

Effects of false smut inoculation on switchgrass phenotypic traits

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Introduction

Switchgrass is a perennial C4 grass native to North America that has been used for grazing, soil conservation, and as a bioenergy crop¹. Switchgrass is affected by several diseases that could impact its industrial development. In 2019, false smut symptoms, caused by *Epicoccum* spp., with a brain-like appearance (Fig. 1) were observed for the first time on the surface of seeds of switchgrass accessions planted in Watkinsville, GA, Tifton, GA, and Knoxville, TN.

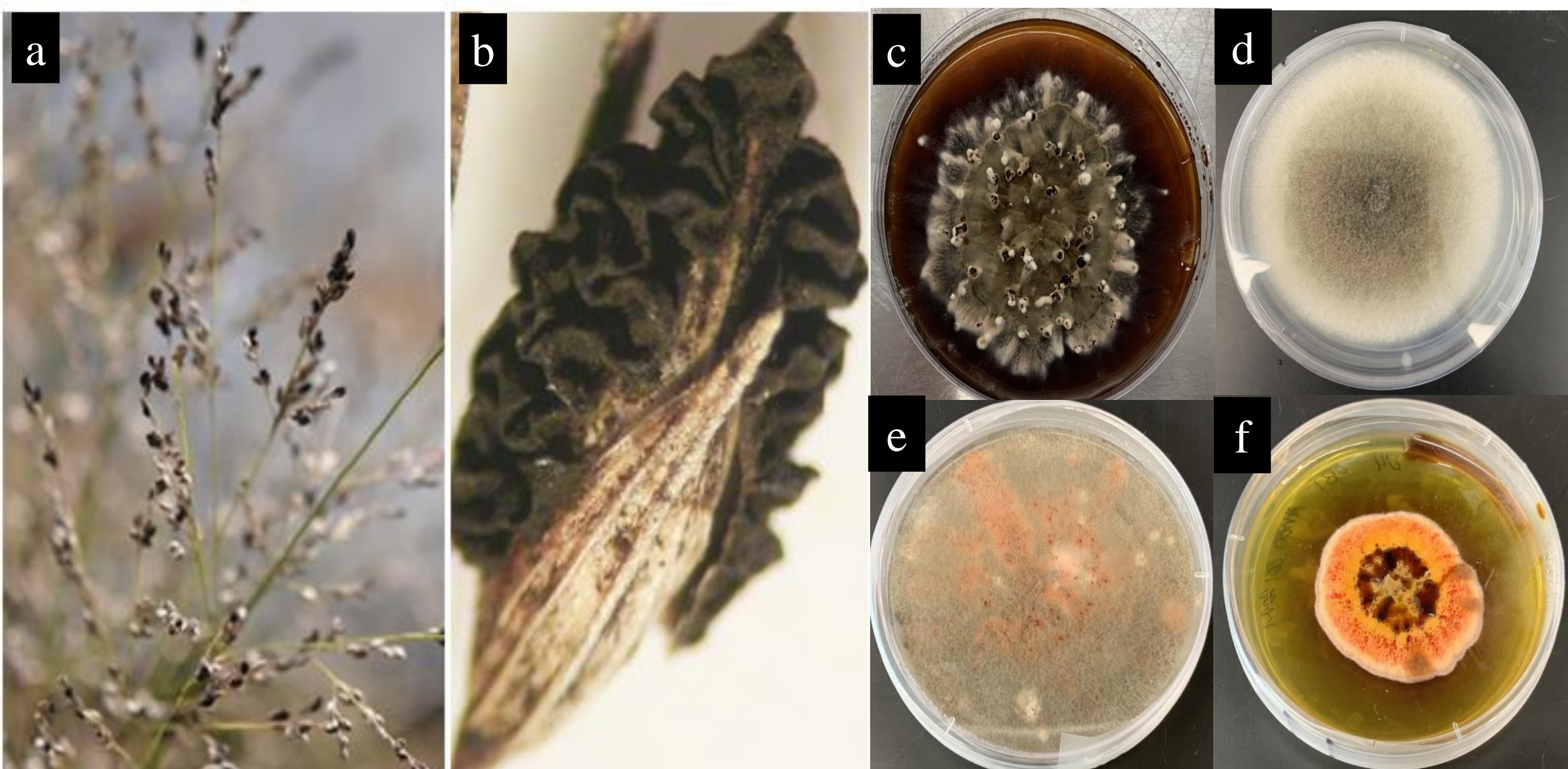


Fig. 1: Symptoms of false smut on switchgrass (a); brain-like appearance in a single seed head (b); 21-days-old cultures of *Epicoccum andropogonis* (c), *E. sorghinum* (d), *E. spegazzinii* (e) and *E. nigrum* (f) on PDA media

Objectives

- ✓ To evaluate the effects of the disease on switchgrass phenotypic traits.
- ✓ To identify *Epicoccum* species associated with false smut symptoms in the field.

Methods

- ✓ Cultivar "Alamo" and "Summer" seeds were inoculated with false smut inoculum sampled from Watkinsville, GA (Field 1 in 2020, Field 2 in 2021).
- ✓ Plant development was followed in the greenhouse for 10 months and assessed for 11 phenotypic traits (Table 1).
- ✓ Germination rate on Petri dish of Summer seeds (50) collected from inoculated and non-inoculated plants was assessed.
