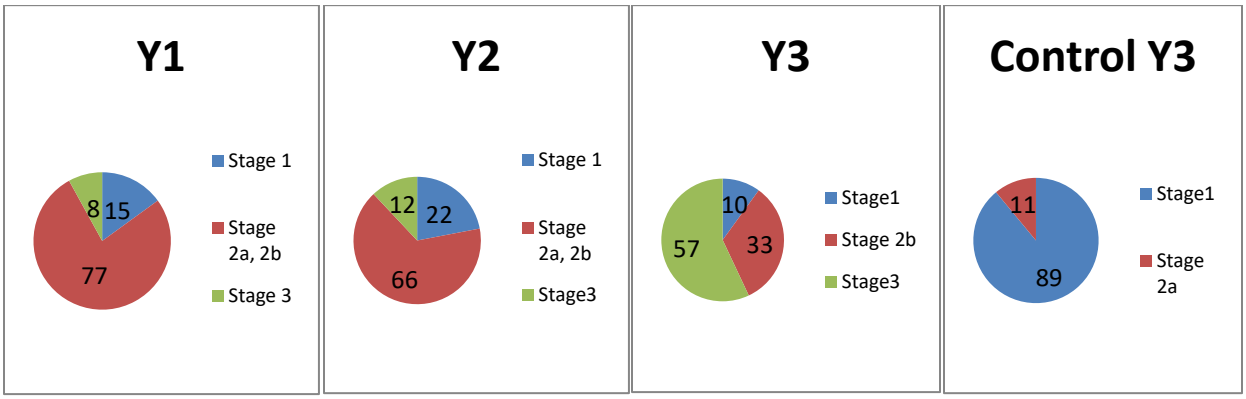
CUSP Fungal Degradation Investigation: Report for Season 3, 2017

In late 2014 CUSP began investigating native wood rotting mushrooms by collecting wild strains and culturing them on woodchip media and wood chips. This investigation is being conducted to study the possibilities that the techniques of myco-remediation offer promise as a tool for forest management practitioners. Now in its fourth year, the results show a marked degradation of one of the most resilient molecules in the forest: cellulose.

The plots are located in the wild and monitored monthly. This investigation seeks to create a baseline guide for these types of treatments and to document the rates of inoculation, rates of spread, and efficiency of degradation over time.

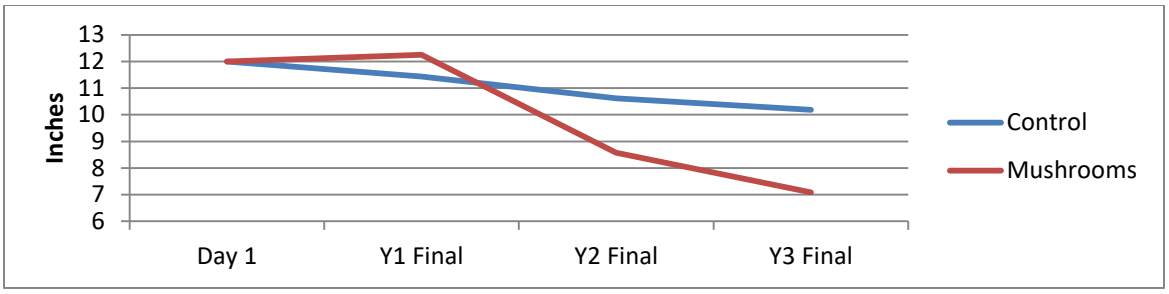
For the purposes of this project, chips are delineated into 4 stages of decay: Stage 1) raw wood chips. Stage 2) Chips involved with mycelium in an initial and a mature stage (2a, 2b). Stage 3) Compost. Stage 4) Post-compost- which is a polymer-like, highly plastic form created by subsequent bacterial and insect decay of the compost. Currently, Stage 4 represents <1% of the test beds and is not included in the following charts.

Conversion rates of wood chips into compost by volume, by season (measured at seasons end):



By then end of season 3 we have seen a near-complete reversal of chip to decay ratios from our test beds versus the control. While the control bed remains 89% unaltered wood chips and 11% pre-compost, the test bed is 90% involved in degradation with only 10% stage 1 wood chips remaining. It is worth noting that no chips have reached Stage 3 in the control beds. We are seeing similar results in our replication test beds.

Wood chip Bed depth



Decomposition occurs below the moisture horizon. Incomplete data exists on moisture horizon depth in mushroom vs. control and this is data we are collecting at the replication test site inoculated on Sept. 30, 2017. However, the current data indicates that moisture content below the horizon varies greatly, with mushroom infected chips holding over 59% moisture (on avg.), compared to 38% for raw wood chips. This suggests that mushroom piles could have greater resistance to ignition than a similar wood chip pile; this is an area for further investigation. The greater moisture content will also aid in secondary forms of decay.

Nutrient Composition of the Compost:

Mushroom respiration is similar to animals in that O2 is inhaled and CO2 is exhaled. This converts a substantial amount of the carbon in the cellulose into atmospheric CO2. This leads to the characterization of fungal enzymatic digestion as: “cold fire”. Where this process differs greatly from fire, is that fire will destroy nearly all organic nitrogen when it de-constructs the wood. Oyster mushrooms (Pleurotus sp.) fortify organic nitrogen both through symbiosis with nitrogen fixing bacteria, and also by predation of nematodes which they capture and digest when free nitrogen is scarce. These mechanisms preserve and even fortify the available stores of organic nitrogen, a limiting nutrient in forest ecosystems.

Metric	Wood Chips	Compost	Conifer OA*
C:N Ratio	169	34	35.5
PH	4.94	7.01	5.7
N	0.279 %	0.264%	0.24%
P	0.010%	0.027%	0.005%
K	0.021%	0.061%	0.026
Org. Matter	89.2%	16.8%	8.8%

***OA horizon is the top layer of decaying organic matter (Duff)**

Our compost shows a five-fold decrease in the carbon to nitrogen ratio(C:N) from the parent material; from 169:1, to 34:1. This is a useable ratio for plant uptake, and they will be the end benefactors of this nutrient cycle. Not only does this process increase available Nitrogen to the forest floor, it increases the availability of phosphorus (2.7X) and potassium (2.9X); the other 2 macro nutrients required for plant growth. The pH of the finished material in neutral (pH 7.01).This is compared to pH5 to pH4 for natural forest litter compost. This indicates increased bio availability of nutrients; Phosphates and micro nutrients in particular.

Raw woodchips on top of Stage 2 chips.

Stage 3 woodchips (Compost)

This investigation continues with large scale treatment applications both in process and in the planning stages. Work is being done to incorporate this technique into forest mitigation prescriptions from their very start. The completed initial study is on track for submission for academic publication in 2020, after our planned 5 years of monitoring is complete. It appears that this technique holds great promise for a variety of applications within the resource management fields.

Cooperating Partners:

Coalition for the Upper South Platte
Denver Mountain Parks
Denver Botanic Gardens- Sam Mitchell Herbarium of Fungi

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