

Conversion of bermudagrass to a switchgrass monoculture or mixed native grasses

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Abstract

Switchgrass (*Panicum virgatum*) is touted for its ability to produce biomass on marginal ground. This biomass is then used as a biofuel feedstock. In the Southern Plains, marginal ground is often in established bermudagrass (*Cynodon dactylon*). In recent years, establishing native grass into areas occupied with bermudagrass has increased in interest because of wildlife benefits, land value and low maintenance cost. Bermudagrass is difficult to control because of its creeping growth habit due to the formation of rhizomes and stolons, and grass herbicide tolerance. For bermudagrass to be converted to switchgrass or native grass, establishment methods need to be developed to suppress or control the bermudagrass, allowing time for switchgrass or native grass to establish. A two-year study was developed to evaluate the effectiveness of 12 treatments on bermudagrass suppression prior to the establishment of switchgrass ('Alamo') or a mixture of little bluestem (*Schizachyrium acoparium* 'Cimarron'), big bluestem (*Andropogon gerardii* 'Kaw'), indiagrass (*Sorghastrum nutans* 'common'), switchgrass ('Alamo') and green sprangletop (*Leptochloa dubia* 'common'). Treatments consisted of six no-till and six conventional tillage planting methods, each with or without a winter cover crop of cereal rye (*Secale cereale* 'Maton II') and summer cover crop of sorghum sudan (*Andropogon bicolor* 'Sweet Sunny Sue'), and combinations of glyphosate and preparation time (7 to 19 months prior to planting) across two locations. The first year of the study began in the fall of 2009, and the planting date for all first-year treatments was April 2011. Stand counts were taken in June 2011, and the first-year harvest date was March 2013. The second year of the study was planted in April 2012. Only data from the first year of the study is presented. Switchgrass and native grass stand counts across both locations that were no-till planted averaged 20% and 11%, respectively. Switchgrass and native grass stand counts across both locations planted with conventional tillage methods averaged 76% and 41% respectively. Results varied by location. On a fine sandy loam soil switchgrass tillage mean treatment yield (8,187 kg ha⁻¹) was greater than no-till treatment (3,166 kg ha⁻¹) $P < 0.05$. Tillage had no effect on switchgrass yields on a loamy, fine sand location. Tillage improved native grass yields at both locations ($P < 0.05$). No single treatment appeared superior to others, but, within the tillage treatments, an 11-month preparation time with two cover crops produced more consistent results. Across both locations, weeds (mostly bermudagrass) composed 29.5% of switchgrass plots and 72.5% of native grass plots. The difference is attributed to the quicker development of switchgrass stands that created a canopy that shaded and suppressed bermudagrass and other weed development. Based on first-year results, establishment methods with tillage are superior to no-till establishment.

