# Flowering Behavior in Prairie Cordgrass and Switchgrass in Response to Variation in Ambient Day Length

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## INTRODUCTION

In warm season grasses, sexual reproductive development is strongly influenced by photoperiod even under optimal temperatures . However, very little is known about the growth and morphological development of prairie cordgrass and switchgrass when forced, by temperature, to break autumn-induced dormancy and be immediately subjected to a set of different ambient photoperiods that are outside the range of those that occur during the average growing season in their natural habitats. Such ambient photoperiods would be decreasing photoperiods from September 21 through December 21 and increasing photoperiods from December 22 up to the time of normal green up, i.e., generally from early April in the Midwest to early May in the northern Great Plains. Several past studies have indicated that floral development in switchgrass does not occur in controlled day lengths < 12 hrs. However, no studies have investigated the effect of ambient decreasing or increasing day lengths, in the range of from about 8.5 hours to 11 hours, on vegetative and reproductive growth in switchgrass and prairie cordgrass. Furthermore, whether or not these putatively non-inductive photoperiods might be useful for synchronizing flowering from initial or subsequent flushes of tillers of genetically diverse populations is unknown.

**Prairie Cordgrass (*Spartina pectinata* Link) (PCG)**, a warm-season native**,** is one of the most promising herbaceous biofuel feedstocks for use on wet marginal land. Its wide geographic range and associated genetic variation, high biomass yield potential, and large root and rhizome systems place it as an important component of landscape-based biodiverse bioenegy crop systems in temperate North America

**Switchgrass (*Panicum virgatum* L.) (SW)** is also a perennial warm-season grass native to North American. It has been extensively researched for bioenergy production since the mid-1980s and is recognized as a model species for cellulosic bioenergy production on dry and relatively unfertile marginal land throughout the eastern 2/3 of the USA.

Both of these two grasses have potential to be the candidates as next generation bioenergy crops for improving marginal land ecologically and economically.

## OBJECTIVE

The objective of this study was to determine the growth and flowering behavior of prairie cordgrass and switchgrass under ambient day lengths outside the range of photoperiods they would normally encounter during the growing season in their natural habitats.

## JUSTIFICATION

Transplanting study under shifting photoperiod condition normally requires synchronized dormancy breaking date. Thus we monitored the number of days that it took for new tillers of each genotype to begin to emerge at 25 ℃ in greenhouse.

| | IL102 | PCG | SW |
|---|---|---|---|
| Days to emerge | 15.3±2.6 | 13.9±2.0 | 17.8±5.7 |

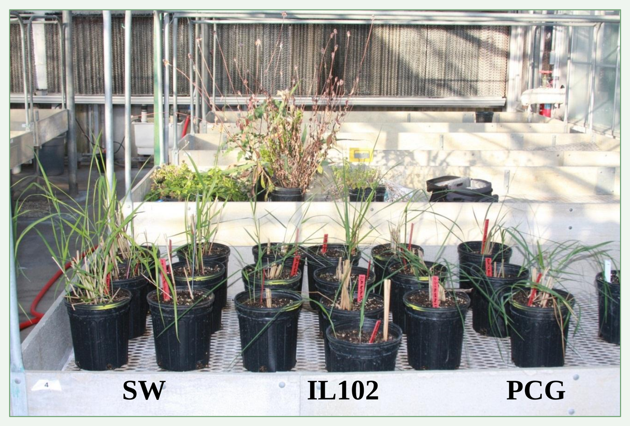
The dormancy breaking days are quite constant within genotypes. Switchgrass spent more days to break dormancy than prairie cordgrass. And as we expected, PCG, a northern genotype of prairie cordgrass, took less time to break dormancy.

## METHODS

From fall of 2011 to spring of 2012, two genotypes of prairie cordgrass (*Spartina pectinata* Link): PCG and IL102, and one upland cultivar of switchgrass (*Panicum virgatum* L.), 'Cave-In-Rock', were transplanted at end of every month from the Energy Farm in Urbana, Illinois and grown in a greenhouse to be evaluated for morphological traits. Tillers were sprouted under 25 ℃ room temperature. Clones from each genotype were compared during vegetative and reproductive growth under ambient light. Two sets of clones transplanted on Oct.26 and Nov.21 were grown under decreasing day length condition while the other three sets of clones, transplanted on Dec.21, Jan.27 and Feb.24 respectively, were placed under increasing day length condition. This experiment was replicated in Brookings, South Dakota.

