resource Management ▪ Resource Conservation
Integrated Waste Management	▪ Management of Hazardous Chemicals and Wastes ▪ Management of Organic and Inorganic Wastes
Fair Labor Practices	▪ Hiring and Employment Practices ▪ Workplace Conditions ▪ Benefits and Access to Services for Workers and their Families
Community Benefits	▪ Addressing Local and Regional Community Impact ▪ Providing Local and Regional Community Support
Product Quality	▪ Product Quality

Veriflora® Responsibly Managed Peatlands Program Goals

- Encourage a growing segment of the peat moss production sector to implement best management practices in terms of environmental, social and quality performance;
- Stimulate innovation and promote continuous improvement over time;
- Provide a uniform standard and assessment matrix that can be applied when evaluating the performance of a diverse array of responsible peatland management approaches;
- Reduce the environmental footprint of peat moss production and enhance the degree to which peat moss production operations restore carbon accumulating wetland ecosystems;
- Promote sound and responsible working conditions and ensure adequate health and safety measures for workers' protection;
- Encourage peat moss producers to be good neighbors in their engagement with the surrounding community;
- Raise public awareness about the issues and solutions associated with peat moss production;
- Stimulate consumer purchases that reinforce responsible peatland management.

[2] From Responsibly Managed Peatlands, A Veriflora Standard for Responsible Horticultural Peat Moss Production, version 1.0. https://cdn.scsglobalservices.com/files/program_documents/scs_stn_responsiblymanagedpeatlands_v1-0_080217_new.pdf

Examples of Requirements under the Veriflora® Certification

The Veriflora® Certification allows producers to improve the resource development and the environmental footprint. Below are examples of actions that producers must demonstrate and comply with the certification:

- **Greenhouse Gas Inventory and Target:** Certified producers must develop an accurate baseline GHG inventory, as indicated in the Responsibly Managed Peatlands – Greenhouse Gas Inventory Policy and Reference Guide [1]. The baseline GHG inventory is the basis to develop a GHG target and strategies to reduce the GHG emissions and/or increase GHG sequestration, with timetables for implementation. The producer is then responsible to track and document progress towards meetings the GHG target. A GHG calculator [2] has been developed by the industry to help all peat producers to comply with this requirement.
- **Buffer Zones:** Producers must maintain buffer zones adjacent to water bodies in watershed recharge zones, and between peat operations and High Ecological Value (HEV) areas.
- **Donor site:** Producers shall demonstrate that it has established a donor site representing 10% of the peatland harvested areas. Donor sites must be monitored following a specific timetable, to ensure their viability for restoration purposes.
- **Consumption Activities:** Producers must provide a summary of electricity and fuel consumption activities and records of fuel and electricity used for production processes, screening and mixing operations, and administrative facilities.
- **Energy Efficiency:** Producers must develop and implement written protocols and procedures to reduce energy consumption in operations (e.g., fuel, electricity, transportation), including energy efficiency targets and timetables.
- **Packaging Resource Minimization:** Producers must provide information, when available, about the degree to which packaging components are reused, made from recycled sources, made to be compostable, or made from sustainably sourced materials.
- **New and Emergent Technologies:** Producers must demonstrate the use of effective new technologies that improve operational efficiencies and/or reduce the environmental footprint of the operation.

Certified Canadian Horticultural Peat Production

As of 2021, approx. 80% of the Canadian peat production is certified under the Veriflora® Program. This proportion will increase as more companies are obtaining certification. For the Horticultural Peat Industry, the Veriflora® Program is North America's leading differentiator of horticultural peat products. **Certification guarantees peat is harvested from peatlands managed in an environmentally and socially responsible manner and meets the highest product quality standards.** It's important to note that non-certified producers may also apply best practices above the ones required by regulations but may not have the means to initiate the certification process.

Labelling and Recognition

In 2022 the peat industry worked with SCS Global to develop new recommendations for clearer and more informative labeling to provide a better understanding of the certification and its value to a wider audience. The addition to the Veriflora® Guidelines and the combined logo and text is much more than just the Kingfisher logo as it also provides a meaningful explanation of what the certification truly stands for. This is recommended to be incorporated on producer marketing materials such as bags, websites etc.