- ✓ The *Epicoccum* species associated with false smut symptoms from the 2 fields in Watkinsville GA, as well as for 1 field in Tifton GA, were identified by culturing method, ITS Sanger sequencing and BLAST against NCBI database.

Table 1: Means of the eleven phenotypic traits assessed² for inoculated and non-inoculated cvs. Alamo and Summer. ***: p<0.001; **: p<0.01; *: p<0.05; NS: not significant.

Phenotypic traits	Alamo			Summer		
	Means (No. of observations)	Sig. code	Means (No. of observations)	Sig. code	Means (No. of observations)	Sig. code
Overall tiller height at 10 months (cm)	122 (68)	**	94 (251)	***	75 (295)	*
Number of seeds on main tiller	226 (2)	*	192 (3)	NS	117 (5)	NS
Number of spikelets on main tiller	311 (2)	**	150 (3)	NS	95 (5)	NS
Percentage of flowering tillers per plant (%)	46 (5)	***	18 (16)	*	31 (28)	*
Plant height at flowering (main)	168 (5)	*	172 (13)	NS	150 (14)	NS
Overall tiller height at flowering (cm)	154 (30)	NS	152 (46)	***	121 (91)	***
Biomass production per plant (g)	64 (5)	NS	69 (16)	*	22 (28)	NS

Foot note: Overall panicle length and number of tillers were measure and found to be not significant. Panicle length of main tiller summer 2021 was significant (*). Tiller diameter of alamo (*) and summer (*) 2021 was significant.

The field inoculum significantly impacted the overall plant height of switchgrass cv. Alamo and cv. Summer

Ten-month old inoculated Summer plants were significantly taller than non-inoculated plants in 2020 and 2021 trials (Fig. 2).