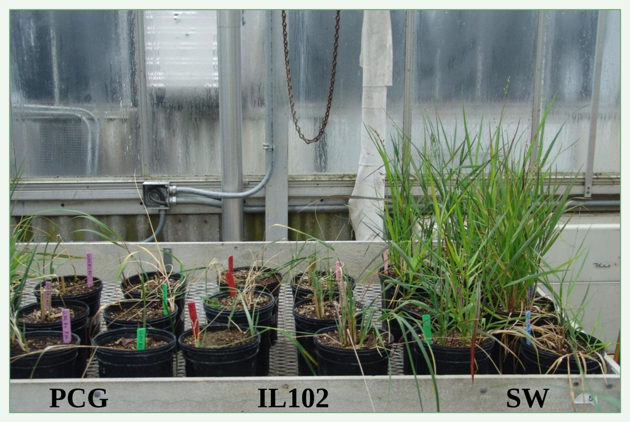
## MATERIALS

Two different plants from each genotypes were transplanted from field and each plant were separated into three clones. A total of 18 clones were evaluated for each transplanting date from Oct.26 to Feb.24.

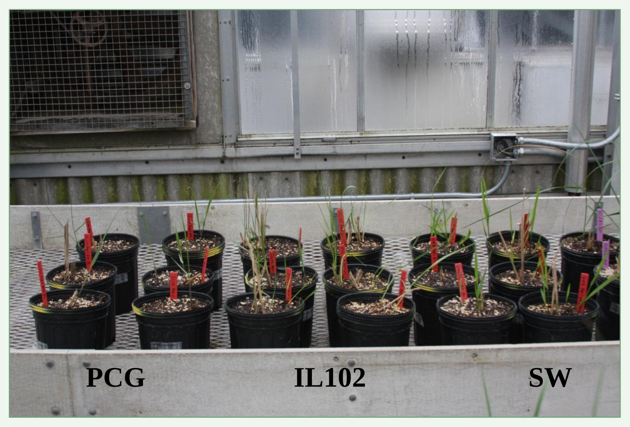



October, 2011 collection

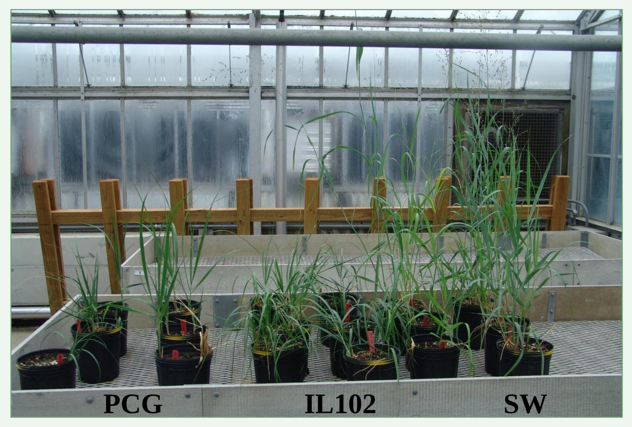

November, 2011 collection




December, 2011 collection