The Horticultural Peat found in this packaging has been extracted from bogs that are certified under the Veriflora® Responsibly Managed Peatlands program. This certification demonstrates our commitment to the application of good management principles in all aspect of sustainable development including, ecosystem protection, social engagement, and product quality.

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Note about this fact sheet: The reader will notice that this section does not contain as much published references as the previous ones. As much as the industry would like to rely on peer-reviewed information, this sector is a fast-evolving one, especially with the need for reliable and efficient substrates for food production and the recent development of new alternative materials. Although several scientists are currently focusing on these topics, little information is available yet. However, the North American peat industry has been conducting research about the characteristics of peat and other materials for decades. This fact sheet is based on this renowned expertise and includes the available literature when available.

PART 4 - ALTERNATIVE MATERIALS AND THE WISE USE OF PEAT

<u>Key Facts</u>

- **Preferred option:** Peat is the growing media constituent[1] of choice, with unequalled characteristics. It is essential for North American food security and well being.

- **Peat + alternatives is the best combination**: All alternatives benefit from the unique properties of peat with peat acting as an "enabler" to bring the best out of the other growing media components.

- **Used by** Professional growers (70%) and home gardeners (30%).

- **Used for** Floriculture, fruits and vegetable production, mushroom cultivation, cannabis production, shrubs and trees including seedlings for reforestation, and home gardening. **Not used for** energy in North America.

- **Significant economic impact**: An estimated impact of eliminating peat usage of 18B US$ in Gross Domestic Product (GDP) through cost of production increases.

[1] There is no consensus in horticulture about the terminology to use to describe growing media. Although there are several words used in the sector, and that distinctions should be made for each of them, the more common words such as "constituents", "alternatives" are used in this fact sheet to ensure clarity.

- **Alternatives with limitations**: Most alternatives to peat are components of value but with limitations, including variable suitability for growing plants, availability, safety risks, cost, sustainability, and environmental and social footprint.

- **Increased demand for growing media**: The proportion peat-based growing media will continue to grow over the years to ensure fulfilling the ever-increasing demand.

Horticultural Peat's Context

- A growing media of choice around the world.
- Approximately 400-450 million cubic feet extracted yearly in Canada with 85% going to the United States, providing 90% of its imports.
- The horticultural peat industry has a relatively small footprint: 0.03% out of the 119 million hectares of Canadian peatlands or 35,300 ha have been "managed" since its beginning around 1930, 25% of which have been restored.
- Peat is not used for energy production in North America.

Peat: A growing media component with unique and unrivaled characteristics

- Water retention – 12-20 times its own weight
- Nutrient retention
- Aeration – Natural porosity needed for healthy root development and root penetration
- Chemical properties – Low EC and pH levels needed for plant health and growth
- Stability – As compared to other fibers like compost, coco, wood chips, etc.
- Low phytosanitary risks – like bacteria or fungus related diseases

Peat Uses and Benefits

- Essential for North American **food security and well-being**
- Used by **professional growers (70%) and home gardeners (30%)**
- A growing media component supporting a wide range of usage: for food production (vegetables, fruits, herbs and mushrooms), ornamental plants, cannabis and production of shrubs and trees including seedlings for reforestation. It is used both for soilless and soil-based cultivation, in greenhouses, for home gardening and professional production.
- According to an economic study produced in collaboration with the peat industry (Doyon and Bergeron, 2021), there would be an increase in the cost of production of most horticultural products when shifting away from a peat-based production:
  - Mushroom production: 28% to 58%
  - Ornamental horticulture: 12% to 27%
  - Hydroponic production: 15% to 32%
- The total economic impact (in loss of GDP) of eliminating peat usage in North America is estimated at **18B$ US annually** (table 1).

Table 1: Economic Impact of eliminating Peat usage in North America (NA) on sectors that rely on peat. Adapted from Doyon and Bergeron, 2021.

