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Mixed species seeding: A means to increase production in temperate pastures

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Introduction

Seeding mixed species for forage production has been suggested as a means of increasing productivity and stabilizing yields under a changing climate. Forages have traditionally been sown as monocultures or binary mixtures only, with the emphasis being on species and not necessarily their function or compatibility. While natural plant communities typically may be dominated by a single species, they are comprised of several species and functional groups.

This paper provides the results of sowing multiple species at semiarid sites within the North American Great Plains and identifies a similar result from a more humid region reported within the literature.

Materials and Methods

At the semi-arid site located at the Semiarid Prairie Agricultural Research Centre of Agriculture and Agri-Food Canada (Swift Current, Saskatchewan, Canada), 4 perennial species, representing 2 functional groups were sown. These were comprised of the legumes, alfalfa (*Medicago sativa* L.) and purple prairie clover (*Dalea purpurea* Vent.), and the C₃ grasses, western wheatgrass (*Pascopyrum smithii* (Rydb.) Barkworth & D.R. Dewey) and green needle grass (*Nasella viridula* (Trin.) Barkworth). Plots (2 m by 10 m) were sown at a rate of 100 live seeds/m, with a 30 cm row separation, and the trial design was a fully factorial randomized complete block with 4 replicates. All species combinations were represented. Analysis of variance was conducted using a mixed model approach.

Results

At the semi-arid site, inclusion of two legumes resulted in increases of both forage DM yield and crude protein (Table 1). Combinations of grass and legume functional groups out-yielded monocultures of either legumes or grasses. Alfalfa was the highest yielding forage in all combinations for both sites (data not shown). The combination of species within the functional groups can be important in providing the increase in productivity (Schellenberg and Banerjee 2002), and maintaining nutritional value throughout the grazing season (Schellenberg *et al.* 2012).

Discussion

The noted benefits for polycultures and higher yielding

Table 1. Forage dry matter (DM) yield (kg/ha) and nutritive value (g/kg DM) for different functional groups at Swift Current, SK, Canada.

Functional group	DM yield	ADF ^z	NDF	CP
2 legumes	5891 a ^y	438 a	525d e	108 ab
2 legumes + 2 grasses	5602 a	431 ab	569 cd	99 bc
2 legumes + 1 grass	5401 a	422 ab	561 cd	98 b
1 legume + 1 grass	4439 b	398 bc	595 bc	87 cd
1 legume + 2 grasses	3930 b	394 bc	595 bc	83 d
1 legume	3648 b	382 c	475 e	116 a
2 grasses	2412 c	370 c	635 ab	66 e
1 grass	2148 c	384 c	669 a	56 e
<i>P</i>	<0.0001	0.0094	<0.0001	<0.0001
SEM ^x	533	26	33	13

^zADF, acid detergent fiber; NDF, Neutral detergent fiber; CP, Crude protein; ^yMeans within a column with the same lower case letter are not significantly different ($P>0.05$); ^xStandard error of the means.

from well adapted species found within a semiarid environment are not confined to this type of environment. At Ames, Iowa, a humid environment in which 8 perennial species from 4 functional groups were sown: Legumes consisted of alfalfa, white clover (*Trifolium repens* L.) and Illinois bundle flower (*Desmanthus illinoensis* (Michx.) MacM. Ex B.L. Robins. and Fern). C₃ grasses comprised orchardgrass (*Dactylis glomerata* L.) and intermediate grass (*Thinopyrum intermedium* (Host) Barkworth and D.R. Dewey). C₄ grasses consisted of switchgrass (*Panicum virgatum* L.) and eastern gamagrass (*Tripsacum dactyloides* (L.) L. The Compositae forb, Maximilian sunflower (*Helianthus maximiliani* Schrad.), was also included (Picasso *et al.* 2008). Polycultures out yielded on average by 73%, but well-adapted species produced high amounts of biomass (Picasso *et al.* 2008). Complementarity increased as species richness increased and was consistent over years (Picasso *et al.* 2011).

Conclusion

Increasing diversity in species and functional groups increased productivity under both semi-arid and humid environments. The key for increased productivity in mixed species seeding is complementarity between the sown components.

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