2001

Small grain and annual forage legume intercrops for Iowa

Charlie W. Brummer
Iowa State University

James Holland
United States Department of Agriculture

Follow this and additional works at: http://lib.dr.iastate.edu/leopold_grantreports

Part of the Agricultural Science Commons, Agriculture Commons, and the Agronomy and Crop Sciences Commons

Recommended Citation
Brummer, Charlie W. and Holland, James, "Small grain and annual forage legume intercrops for Iowa" (2001). Leopold Center Completed Grant Reports. 162.
http://lib.dr.iastate.edu/leopold_grantreports/162

This Article is brought to you for free and open access by the Leopold Center for Sustainable Agriculture at Iowa State University Digital Repository. It has been accepted for inclusion in Leopold Center Completed Grant Reports by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
Small grain and annual forage legume intercrops for Iowa

Abstract
Current cropping practices in Iowa have reduced diversity in crop production to predominantly corn and soybean. Low prices, weed and pest control problems, and erosion have plagued these monoculture crop systems. Small grains and forages represent potentially viable alternative crops to corn and soybean in Iowa. Producers could opt for an annual intercrop that provides grain and forage without taking land out of corn and soybean for more than one year. This project tested the possibilities for combining small grains with a forage crop for a one-year intercrop.

Keywords
Agronomy, Corn-soybean cropping systems, Animal management and forage

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

This article is available at Iowa State University Digital Repository: http://lib.dr.iastate.edu/leopold_grantreports/162
Small grain and annual forage legume intercrops for Iowa

Abstract: Current cropping practices in Iowa have reduced diversity in crop production to predominantly corn and soybean. Low prices, weed and pest control problems, and erosion have plagued these monoculture crop systems. Small grains and forages represent potentially viable alternative crops to corn and soybean in Iowa. Producers could opt for an annual intercrop that provides grain and forage without taking land out of corn and soybean for more than one year. This project tested the possibilities for combining small grains with a forage crop for a one-year intercrop.

Background

Breeding programs must account for variation in intercropping ability during the cultivar development program because breeding a species in isolation may not correctly foretell its performance when cultivated in an intercrop situation. Variety or species recommendations need to take into account the differences in performance under monoculture and intercrop growing systems.

The interaction of cultivars or species in intercrop systems can be evaluated in terms of general ecological combining ability (GECA) or specific ecological combining ability (SECA). GECA defines the performance of a species or cultivar over a range of companion crops. SECA refers to particular combinations of species or cultivars and indicates that intercrop performance is dependent upon the specific cultivars/species being tested. Statistical methodology is available to analyze these cropping mixture experiments.

In prior work, the project investigators developed three terms to clarify performance of a cultivar or species in an intercrop, defining it as general intercrop ability (GIA), which can be divided into general monoculture ability (GMA) and the general intercrop response (GIR). GIR represents cultivar differences observed in intercrops that are not accounted for by differences in monocultures. Thus, GIR differences among cultivars of the same species or functional group would indicate that intercropping performances cannot be predicted from monoculture evaluations. These tools were used in the project for selection, evaluation, and variety recommendations.

Project objectives were to determine the:

• Potential agronomic values of several small-grain-annual forage legume intercrops for Iowa farmers, and
• Relative importance of GMA, GIA, and GIR effects among these small grain-annual forage intercrops.

Approach and methods

Five small grain cultivars (three oat with varying maturity dates and two barley) and five forage species/cultivars, plus an alfalfa variety entered as a check crop, were included in the monocrop and binary intercrop experiments that were conducted at the ISU research farms near Ames (1997 and 1998) and Nashua (1997).

Due to maturity differences among the cultivars, an early group of entries and a late group of entries were defined and harvested at the appropriate time, roughly 7 to 10 days apart.
All plots were harvested at least three times. Early forage plots in Ames (1997) were harvested four times. Total forage yields were summarized over all harvest periods. Total crop biomass included all forage yields together with small grain forage, grain, and/or straw where appropriate.