SECTOR	NA loss of GDP (B$ US)	%
Food production (including mushrooms)	11,02	61
Ornemental horticulture	5,47	30
Cannabis	0,78	5
Growing media for home gardening	0,48	3
Reforestation (tree seedlings)	0,16	1
Total economic impact	18,00	

Table 2: Overview of performance, economics, and environmental impacts of Peat

Performance	Economics	Environment
- High water retention - High air capacity - Low pH and nutrient level - Good structural stability - Lack of weed seeds - Reliable high quality - Unique microporous properties and resistance to degradation	- Low cost - Largely available throughout the year but sometimes impacted by weather - Requires relatively little treatment or few additional inputs to deliver an effective performance; thereby minimizing secondary processing costs - Low bulk density (cost-effective transport)	- Absence of toxic substances - Absence of pathogens - Low microbial activity - Carbon emission from peat extraction which can be partly mitigated by quick restoration

North America's Wise Use of Peat

- In keeping with its adopted principle of Wise Use of peat, the Horticultural Peat Industry estimates that the **proportion of other constituents blended with peat will continue to grow over the years** to ensure fulfilling the ever-increasing demand for growing media.
- Most of alternatives / extenders are constituents of value but with limitations, including variable suitability for growing, availability, risks, cost, sustainability, and environmental footprint.
- As literature suggests, some alternatives can be acceptable for various uses but, when blended with peat, **they all benefit from the unique properties of peat, the latter acting as an "enabler".**
- The Horticultural Peat Industry is committed to continue working closely and intensively with users and the science community to devise the growing media of the future that will answer the needs of such users, including quality and yield.

- Regarding its availability, the industry permanently works with provincial governments to enable a sustainable access to the peat resource to ensure its able to meet the needs for horticultural peat for generations to come.

Alternative Materials

Peat extraction highly regulated context, with activities sometimes affected by weather, and a steady increase in demand for growing media are impacting the ability of peat producers to meet the demand for peat. Thus, North American growing media producers, including peat producers, and growers alike have been looking for options to 'stretch' the available peat using suitable growing media alternatives either in part (as extenders) or completely (full replacement). However, it's clear through the research available that there is still no totally viable alternative to peat and the benefits it delivers as an enabler. Table 3 and 4 below provide the knowledge available, as of the date of the last revision of this fact sheet.

Table 3: Overview of performance, economics, and environmental impacts of some alternative growing media components

Performance	Economics	Environment
Coconut Coir		
- Lightweight - Good porosity - Good water holding characteristics - Less acidic than peat moss - Must be washed in fresh water and sometimes buffered to reduce sodium and potassium levels - Elevated salinity - Depending on the origin and handling, presence of possible contaminants, bringing phytosanitary risks - Chemical and physical properties may vary depending on its origin	- Cost influenced by ocean freight cost (import) - Limited availability that meets the quality standard of horticultural production - Compressed coconut coir has low local transportation cost	- Use can indirectly contribute to the increase of the surface developed for coconut production, which may have important negative environmental impacts - High production energy required - Requires extensive washing with water to reduce salt concentration; wastewater pollution.
Bark		
- Reduces the water retention capabilities of the substrate - Heavier than other constituents making it an ideal amendment to stabilize containers that must remain	- By-product of the forest industry - Available cheaply near forest industry with pines, but price variations due to competitive	- Unused by-product (sustainable and renewable) - Low energy production - Increases the frequency of watering, which requires more

outdoors (trees and shrubs production) - Very good structural stability - Potential to immobilize fertilizer nitrogen with fresh or partially composted bark - May be used fresh from sawmills, but aged bark is preferred as a basic component of soilless substrates used for container nursery production - Composting improves bark stability and water retention capacity	markets (ex: biomass energy, etc.) - Maintenance required to prevent weeds and need to regularly rotate the bark increases cost - Heavier (more expensive to transport) - Higher cost of production because of increasing irrigation frequency, fertilization, and monitoring	water and cause nutrient leaching - Water treatment system requirement for aged and composted bark production
Wood Fiber		
- High total porosity and very high air content; high oxygen diffusion rate - Slightly reduced water retention capacity of the substrate - Lightweight - Good porosity - Potential to immobilize fertilizer nitrogen	- By-product of the forest industry - Production is expensive - High compression and light weight (cost saving when shipped over long distances) - Increasing demand has increased cost	- By-product of the forest industry (renewable resource) - Lower production energy then peat moss harvesting or to treat coconut coir
Compost		
- Various types of feedstocks and the conditions under which they are composted does not allow a generalization of the characteristics of compost physical and chemical properties - To adapt production methods, all compost need to be tested for pathogens, pH levels, electrical conductivity, and nutrient contents prior to use.	- By-products of existing industries (competitive prices; low price) - Available through local production (lowers transportation cost) - Heavier than other materials (increases transportation cost) - Quality variation - Natural source of nutrients (lowers the cost and reliance on synthetic fertilizers)	- Local supply available - Creating value with bio-waste and by-products eases pressure on landfills and increases the circular economy - Methane emissions if not properly aerated - Sources of raw material might not allow product to be approved as an input for organic production