January, 2011 collection

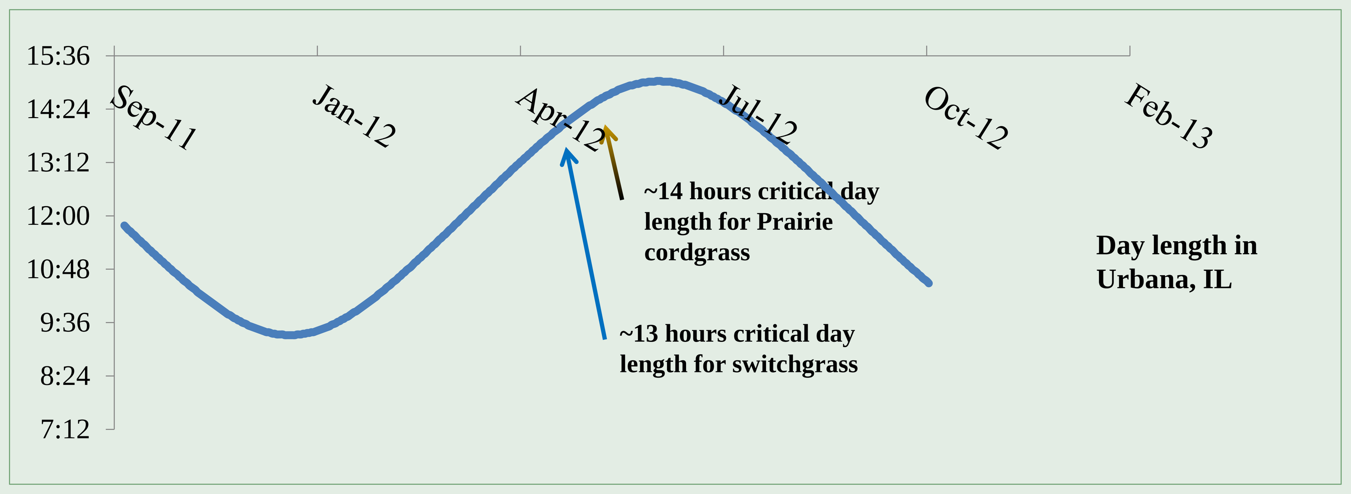


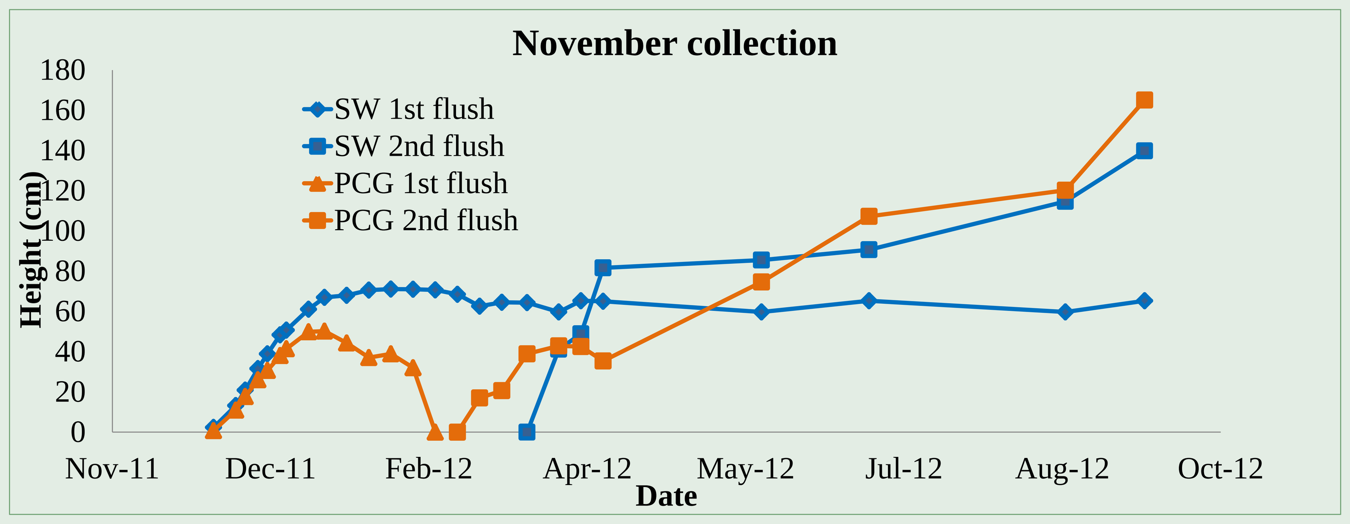

February, 2012 collection

## ANALYSIS

The behavior of plants reactions to shifting day length conditions were record based on visual rating on dormancy symptoms, plant height, panicle number and length, leaf number and flowering date. Comparison among species and between genotypes were performed by using SAS (SAS Institute, Cary, NC).