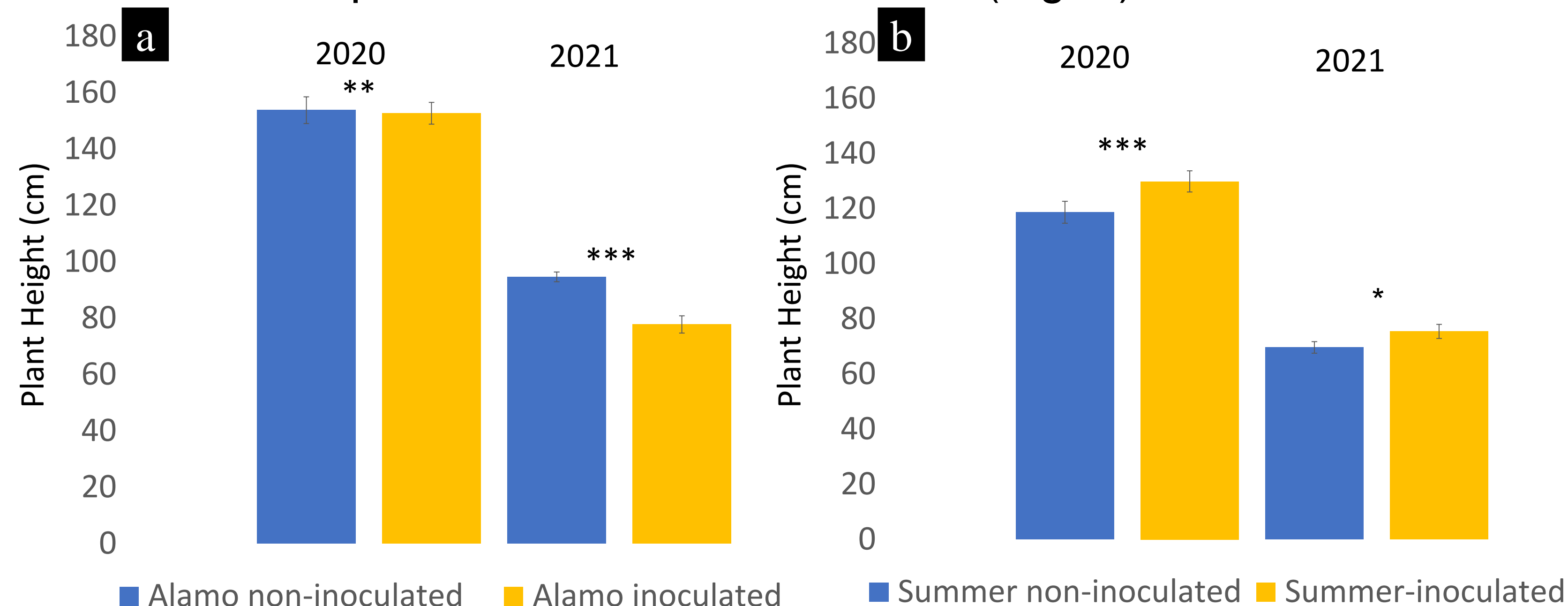


Fig. 2: Average plant height of non-inoculated and inoculated Alamo (a) and Summer plants (b) at 10-months old. Error bars represent Standard Error. Significant codes of ANOVA results : ***: p<0.001; **: p<0.01; *: p<0.05; NS: p not significant

The field inoculum significantly impacted the seed germination rate of switchgrass cv. Summer

Harvested seed from inoculated Summer were observed to have a significantly higher seed germination rate at 5 weeks (P=0.0372) (Fig. 3). Seeds harvested from inoculated and non-inoculated Summer plants germinated 1 weeks after Summer seed stock.

