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Prevalence and Behavior of Blastobasis repartella (Dietz) in Switchgrass

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ABSTRACT

Switchgrass (*Panicum virgatum*) is growing in recognition as a potential source for biomass. In order to use switchgrass optimally as a crop for biofuel production potential pests need to be detected and studied. Currently, one pest being studied is the stem-boring larva of the moth *Blastobasis repartella*. The objective of this experiment was to compare effects of larval feeding on rhizome buds for two cultivars of switchgrass, and to observe and document feeding behavior of the larva. The two cultivars of switchgrass used were Pathfinder (PTH), a lowland variety, and Sunburst (SBS), an upland variety. Six, 15-cm^2 samples of rhizome clusters from each cultivar were taken in September 2011 from South Dakota State University's Aurora Research Farm. A total of 136 tillers were collected from both varieties containing 345 buds; 114 of those buds were killed by *B. repartella*. Pathfinder rhizome samples produced 25 larvae while those of Sunburst had 22 larvae. No significant differences were detected between PTH and SBS in regards to the number of new buds present, the number of damaged buds, the number of larvae, or the rate of damage caused by larvae. It appears that *B. repartella* larvae do similar amounts of damage to both varieties and that there is a significant pest status with approximately one-third of the potential biomass producing buds being killed.

Keywords: Bioenergy, biofuels, *Blastobasis repartella*, switchgrass, Panicum virgatum

INTRODUCTION

With an increase in demand for resources such as fossil fuels, there is a need for different types of renewable resources that can be easily harvested and sustainable. One way to do this is by using different crops for bioenergy. Bioenergy is renewable energy from different biological sources which can be used for heat, electricity and fuel (Yuan et al., 2008). The most abundant biofuel in the industry at the present time is corn-based ethanol (McLaughlin et al., 1999). New studies are looking at the use of switchgrass, *Panicum virgatum* Linnaeus, as a new biofuel source. Switchgrass is a warm-season, perennial grass that is native to Central and North America and is a characteristic species of tall-grass prairie (Rinehart, 2006). Agronomically, there are two classifications for switchgrass ecotypes that refer to their growth habits: lowland ecotypes that are taller on more mesic sites and upland ecotypes that are smaller in stature on drier sites (Keshwani & Cheng ,2008). Using switchgrass as a biofuel source may be advantageous compared to corn as it promotes conservation of native prairie grasses and provides wildlife benefits (Keshwani & Cheng, 2008). In order to use switchgrass for a biofuel crop, potential pests need to be detected and studied. Currently, one pest being studied is a stem-boring caterpillar, *Blastobasis repartella* .

Blastobasis repartella is a stem-boring caterpillar that bores into the proaxis and basal nodes of switchgrass and kills individual plant tillers (Adamski et al., 2010). Adamski et al. (2010) provided descriptions of the life-stages of *B. repartella* and some observations of its biology in switchgrass. Prasifka et al. (2011) noted in their study of stem-boring caterpillars in switchgrass that none of the stem-borers seemed to be threats to switchgrass or other crops. Studies have shown that only one larva occupies a stem of switchgrass at a time (Adamski et al., 2010; Prasifka et al., 2010). This study was part of a larger study on the insect/plant relationship and designed as an exploratory test to determine the prevalence of *B. repartella* larva in two different switchgrass cultivars as well as describe feeding behavior of the larva on the switchgrass rhizomes. Results of this study were intended to help determine directions of further investigations.

METHODS

This study was conducted at the South Dakota State University Aurora Research Farm located at 44°19’ N, 96°42’ W, Brookings County, South Dakota. This agricultural study site supports harvestable crops for the purposes of research. The plots of switchgrass varieties are arranged in rows with the different cultivars in 1 x 6 meter lots. The different types of cultivars are randomly planted with buffer strips to avoid cross invasion.

For this study, we examined two cultivars: Pathfinder (PTH) and Sunburst (SBS). The two varieties were planted in a randomized block design with ‘6’ blocks and ‘6’ replications per block. Samples of 15-cm x 15-cm were taken from 6 plots each of PTH and SBS cultivars within each block on 29 September 2011. For this study only the rhizomes and roots were needed from the switchgrass so the stems were cut just above the ground and the rhizome/root masses were dug 5.08cm below the soil surface. The samples were placed in one-gallon sized Ziploc® bags and labeled with the date of collection and plot location. A flag was placed at the sample location to avoid adjacent sampling. Samples were placed in a freezer at 0°F until specimen recovery and counts were made.