## Growth rate monitoring



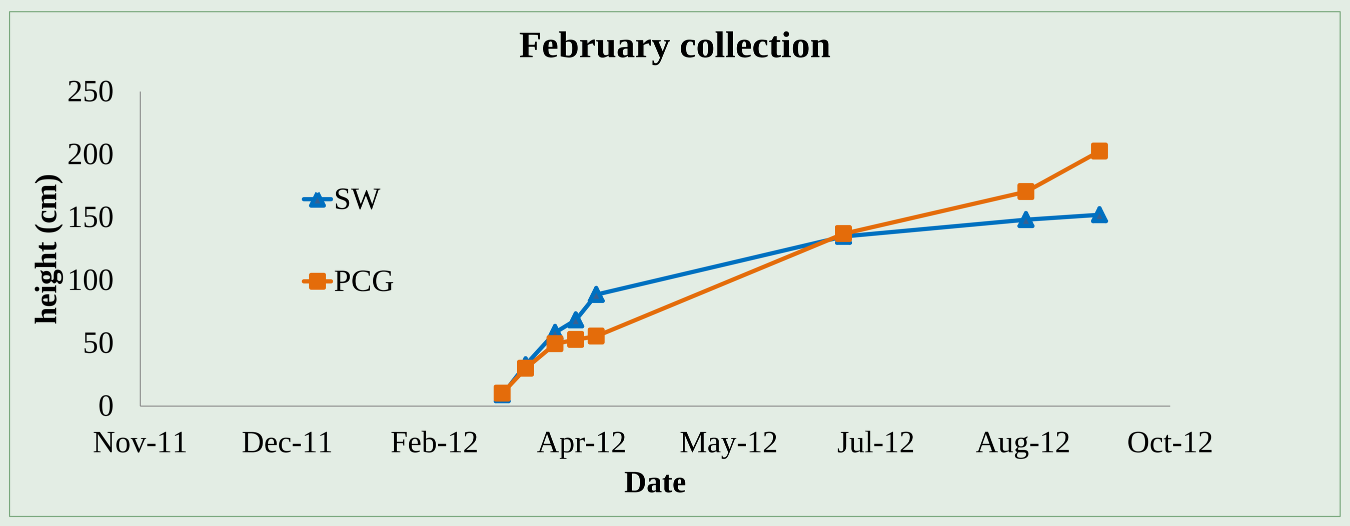
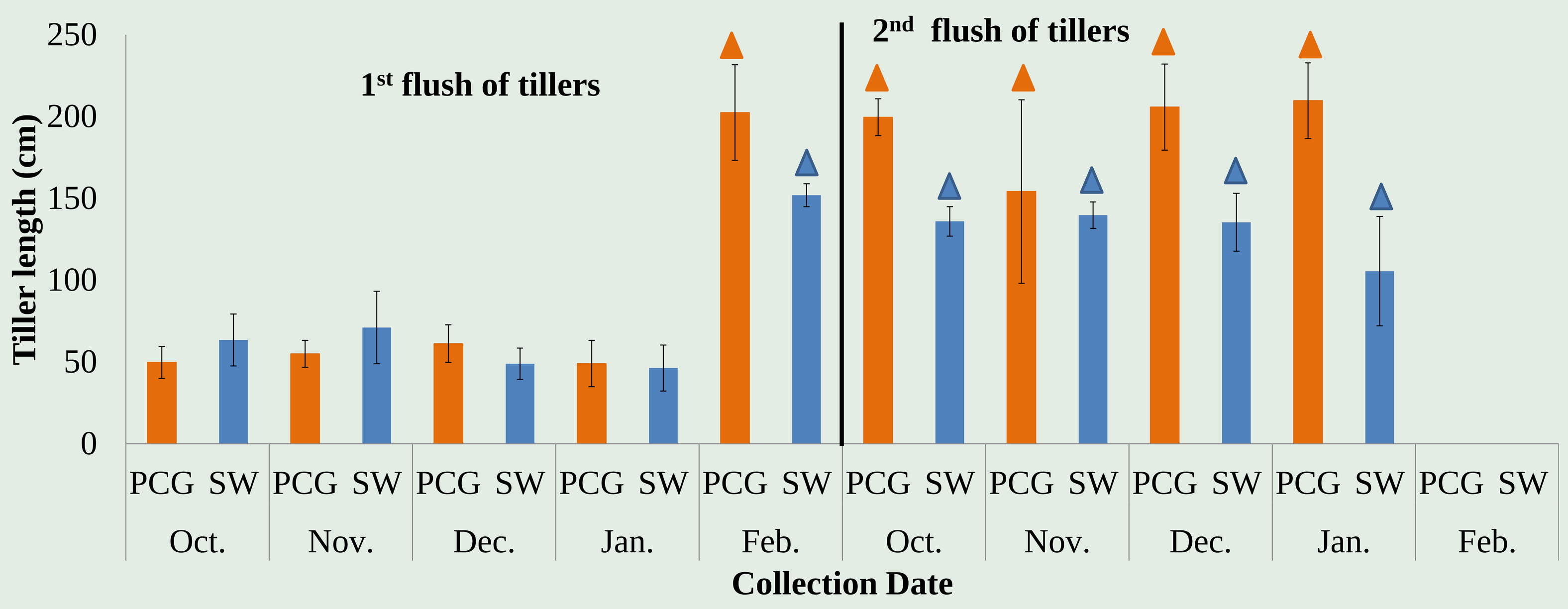