Methods

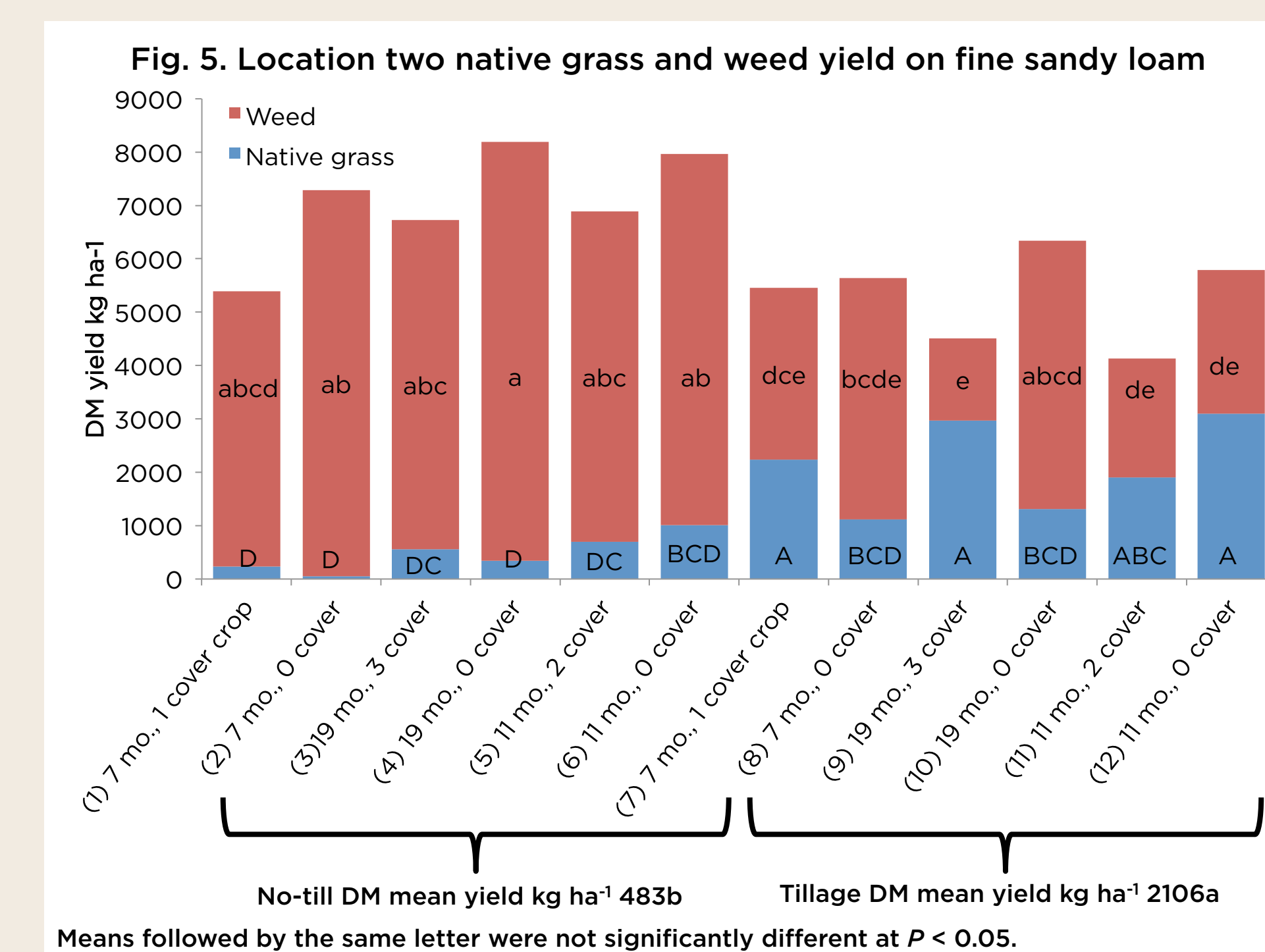
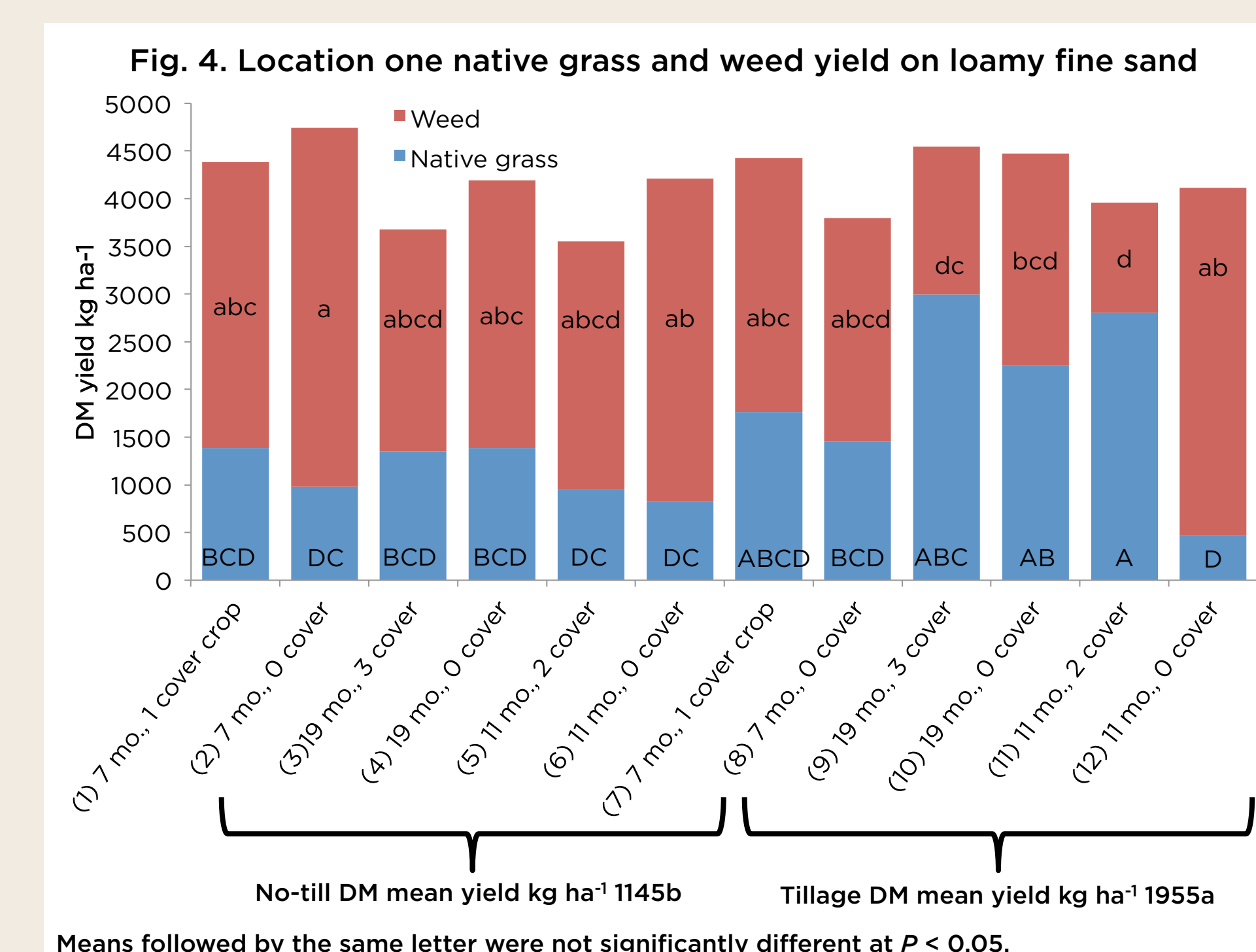
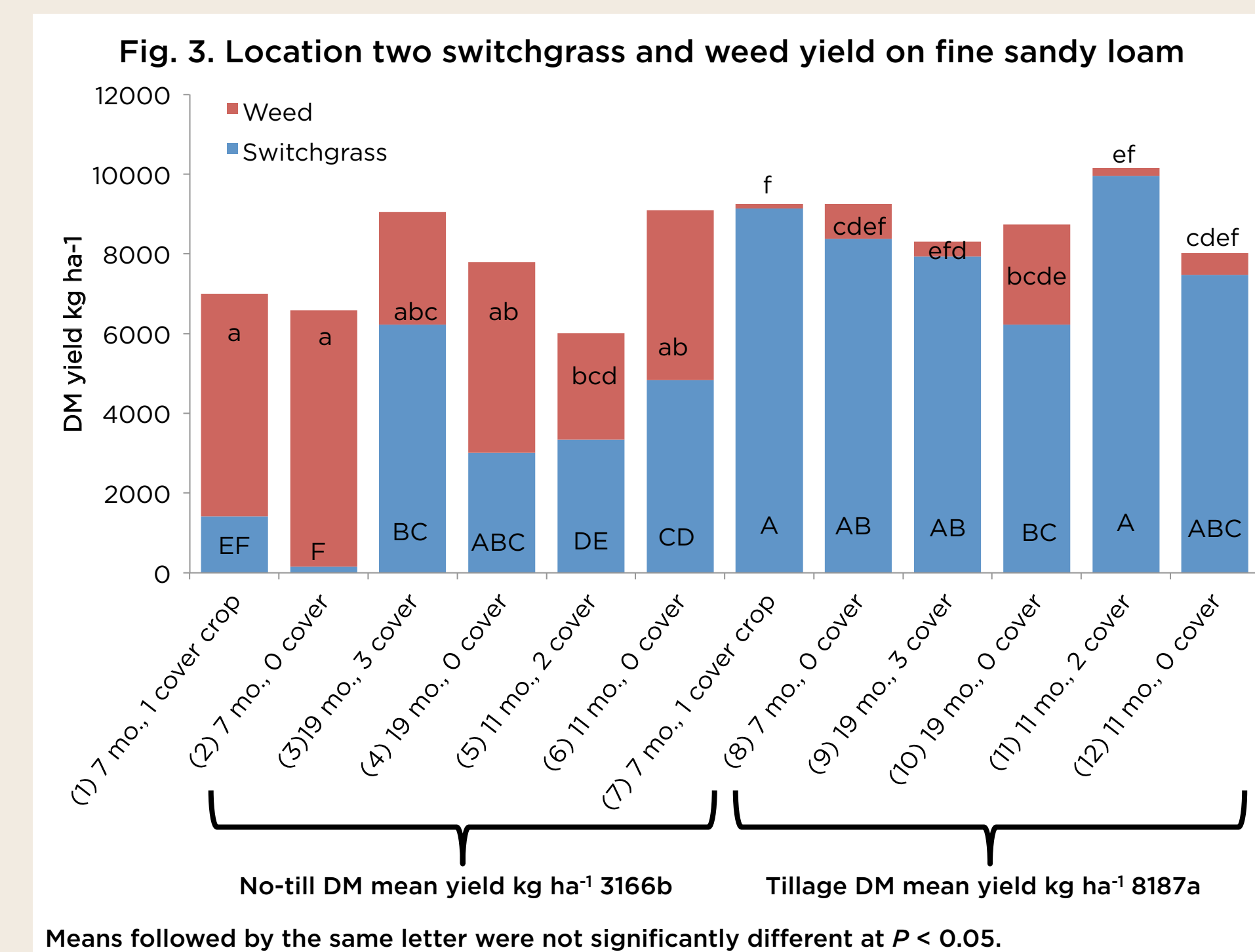
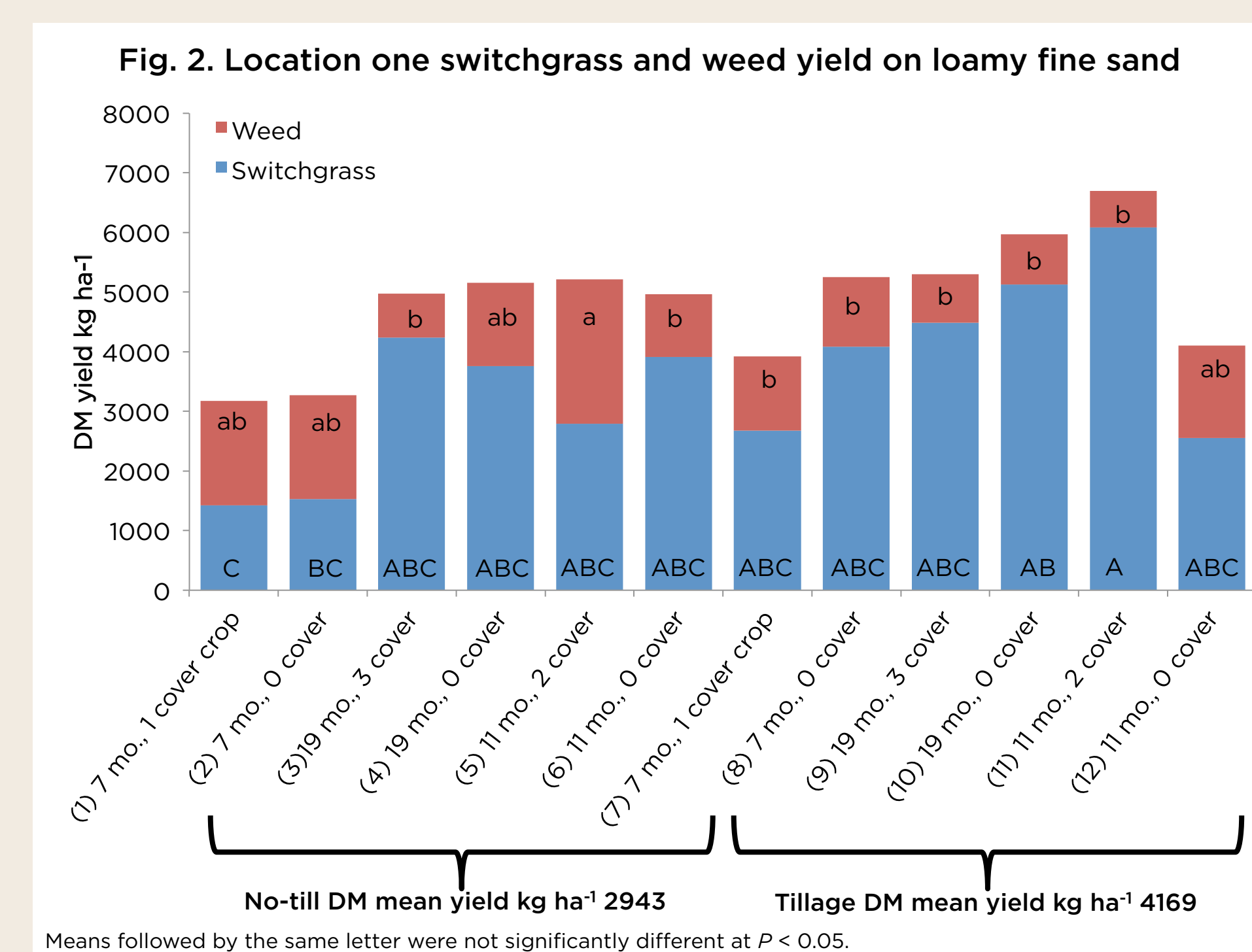
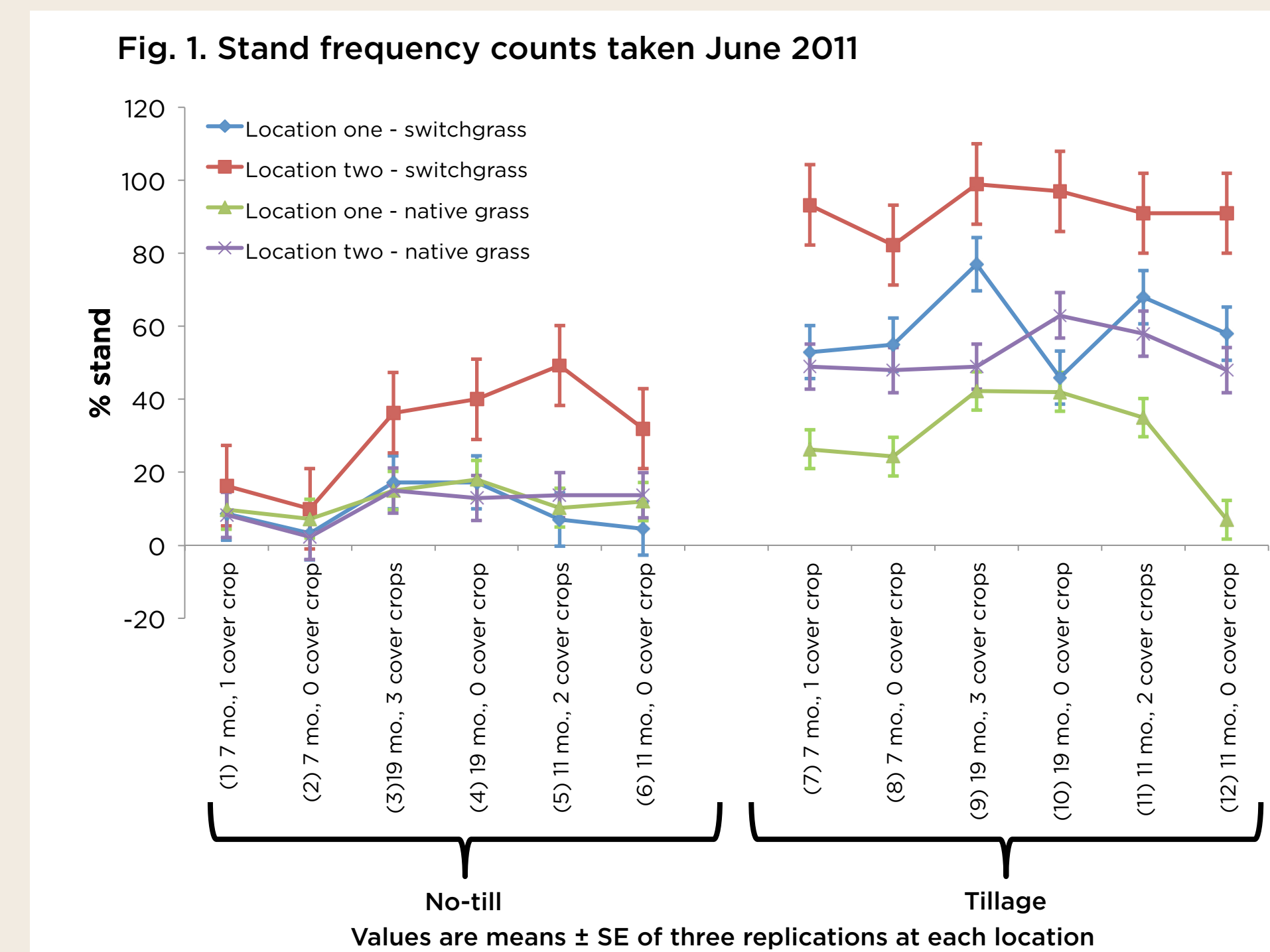
Trt	Preparation time	Treatment start date	Planting date	# Tillage trips	# Cover crops	Total glyphosate L ha ⁻¹	# Glyphosate treatments
1	7 months	September 2010	April 2011	No-till	Cereal rye	13.8	2
2	7 months	September 2010	April 2011	No-till	0	13.8	2
3	19 months	September 2009	April 2011	No-till	Cereal rye/ sorghum sudan/ cereal rye	23.0	4
4	19 months	September 2009	April 2011	No-till	0	13.8	2
5	11 months	May 2010	April 2011	No-till	Sorghum sudan/ cereal rye	18.4	3
6	11 months	May 2010	April 2011	No-till	0	13.8	2
7	7 months	September 2010	April 2011	2	Cereal rye	13.8	2
8	7 months	September 2010	April 2011	2	0	13.8	2
9	19 months	September 2009	April 2011	4	Cereal rye/ sorghum sudan/ cereal rye	23.0	5
10	19 months	September 2009	April 2011	3	0	13.8	3
11	11 months	May 2010	April 2011	3	Sorghum sudan/ cereal rye	18.4	3
12	11 months	May 2010	April 2011	2	0	13.8	2

