# Switchgrass Morphological Components

**Purpose**: The purpose of this publication is to describe the differences in composition among switchgrass morphological components. All data presented here is from the cultivar 'Cave-in-Rock'.

### Proportion of the Dry Matter

Samples were collected from both the Willsboro and the Freeville, NY sites. The Freeville site had 10 field replicates, but did not have multiple treatments. The Willsboro sites were on sandy and clay soils, and each had 6 treatments. N, NP, and NPK fertilizer were applied. Also fresh and composted dairy manure were applied, as well as a check treatment.

Switchgrass samples were cut at a 4" stubble height and separated into the morphological components Stem (ST), Leaf Blade (LB), Leaf Sheath (LS), and Inflorescence (IN). In mature plants in the fall, almost half of the dry matter consisted of stem, and about ¼ of the dry matter was leaf blade (Fig. 1).

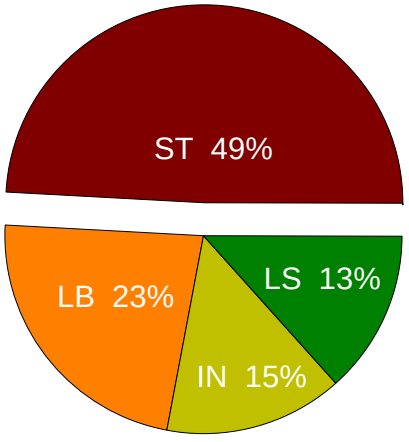


Fig. 1. Percent of dry matter for each morphological component of switchgrass in the fall at Willsboro, NY (average of 6 treatments, 2 sites and 4 years).

These proportions were not variable across treatments, sites, or years, with the exception of the check treatment. Check treatments averaged 2.4% units lower inflorescence DM proportion than the average of the other five treatments. Over 4 years, stem % ranged from 48 to 50% at the Willsboro site.

### Impact of Overwintering in the Field

Switchgrass can be overwintered in the field and mowed and baled the following spring, in order to alter composition. This has a major impact on the morphological components (Fig. 2). In particular, inflorescence and leaf blades are much more likely to drop off the plant prior to harvest. 'Cave-in-Rock' switchgrass at the Freeville site was shorter in 2009, compared to the Willsboro site, resulting in more leaf and less stem in the fall.

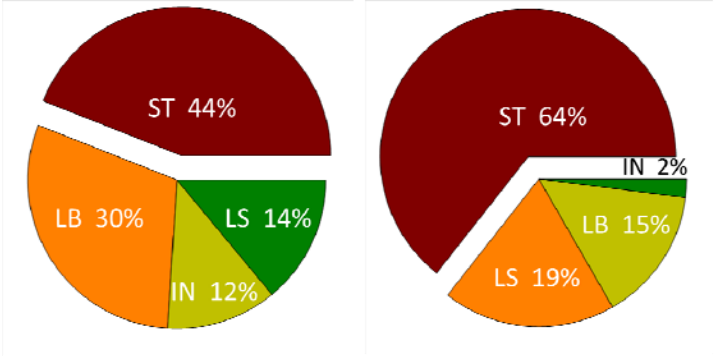


Fig. 2. Percent of dry matter for each morphological component of switchgrass in the fall of 2009, compared to overwintering standing switchgrass the following spring at Freeville, NY.

The loss of primarily inflorescence and leaf blade over winter can reduce yields significantly (Bioenergy Information Sheet #10). The proportion of both stem and sheath increased in overwintered grass, due to much greater losses of the other morphological components over winter.

This example is of standing switchgrass left over winter. If the grass is mowed into a windrow in the late fall and left in the field over winter, the proportions of morphological components will likely differ from this example.

## Morphological Component Composition

Ash and BTU content varied some with site and treatment at Willsboro in 2012. They also varied considerably with morphological component, and ash and BTU were correlated with each other within each component (Fig. 3).

Ash content was highest for leaf blade, followed by inflorescence, sheath, and stem. Stem and inflorescence were considerably higher in BTU content than leaf components.

