

HAIR
IN
SOIL

R
E
P
O
R
T

2022

EXECUTIVE SUMMARY

Hair is one of the highest nitrogen-containing organic materials in nature. When added to soil, it releases nitrogen, albeit slowly, and thus is suitable as a soil amendment. It has the capacity to increase microbial community and mycorrhizal associations which influence the uptake of various nutrients. It can increase water retention and soil structure. Because it degrades slowly, hair should not be used as a solitary fertilizer. The addition of keratinous fungi can accelerate the degradation of hair and thus the availability of nitrogen in soil. One caution of adding hair to soil is that it can increase soil pH.

Written by: Stephanie Hodgson
Head of Research and Development
Green Salon Collective

INTRODUCTION

There is a real need for circular solutions for all waste streams. Hair is no exception. At Green Salon Collective, we don't believe in landfill and we are always researching alternative solutions for every single waste stream created by the hair and beauty industry, with the absolute last option being waste to energy.

In our first year of operation, our members sent us roughly two tonnes of salon hair waste. The majority of that was sent to our UK-based composting partner and some of it was used to make hair booms to clean up oil spills (pictured).



Fry Taylor using hair booms to contain an oil spill in Ireland.

Green Salon Collective is growing fast and we will be handling more and more and yet more salon hair waste in the coming years. We are continuously pushing the boundaries of what can be done with this unique waste stream but even the materials and products we make with it still need to be disposed of eventually as well. It is therefore imperative that we more fully understand the impact of hair in soil by looking at scientific, peer-reviewed research.

In this report, we share the scientific evidence for how hair can contribute to enriching soil with nitrogen, improving soil quality and resisting pests. We have included research on similar keratinous, high-nitrogen waste materials (e.g. wool). We also examine the slow degradation of hair and ways to expedite the process. The report ends with a cautionary note on the impacts of hair on soil pH.

SOURCE OF NITROGEN

The three main nutrients plants need to grow are nitrogen (N), phosphorus (P) and potassium (K). In modern agriculture, there is a need for organic, low-cost fertilizers containing these nutrients and others. Nitrogen fertilizers are typically made from nitrogen in the air and natural gas to create ammonia using the Haber-Bosch process which is very energy-intensive.

Human hair has been considered in agriculture because it is one of the highest N-containing organic materials in nature (~16%). Zheljzkov (2005) found that uncomposted wool and hair were effective as soil amendments and nutrient sources (N, P and K) for basil, apple, peppermint and sage plants. A follow-up experiment (Jeliazkov et al 2008) similarly found that uncomposted hair served as a nutrient source for horticultural crops like lettuce, wormwood, yellow poppy and feverfew. Both studies highlighted that hair could be useful as a slow release fertilizer due to the slow degradation of hair and that it should be used together with other fertilizers.

Jeliazkov, Stratton and Sturz (2008) showed once again that uncomposted hair and wool wastes could be used as a nutrient source. This experiment looked at the high value, non-edible crops marigold, valerian and foxglove which represent medicinal and ornamental plant markets. Beyond nutrient uptake, they also monitored soil microbial community and mycorrhizal associations which can influence the uptake of various nutrients including N and P.

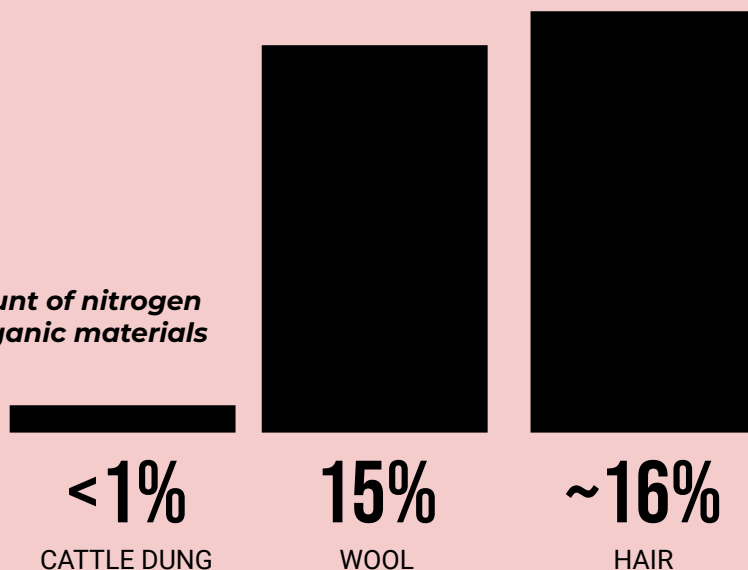
More recent studies have looked at related keratinous waste materials such as wool and chicken feathers. Sunda et. al. (2021) found that wool waste placed at the bottom of planting pits or else mixed into compost for bottle gourd plants improved N content as well as water retention. Kumar, Kumar and Kushwaha (2021) found that fertilizers made

from chicken feathers increased the availability of N and P in soil.

SOIL QUALITY

Bacteria and microorganisms are essential to soil health. Above we mentioned how uncomposted hair and wool as a soil amendment also played a critical role in the presence of mycorrhizae and increased microbial community (Jeliazkov, Stratton & Sturz 2008). Oh, Yun and Park (2011) also found that hydrolyzed hair increased hot pepper plant growth, protected the plants against wilt disease and, relevant to this topic, increased bacterial community.