**Figure 1. Day length in Urbana, IL, USNO, W 88 º13´ N40 º06´ (Top), plant growth development of November (Middle) and February (Bottom)collections response to ambient day length during November 2011 though October, 2012.**

## Morphological traits (△:flowered )



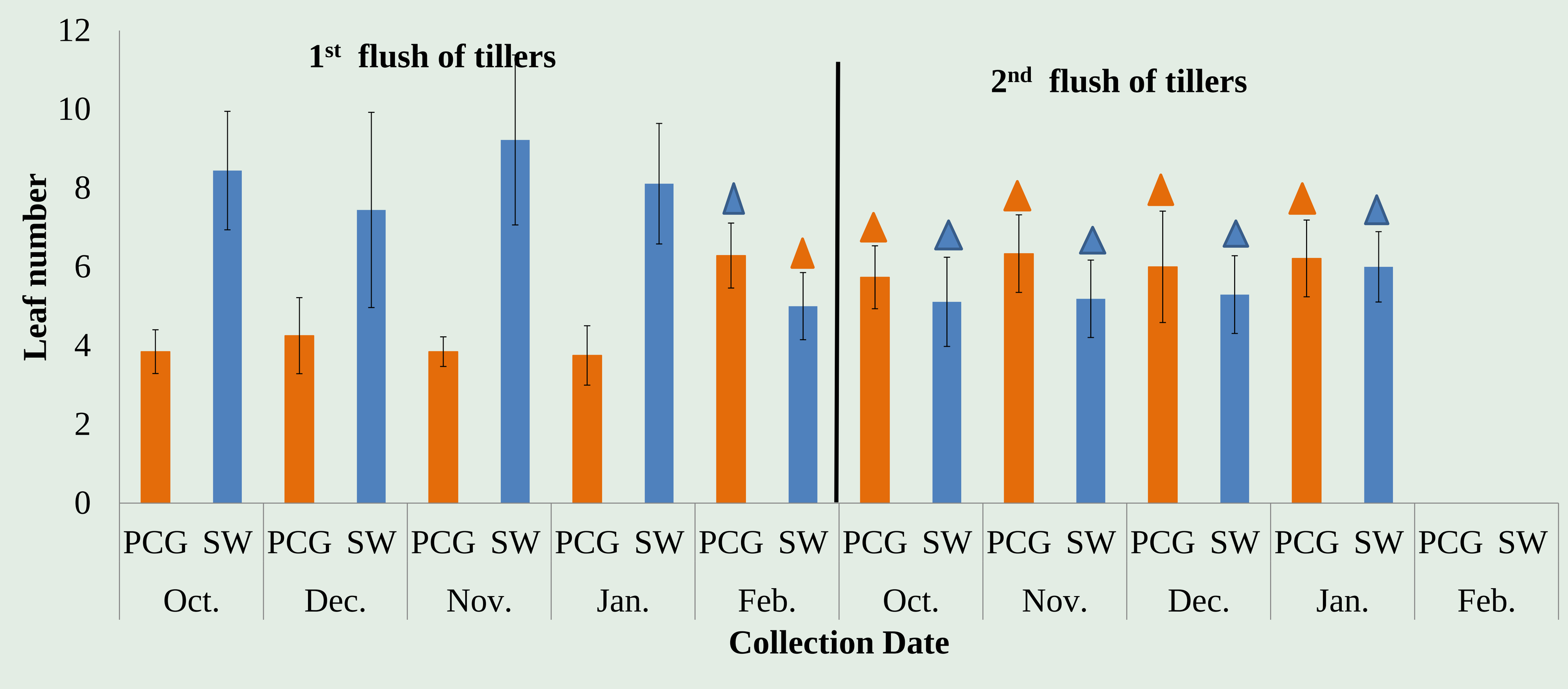




**Figure 2. Variation in morphological traits related to species, date of collections, and tiller generations (1st flush vs 2nd flush tiller)**