	- Competitive buying market (biogas plants, mixers of sludge from waste treatment plant, thermal power plant)	
Biochar		
- Needs analysis	- Feedstock to produce biochar is available in most locations, making it an ideal solution to reduce transportation cost. - Equipment needed for pyrolysis and preparation of the feedstock currently make the process not economically viable	- Biochar can be created from almost any organic by-products and waste streams, making it an interesting technology to promote circular economy and reduce disposable waste - Availability near many production sites reduces the impacts of transportation. - Process of pyrolysis sequesters carbon and helps combat climate change

Table 4: Material Quality and Effects on Plant Growth – End Results

Material	Quality and Effects on Plant Growth
Peat	As a stable, lightweight material and for its well-balanced properties for plant growth, peat has proved a nearly unique worldwide candidate for growing media, meeting the high-volume demand at a low price and a wide availability. **When peat is blended, other materials benefit from the unique peat properties.**
Coconut Coir	Coir is particularly valued as a rooting medium, but its water-holding ability and wettability make it an attractive proposition for bedding and pot plants, where growth in the latter has often been shown to be superior to that in peat.
Bark	Bark is often mixed with other organic as well as inorganic components (peat, sand, etc.) to produce nursery stock media. A specialized use of bark includes chips for the cultivation of epiphytes such as orchids and bromeliads.
Wood Fiber	Generally not used as a stand-alone growing media component because it retains insufficient plant-available water and becomes compressed during use. In some cases, phytotoxic substances may inhibit plant growth, but in most instances depletion of nitrogen is responsible for growth inhibition. Successfully used with a range of protected vegetable crops.
Composts	Inclusion in growing media to suppress a wide variety of root zone plant pathogens is a well-established and effective method. Provides natural microorganisms for organic fertilizers mineralization when organic production input approval is required.

Biochar	Biochar was intended for application in agriculture fields since it has been shown to enhance soil fertility, nutrient uptake, immobilization of organic and inorganic pollutants and increased growth. More recent research has examined biochar's potential role as a growing medium in horticultural production.

Greenhouse trial findings on physical and chemical characteristics of soil alternatives without peat currently available on the market (Industry Trials)

The chemical analysis of some alternatives currently available on the market show results incompatible with adequate plant cultivation. In most cases, Acidic Level (pH), Electric Conductivity (EC) and Chloride Level (Cl^-) are too high, which is problematic for plant culture:

- A high pH makes it difficult for certain nutrients to be available for the plant, particularly micronutrients, such as Fe and Mn;
- A high EC indirectly impacts the ratio of nutrients required and causes plant root and/or foliage damage;
- A high Cl^- will burn leaves and reduce root growth and competes with nutritive elements and can be toxic to many plants.

Similar conclusions can be drawn with regard to some physical and physico-chemical characteristics of these soil alternatives without peat such as initial wettability and water-holding capacity which are too low

- A low initial wettability indicates a soil difficult to rewet
- A low water-holding capacity indicates difficulty for the soil to maintain an optimal level of water content for plant growth. This increases watering frequency and usage.

Plant performance results of most soil alternatives without peat tested for the cultivation of petunia, basil and geranium are in line with the findings above.

Plants grown in premium peat-based mixes produce 60%, 40% and 150% more dry biomass weight for petunia, basil and geranium than those grown in most soil alternatives without peat.

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