- Two locations -
 - Carter County, Oklahoma, 34° 17' N, 97° 08' W, loamy fine sand
 - Soil test 0-15 cm, pH - 5.5, P - 16 kg ha⁻¹, K - 180 kg ha⁻¹
 - Love County, Oklahoma, 33° 9' N, 97° 3' W, fine sandy loam
 - Soil test 0-15 cm, pH - 5.6, P - 74 kg ha⁻¹, K - 150 kg ha⁻¹
- Randomized complete block design
- Plot size - 3.7m X 6.1m
- Planting rate -
 - Native grass mix - 11.2 kg ha⁻¹ bulk
 - Switchgrass - 10 kg ha⁻¹ bulk
 - Planting depth - .64-1.3 cm
 - Cereal rye winter cover crop, 112 kg ha⁻¹
 - Planting depth 2.54 cm
 - Sorghum sudan summer cover crop, 31 kg ha⁻¹
 - Planting depth 1.3-2.54 cm
- Glyphosate application procedure -
 - 9.2 L ha⁻¹ first application
 - 4.6 L ha⁻¹ each additional application

Both study locations were in bermudagrass ('common') established in excess of 10 years. Previous management at location one was unknown while location two had been managed for hay production. All treatments began with a 9.2 L ha⁻¹ application of glyphosate. Additional applications of glyphosate were applied prior to planting each cover crop and prior to planting switchgrass or native grass. Cover crops were established either no-till or conventionally according to treatment number. Nitrogen, phosphorus and potassium were applied to cover crops according to soil test levels at rates high enough that deficiencies of those elements would be unlikely to limit yield. For location one, this was usually 70-70-70 kg ha⁻¹ for both winter and summer cover crops, while at location two, 70-0-0 kg ha⁻¹ would be used for both winter and summer cover crops. Cover crops were harvested, and yield and nutritive values were determined (data not presented). Tillage was done using a tractor-powered rototiller followed by cultipacking and seeding. Conventionally established cover crops were planted with a Hege 500 plot drill while no-till cover crops were planted using a Hege 1000 plot drill. Switchgrass and native grass plots were established using a Great Plains 705 drill. All drills were calibrated prior to use. Weed control was not required in the cover crops. In switchgrass and native grass plots, broadleaf weeds were controlled using 2.3 L ha⁻¹ of 2,4-D applied as needed, but after switchgrass and native grass had reached a three-to four-leaf stage.

All switchgrass and native grass plots were planted on a common date in April 2011. All switchgrass and native grass plots planted following a cover crop were planted behind cereal rye. Stand counts were taken using the grid method (a grid of 25 cells of 0.15 cm² each) frequency frame dropped four times within each plot (Vogel and Masters, 2001). Plots were harvested in March 2013 with a

0.25-m² frame dropped four times within each plot for a total of 1-m² harvest area. Harvest samples were hand-separated by component, then air-dried at 60° C to constant weight for dry matter and forage mass determination.



Summary

- Switchgrass stand counts established with tillage (Fig. 1) were greater than 40%. One no-till treatment (5) was greater than 40%. A 40% stand has been established as a threshold for good stand establishment (Schmar et al., 2006). Native grass stand counts reached 40% only at location two and only for the tillage treatments.
- Cover crops and preparation time had no effect on switchgrass or native grass yields (Figures 2-5).
- Weed (mostly bermudagrass) suppression was greater in switchgrass plots.
- Preparing a seedbed with tillage improved stand counts and yield of switchgrass and bermudagrass.
- Additional research is needed to improve no-till establishment of switchgrass and native grass.