Amount of nitrogen in organic materials



PEST RESISTANCE

Coir or coconut fiber is commonly used as a top layer for seedlings and plants to deter pests. Hair has been used in a similar fashion and Gupta (2014) has provided an excellent summary of those applications. Hair has protected plants from hungry rabbits in Mauritius (Facknath & Lalljee 2005). It has discouraged deer that are afraid of humans in America (Scott & Townsend 1985). At least two research papers have shown how hair has deterred rhinoceros beetles in India (Siddhi 1997; Deka, Bhuyan & Hazarika 2006). Hair mats used on Florida farms resulted in limiting the need for

conventional pesticides saving farmers tens of thousands of dollars in a year (Negrete 2008).

DEGRADATION

Most research on hair in soil regards it as a slow release fertilizer due to the slow degradation of hair (Jeliazkov et. al. 2008). Under normal conditions hair degrades slowly however there is some research that has shown that with moisture and keratinolytic or keratinophilic fungi the process is accelerated (Sharma, Sharma & Rao 2011; Kumar, Kumar & Kushwaha 2021). Such fungi can be present in soil, animal manure and sewage sludge.

Gupta also contends that “finely shredded hair...is better for faster decomposition” (2014, p.4).

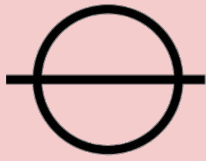
SOIL PH

At least two of the research papers mentioned above have found that adding hair to soil alters pH towards alkalinity (Jeliazkov, Stratton & Sturz 2008; Sharma, Sharma & Rao 2011). This happens with the “mineralisation and oxidation of S and N-containing compounds” (Jeliazkov, Stratton & Sturz 2008, p.1613) and the recommendation is to consider liming whenever hair or wool waste is added to balance the soil.



REFERENCES

- Deka, M.K., Bhuyan, M. and Hazarika, L.K. (2006) Traditional pest management practices of Assam. *Indian Journal of Traditional Knowledge*, 5(1): 75–78.
- Facknath, S. and Lalljee, B. (2005) Indigenous/traditional knowledge adopted in Mauritius for sustainable agriculture. In *Sustainable Agriculture: Issues in Production, Management, Agronomy, and ICT Applications*. Eds: Bandopadhyay, A., Sundaram, K.V., Moni, M., Kundu, P.S., and Jha, M.M. Northern Books Center, New Delhi, 147-64.
- Gupta, A. (2014) Human hair “waste” and its utilization: Gaps and possibilities. *Journal of Waste Management*, 2014: 1-17.
- Kumar, J., Kumar, P., and Kushwaha, R.K.S. (2021) Significance of keratinophiles in biofertilizer development from keratinous waste: Upcoming perspective. In *Biofertilizers, Vol.1: Advances in Bio-Inoculants*. Eds: Rakshit, A., Meena, V.S., Parihar, M., Singh, H.B., Singh, A.K. Woodhead Publishing, Chapter 8: 95-101.
- Negrete, T.F. (2008) Human hair market growing fast. *Sarasota Herald-Tribune*. Accessible at: <https://eu.heraldtribune.com/story/news/2008/01/06/human-hair-market-growing-fast/28601286007/>
- Oh, S.O., Yun, A. and Park, D.H. (2011) Effects of physicochemically hydrolyzed human hairs on the soil microbial community and growth of the hot pepper plant. *Biotechnology and Bioprocess Engineering*, 16(4):746-54.
- Scott, J.D. and Townsend, T.W. (1985) Methods used by selected Ohio growers to control damage by deer. *Wildlife Society Bulletin*, 13(3): 234–240.
- Sharma, M., Sharma, M. and Rao, V.M. (2011) In vitro biodegradation of keratin by dermatophytes and some soil karatinophiles. *African Journal of Biochemistry Research*, 5(1): 1-6.
- Siddhi, H. (1997) Hair hinders rhinoceros beetle. *Honey Bee*, 8(2): 8.
- Sunda, S.L., Jakhar, R.K., Kharia, S.K., Sharma, R.K. and Kumawat, S. (2021) Influence of wool waste on nutrient content and uptake of bottle gourd (*Lagenaria siceraria*) in Western Rajasthan. *The Pharma Innovation*, 10(8): 903-907.
- Zheljzakov, V.D. (2005) Assessment of Wool Waste and Hair Waste as Soil Amendment and Nutrient Source. *Journal of Environmental Quality*, 34(6) 2310-7.
- Zheljzakov, V.D., Silva, J.L., Patel, M., Stojanovic, J., Lu, Y., Kim, T. and Horgan, T. (2008) Human Hair as a Nutrient Source for Horticultural Crops. *HortTechnology*, 18(4): 592-6.
- Zheljzakov, V.D., Stratton, G.W. and Sturz, T. (2008) Uncomposted Wool and Hair-Wastes as Soil Amendments for High-Value Crops. *Agronomy Journal*, 100(6): 1605-14.



research@greensaloncollective.com