**Acknowledgements**
Funded by the Energy Biosciences Institute

## Tiller emerging patterns from rhizome

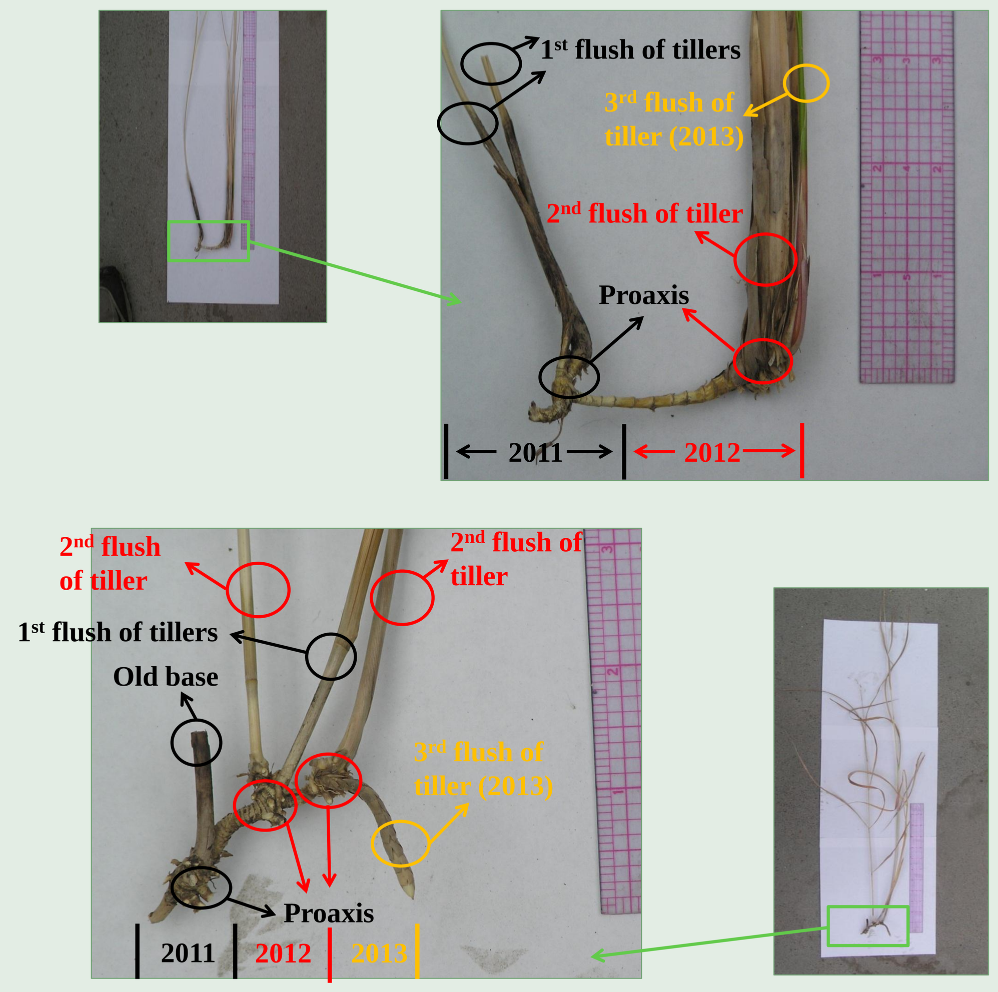



**Figure 3. Tillering system in prairie cordgrass (top) and switchgrass (bottom)**

## Summary

- First flush tillers of both species from Oct. through Jan collections grew poorly, did not produce panicles, and went dormant in both decreasing and increasing photoperiods in which their critical day length requirement was not reached. However, second flush tillers from Oct though Jan collections were vigorous and then produced normal panicles.
- First flush tillers from Feb (IL) and March (SD) were vigorous and produced panicles.
- Two different tiller emergence systems were observed. For switchgrass, tillers in the 2nd flush arose from the proaxis of 1st flush tillers, which emerged from an old tiller; whereas, for cordgrass 1st and 2nd flush tillers emerged from the same proaxis of an old tiller (see hook in Fig. 3 Photo).