Population-source characteristics affect trade-offs between establishment & invasiveness in switchgrass

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Overview

• Context:
  – Sourcing restoration materials, trade-offs
  – Switchgrass (*P. virgatum*) & population-source characteristics

• Experiment & results

• Implications
Terms

- **Strain** (of switchgrass) – “variety” in general sense
- **Restoration (plant) materials** – seeds, vegetative propagules, plants used in restoration projects
- **Breeding history** – manipulative breeding, modify mean value(s) of trait(s)
- **Source (ancestral) population** – natural or wild population(s) from which a switchgrass strain was derived
- **Cultivar** – extensive pre-release testing (stability of trait values), often result of manipulative breeding
- **Ecotype** – pre-release testing not done; explicitly not product of manipulative breeding, assumed very similar to source population
Sourcing Restoration Materials

• Negotiate trade-offs
  – Establish too well...not well enough
  – Adapted to initial conditions...evolutionary potential

• Guidelines
  – E.g., non-bred, “adequate” genetic variation
  – Contradictions reflect complexity, site-specificity

• Availability
  – Constraints on producers
  – Fluctuating demand
Sourcing Restoration Materials

• Result: practitioners rely on
  – Sound practices by producers, distributors
  – Broad category of “genetic origin”
    • Product of manipulative breeding (cultivar, ecotype)
    • # of source populations

What, if any, impact does “genetic origin” (population-source characteristics) have on restored communities?
Switchgrass (*P. virgatum*)

- Native, warm-season (C4) grass, subdominant in tallgrass prairies, wide range of soil textures, moistures
- Outcrosses; seeds & rhizomes
- Upland, lowland ‘types’
- 20+ cultivars released (many as forage)
- Biofuel feedstock
Experiment

What if any impact do population-source characteristics* have on restored communities?
*history of breeding (cultivar, ecotype)
*# of source populations (single, multiple)

Hypotheses: in establishing prairie communities,
(a) cultivars > ecotypes
(b) cultivars: (-) impact on diversity
(c) across sites on average, multiple-source strains > single-source
• 11 switchgrass strains
  – All commercially available
  – 6 ecotypes, 5 cultivars (Cave-In-Rock, Dacotah, Forestburg, Summer, Sunburst)
• May-Jun 2010, agricultural fields
• 6 plots/strain/site (198 total), 1m²
• Community seed mix
  – Grass mix: Big bluestem, indiangrass, little bluestem, sideoats grama, Canada wildrye; broadcast; 10 lbs PLS/ac (~ 1.1 g / plot)
  – Switchgrass: 5% mix, by PLS wt, ½ lb/ac (~ 0.06 g / plot)
  – Forb mix (24 spp): 1:4 forb:grass mix (2.5 lbs/ac, ~ 0.28 g / plot)
1. Breeding history affects switchgrass abundance

Ecotypes on average have 1.4 fewer plants / m^2 than cultivars, when site-site variation accounted for.

(mixed-effects model of sqrt.-transformed count data, breeding history as fixed effect, site as random effect, F on 1, 194 d.f. = 20.418, p<0.001).
2. Species richness not affected by breeding history, no. of source populations, or switchgrass strain

(site variation accounted for; mixed-effects model of spp. richness, breeding history & no. of source-populations or strain as fixed effects, site as random effect)
3. Multiple source-popn. strains had the same abundance and %-cover as strains from single source populations.

(linear regression of sqrt-transformed count data pooled across sites on no. of source pops.; of cover-class midpoints pooled across sites on no. of source pops).
Findings

• As group, cultivars established better than ecotypes; by end of 3rd growing season cultivars more abundant than ecotypes.

• Cultivars do not appear to have a (-) impact on diversity – cultivar & ecotype plots had same species richness.

• Multi-source strains did not do better across sites than single-source strains
Implications

Switchgrass establishment and/or abundance important:
- At low seeding densities, over short time-spans, cultivars are more likely than ecotypes to establish
- No evidence from this experiment that cultivars negatively impact species diversity.

“Breadth of genetic background”
- Does not appear to affect establishment or impact species diversity
- However, it might affect longer-term persistence

Caveats: low density, 3 years, switchgrass abundance data. Biomass may tell a different story.
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• Std dev. of intercept, \( fm4<-lme(switch12\sim breed, data=cover, random=\sim 1|site) \sim 2.6 \) plants

• St devs for breeding hist within site:
  (morris, c,e; stpaul, c,e; waseca, c,e)

0.345745904
0.424451093
4.04699406
2.347575582
1.748562628
1.155731061