Results and discussion

Monoculture performance (GMA)
Among small grains: The later maturing cultivars were superior in total biomass under both management schemes. These cultivars produced more cereal forage, grain, and straw than the early oat and the two barley cultivars. Among forages: Cherokee red clover, Mecca II alfalfa, and Bigbee berseem clover performed better than the annual medic species under both management systems. In addition to their higher yields, these forages also limited weed yields to a greater extent. A major reason for the poor production from the medics was limited regrowth after the first cut. The early harvest treatment permitted some regrowth, but as a whole, their late season production was low. Berseem clover performance might have been understated, as its regrowth may have been depressed by the cutting height, which though standard for alfalfa and clover may be too low for berseem. The perennial, non-dormant cultivars proved most successful across environments.

Intercrop performance (GIA effects)
Among small grains: When grown in intercrops, late-maturing small grain cultivars tended to have higher total biomass and to suppress forage legume yields more than the other cultivars. Later maturing grains had higher cereal legume, grain, and straw yields. Overall, when considering both early and late maturing cultivars, adding forage legumes to small grains increased total biomass, depressed weeds, and had no effect on grain, straw, or cereal forage yields.

Among forages: Red clover, alfalfa, and to a lesser degree, berseem clover outperformed the annual medics in intercrops. The forages had little effect on grain or straw yields. Cherokee red clover tended to have the least effect on oat component traits while simultaneously being least affected in terms of yield depression by the oat companion crop. On average, adding small grains to forage legumes increased total biomass, but decreased the contribution of forage yield. Weed yields were reduced by the presence of small grains.

Differences in performance between monoculture and intercrop (GIR effects)
Among small grains: Overall, few differences were seen among cultivars for GIR; that is, for the small grain cultivars tested here, differential performance under intercrops and monoculture was not evident.

Among forages: Unlike small grains, GIR effects were pronounced among the forages tested. Much of the difference among species can be explained by Cherokee red clover. Total biomass increased substantially under intercropping with Cherokee red clover. Cherokee yields were not reduced substantially by adding small grain in a grain management treatment, unlike all the other species, but its yield was reduced (though not as much as other species) under forage management.

Significant small grain by forage legume SECA effects were noted for weeds under the forage harvest treatment and for biomass, legume forage, and straw under the grain harvest treatment. These results indicate that performance of particular grain-forage combinations cannot be predicted based on GIA.
Conclusions

Late-maturing oat cultivars produced more grain, straw, cereal forage, and total biomass than earlier-maturing cultivars of oat or barley, but forage yields were decreased. Small grains tended to perform similarly under monoculture and intercropping; i.e., small or insignificant GIR effects were observed.

Forage species differed markedly in terms of forage and biomass production. Perennial and nondormant cultivars of red clover and alfalfa, and berseem clover, were superior to two annual medics, mainly due to lack of appreciable regrowth of the latter. Cherokee red clover was both least affected by intercropping and affected its companion crop the least. Weeds were suppressed by intercropping relative to either small grain or forage monocultures.

Impact of results

Based on the results of this study, mixing Ogle oats with Cherokee red clover provides the highest yields and is least likely to perform poorly compared with all other cropping combinations considered. The combination proved to be the most successful under both management systems—when small grains were harvested for forage or for grain. Both the Mecca II alfalfa and Bigbee berseem clover also performed well in at least some experiments, and may represent viable alternatives. However, potato leafhopper feeding depressed alfalfa yields at some harvests, and berseem clover can perform very poorly in some environments. The combination of forage and small grain resulted in nearly complete weed control and allowed successful forage establishment. Small grain companion crops should be recommended for forage establishment.

For more information contact Charles Brummer, Agronomy, Iowa State University, Ames, Iowa 50011; (515) 294-1415, e-mail brummer@iastate.edu