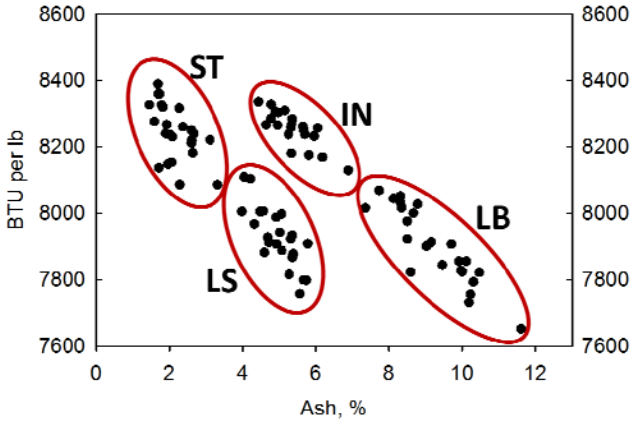


Fig. 3. Relationship between ash and BTU content for switchgrass morphological components in the fall of 2012 at Willsboro, NY.

The primary undesirable chemical components of grass biomass are Cl, N, and K. Chlorine content was significantly affected by both morphological component and by treatment at Willsboro, with no interaction between them. Stem was highest in Cl, with leaf blade lowest. Treatments that included application of chlorine (manure, compost, and NPK) were significantly higher in Cl content that the rest of the treatments.

Table 1. Elemental content of components.

| Part | Cl | N | K | S | P | Ca |
|---|---|---|---|---|---|---|
| | % | | | | | |
| ST | 0.20 | 0.17 | 0.62 | 0.03 | 0.09 | 0.09 |
| LS | 0.15 | 0.44 | 0.43 | 0.04 | 0.10 | 0.18 |
| LB | 0.10 | 0.67 | 0.37 | 0.08 | 0.14 | 0.77 |
| IN | 0.13 | 1.26 | 0.44 | 0.10 | 0.18 | 0.27 |

Stem was also considerably higher in K than other components. Inflorescence contained much more N than other components, and was also highest in S and P content.

Concentrations of total fiber (NDF) and lignin were much higher in stem. Concentrations of aluminum (Al) and Titanium (Ti) (indicative of soil contamination) were highest in leaf blade, followed by inflorescence, sheath and stem. Al and Ti concentrations were 4 to 9 times higher in leaf blade than stem. Leaf blades have the greatest potential for soil contamination.

## Summary

Switchgrass is primarily composed of stem, and the percentage will increase if the crop is kept out in the field over winter. As found with whole plant samples, ash content of morphological components is well correlated with energy content of the biomass crop. Chlorine content of stems was twice that of leaf blades, but overwintering in the field would leach out a considerable portion of the chlorine. It is desirable to reduce the proportion of inflorescence and leaf blade, from a biomass composition standpoint. This could be done by overwintering in the field or by physical separation of components after harvest.

## Additional Resources


Cherney, J.H. and K.M. Paddock. 2013. Overwintering Switchgrass in the Field in NYS. Bioenergy Information Sheet #10. www.grassbioenergy.org.

Cherney, J.H. and K.M. Paddock. 2013. Harvest Management and Switchgrass Composition. Bioenergy Information Sheet #11. www.grassbioenergy.org.

Cherney, J.H. K.M. Paddock, Q. Ketterings, M. Davis, and D.J.R. Cherney. 2013. Switchgrass Stubble Height. Bioenergy Information Sheet #17. www.grassbioenergy.org.


## Acknowledgments


Research was supported by the Northern NY Agric. Development Program, and the Cornell University Agricultural Experiment Station.


For more information

Cornell University Cooperative Extension

Dept. of Crop & Soil Sciences
http://www.GrassBioenergy.org


J.H. Cherney, K.M. Paddock, Q. Ketterings, M. Davis, and D.J.R. Cherney
Cornell University
JHC5@cornell.edu