Each sample was examined for signs or *B. repartella* larva including presence of larva or damage caused by feeding (Figures 1-2). Feeding-related damage may include the initial hole that was bored into the bud or the removal of the plant tissue in the tip of the bud. Recovered specimens of larvae were preserved in alcohol for further study.

Figure 1 Signs of damage caused by B. repartella larva.

Figure 2 Larva of *B. repartella* in rhizome tip.

Data collected and recorded for each switchgrass tiller included the total number of new buds, number of damaged buds, number of buds with larva, number of larva per bud, and the type of damage on each bud. These data were used to quantify the prevalence of and damage caused by *B. repartella* between the two varieties of switchgrass. Differences in productivity, prevalence and damage between the two varieties were analyzed with a two sample t-test assuming equal variance with an alpha level of 0.05.

RESULTS

A total of 136 tillers (65 PTH and 71 SBS) were collected and 345 buds (160 PTH and 185 SBS) were examined (Figure 3). Of those buds, 114 (55 PTH and 59 SBS) were damaged by larva (Figure 3). A total of 47 (25 PTH and 22 SBS) larva were found in the rhizome buds. There was no significant difference between PTH and SBS in the number of new buds present ($p = 0.54$), for the number of damaged buds ($p = 0.93$), and for the number of larva a ($p= 0.4$. Damage prevalence was 34.38% for the PTH variety and 31.89% for the SBS variety.

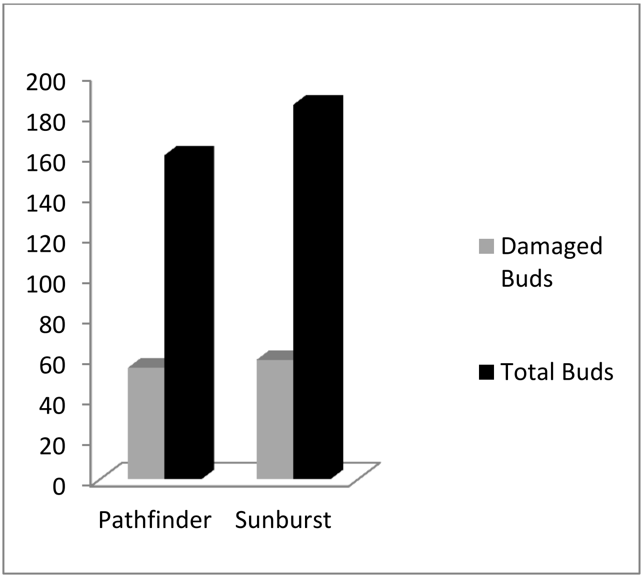

Figure 3 Comparison of total buds and damaged buds caused by B. repartella larvae on Pathfinder and Sunburst cultivars.

Feeding behaviors of the larva were found to occur below ground where the larva feeds on the meristematic tissues of the new rhizome buds in both varieties of switchgrass. There was only one larva found per bud but multiple larvae were found per tiller. The typical presence of a single larva per rhizome with multiple damaged buds suggests that a larva moves from one bud to another.

DISCUSSION

Corn-based ethanol alone cannot reduce the current societal dependency on fossil fuels. For this reason research is focused on determining the advantages of using switchgrass as a biofuel source as well as potential limitations to biofuel yields from this source. We know of no published studies that have looked at how pest relationships may alter the biomass yields. Switchgrass can yield anywhere from ~16 Mg/ha to ~30 Mg/ha depending on factors such as amount of precipitation and type of switchgrass variety being used (McLaughlin et al., 1999). However, the parent project of this one has found decreases in biomass production from between approximately 100-650 kg/ha across six switchgrass cultivars (V. Calles Torrez, personal communication), indicating a potentially serious pest status for the moth larva. This is the first study to examine the prevalence and damage caused by a switchgrass pest feeding on underground portions of the plant. Further research is needed to accurately determine how the larval feeding on underground portions influences potential yields.