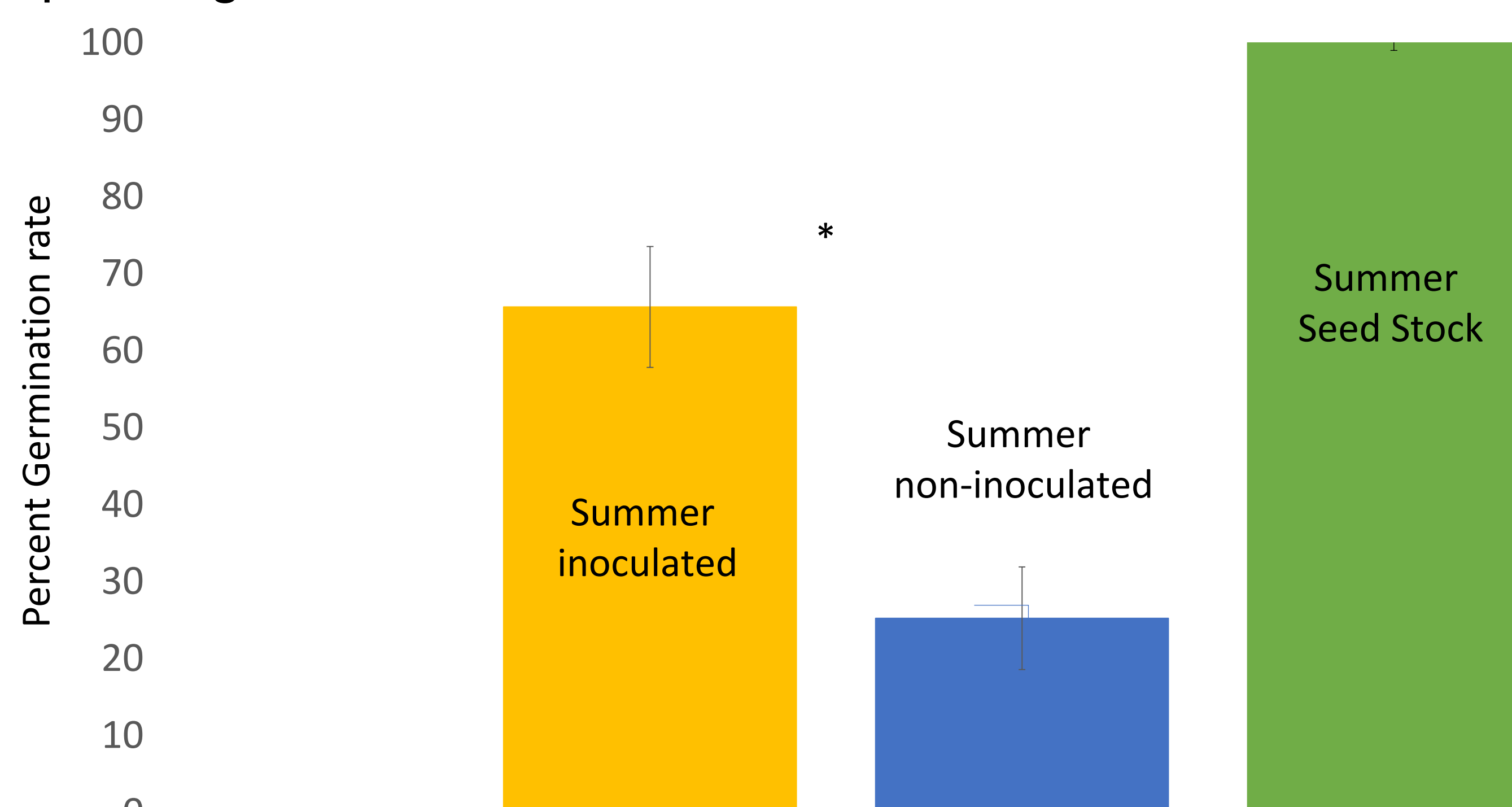


Fig. 3: Germination rate of seeds from inoculated and non-inoculated Summer at 5 weeks. Error bars represent Standard Error. Significant codes of ANOVA results : ***: p<0.001; **: p<0.01; *: p<0.05; NS: p not significant

Epicoccum species complex associated with false smut symptoms varied form field to field

Table 2: *Epicoccum* species identified by plate morphology, TS sanger sequencing and BLAST against NCBI database in switchgrass showing false smut symptoms in Watkinsville GA and Tifton GA fields.

<i>Epicoccum</i> species	Field 1 Watkinsville	Field 2 Watkinsville	Field Tifton
<i>E. andropogonis</i>	✓	✓	-
<i>E. nigrum</i>	✓	✓	✓
<i>E. sorghinum</i>	-	-	✓
<i>E. spegazzinii</i>	-	✓	✓

Summary / Conclusions

- ✓ Overall, false smut infection significantly impacted seed production and overall tiller height in switchgrass
- ✓ *Epicoccum* species composition could have an impact on switchgrass phenotypic traits
- ✓ Additional inoculation experiments with pure cultures of *Epicoccum* spp. are needed to better interpret our results.

Acknowledgement

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References

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