Previous research noted that *B. repartella* had a negative impact on the growth of switchgrass tillers (Prasifka et al., 2010). We know that at the larval stage damage caused by feeding causes cessation of tiller growth in switchgrass (Nyoka et al., 2007). A recent study found that upwards of 40% of tillers may be lost due to damage caused by *B. repartella (P. Johnson, personal communication)*. However, little is known about the effects of larval feeding on switchgrass growth below ground.

Because one-third of the potential biomass producing buds was killed by *B. repartella,* there is a significant pest relationship and this requires the finding of new ways to manage the populations of the switchgrass moth. Possible control includes the use of insecticides. However, additional research would be needed to determine impacts of such control on non-target sources.

Because the larvae feed primarily below ground, the effects on switchgrass by the larvae may differ from the older life stages. Normal switchgrass development typically has tip-killed rhizomes not producing root-bearing proaxis from auxiliary buds and tillers at a 90% rate (A. Boe, personal communication). In our study, we observed that larva below ground feed entirely on the meristematic tissue rhizomes, and damaged rhizome meristems showed an increase in auxiliary bud production after the primary tip was killed by the feeding larva. This may suggest that supplementary tillers may be produced every year, which could potentially increase biomass production. Future research needs to be conducted to determine if *B. repartella* may be beneficial to switchgrass by causing it to respond to predation and produce more rhizomes.

Blastobasis repartella appears to be more prevalent in cultivated plots compared to natural settings at this time. It may be possible that the increase of acres of planted switchgrass plots could lead to a subsequent increase in the distribution and populations sizes of *B. repartella*. Research is needed to understand the prevalence and damage caused by *B. repartella* at a larger scale in order to identify whether appropriate management strategies to control this pest are warranted as the use of switchgrass as a source of biofuels increases.

LIMITATIONS

Limitations for this study included a small sampling number due to the exploratory nature of the study. In the future using more samples will provide more accurate numbers for statistical analyses.

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REFERENCES

Adamksi, D., P. J. Johnson, A. A. Boe, J. D. Bradshaw, and A. Pultyniewicz. 2010. Descriptions of life-stages of *Blasotobasis repartella* (Lepidoptera: Gelechioidea: Coleophorida: Blastobasinae) and observations on its biology in switchgrass. Zootaxa 2656: 41-54.

Keshwani, D. R. and J. J. Cheng. 2008. Switchgrass for bioethanol and other value-added applications: a review. Bioresource Technology 100: 1515-1523.

McLaughlin, S., J. Bouton, D. Bransby, B. Conger, W. Ocumpaugh, D. Parrish, C. Taliaferro, K. Vogel, and S. Wullschleger. 1999. Developing switchgrass as a bioenergy crop. In J. Janick (ed.), Proc. 4th New Crops Symposium 9-11 November 1998, Phoenix, AZ. American Society Horticulture Science, Alexandria, VA.

Nyoka B., P. Jeranyama, V. Owens, A. Boe, and M. Moechnig. 2007. Management guide for biomass feedstock production from switchgrass in the Northern Great Plains. Publication SGINC2-07, Brookings, SD: South Dakota State University.

Prasifka, J. R., J. D. Bradshaw, A. A. Boe, D. Lee, D. Adamski, M. E. Gray. 2010. Symptons, distribution, and abundance of the stem-boring caterpillar, *Blastobasis repartella* (Dietz), in switchgrass. Bioenergy Research 3: 238-242.

Prasifka, J. R., J. E. Buhay, T. W. Sappington, E. A. Heaton, J. D. Bradshaw, and M.E. Gray. 2011. Stem-boring caterpillars of switchgrass in the Midwestern United States. Annals of the Entomological Society of America 104: 507-514.

Rinehart, L. 2006. Swithgrass as a bioenergy crop. ATTRA-National Sustainable Agriculture Information Services. Available: www.attra.ncat.org/attra-pub/switchgrass.html Accessed: 30 Sep. 2011

Yuan, J. S., K. H. Tiller, H. Al-Ahmad, N. R. Stewart, and C. N. Stewart Jr. 2008. Plants to power: bioenergy to fuel the future. Trends in Plant Science 13: 421-42