

Pasture Seeding Mixes: the More, the Merrier?

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December, 1999

A perennial question among grass farmers is what to seed in our pastures. What is the value of planting a complex mixture of species as opposed to growing one or two tried-and-true grasses and legumes? Having started my career as a botanist, I've always been intrigued by this question from an ecological perspective. In agriculture, we usually don't think about how plant species behave within communities or even how they interact with their physical setting. In fact, much of what we do in crop husbandry involves attempts to simplify plant communities by eliminating or controlling weeds. In contrast, a pasture is a diverse plant community by nature, and ecological principles can provide some valuable insights for grass farmers.

Ecologists define complexity in terms of both individual species and 'functional groups.' The concept of combining two functional groups such as grasses and legumes is basic to pasture management. Because they occupy different 'niches' in the plant community, functional groups use and contribute resources in different ways. These groups can complement or enhance each other's performance. A third functional group, broadleaves or 'forbs', usually occurs in pastures in the form of weeds, although chicory is one valuable example of that group.

Within each of these functional groups are many species, each of which has a set of unique qualities that make it valuable for certain settings or management systems. By planting a complex mixture of species, we're more likely to create settings in which well adapted plant communities develop. Well adapted communities can respond spatially to microclimate and soil variations within the field as well as seasonally to changing climatic conditions. This can potentially result in greater productivity. That's the theory. But what is the reality?

A study recently begun by Jim Gerrish of the Forage Systems Research Center of the University of Missouri may help answer these questions (<http://aes.missouri.edu/fsrc/research>). Jim's study looks at a range of mixtures from pure stands of tall fescue or smooth brome to complex mixtures of five grass species and three legumes. Other grasses include timothy, orchardgrass, and big bluestem. Legumes include alfalfa, birdsfoot trefoil, and red clover.

After the first season of grazing, Jim found no real advantage to complex mixtures, either in terms of greater yield or improved seasonal distribution of yield. Indeed, for many of the mixtures, a large proportion of these young swards was made up of foxtail, crabgrass, and other weeds. This reinforces the importance of time in pasture community dynamics. Over time, either our seeded species or volunteers will fill in these empty 'niches'. The question is: what will fill in and is it something that we want? In Jim's Missouri climate, there may be a warm season grass niche, currently being filled by summer annual weedy grasses. Eventually he may find that big bluestem, a warm season perennial grass, will fill that niche as the pasture community stabilizes over time.

Pasture diversity can be important from a spatial perspective as well. Most pastures are not uniform and the value of complex mixtures becomes more important in settings where slope, aspect (e.g. north-facing vs. south-facing), soil type, and other factors result in diverse conditions within a single field.

A long-term study conducted by Ann Clark at the University of Guelph in Ontario (E. Ann Clark, 1999, *Weed Control with Complex Pasture Mixtures*, also see *Agri-View*, 10/28/99, *More Complex Mix for Pasture Profit*). Ann's study compares two complex mixtures across a 50-acre pasture. One mixture contains only grasses:

smooth brome, meadow brome, timothy, orchardgrass, meadow foxtail, and Kentucky bluegrass. The other mixture includes all of the above grasses plus white clover, alfalfa, and birdsfoot trefoil. After seven years, only 10 to 15% of the plants in the pasture are weeds. Among these 'weeds' is quackgrass, a welcome contributor to pasture productivity. Other weeds include broadleaves: dandelion and plantain, suggesting that whether we plant them or not, representatives of each of the three functional group are likely to show up in our pastures.

Ann found that the proportion of the different grass species varied within the pasture, probably in response to variations in those physical factors like slope and aspect. For example, Kentucky bluegrass content varied from 20 to 40% among samples, while orchardgrass varied from 0 to 65%. Neither Kentucky bluegrass with the lowest yield potential, nor orchardgrass with the highest yield potential, influenced overall yield of the pasture. That means that yield did not increase with increasing amounts of orchardgrass, nor did it decline as bluegrass content increased. In fact, no combination of two, three, or four species was found to consistently predict yield across the field.

Similar results were found for the three legumes in the sward, although white clover was generally favored throughout the field. In other words, planting a complex mixture allowed different species to find their niches in different parts of the pasture, each contributing to the overall productivity of the pasture.

A study recently published in *Science* provides ecological documentation for Ann's findings. European researchers compared 5 levels of mixture complexity at 8 sites in a broad range of settings from Sweden to Greece (Hector et al. 1999. *Science*, Vol 286, No. 5442, pp. 1123-1127). The mixtures were composed of species native to the areas where the study was planted and ranged from single species monocultures to mixtures of 32 species. Although this was not a forage production study, many of the species, like orchardgrass, perennial ryegrass, and red and white clover, are well known to North American graziers.

As in Ann's study, the researchers found that no one species or simple mixture of species was responsible for yield. Twenty-nine species significantly influenced productivity, with red clover having the greatest overall effect. In general, the more species that were present, the higher the productivity of the plant community as measured by total biomass at the end of the growing season. They further observed that the total biomass of mixtures consistently exceeded the yield of the highest yielding species planted as a monoculture. The question is: why?

Researchers suggested that two mechanisms may be at work here. One is 'niche complementarity', as we discussed earlier, in which differences among species result in more complete use of resources such as soil fertility and water, resulting in greater overall productivity. For example, planting a grass with a short fibrous root system and alfalfa which has a long taproot allows the plant community to harvest nutrients and water from both shallow and deep horizons of the soil.

The second mechanism is positive mutualistic interactions among species which results in the species helping each other. A simple example would be legumes fixing nitrogen and making it available to grasses as root tissue ages and decays. Like this example, some of these interactions may involve fungal or bacterial components. Although they are not well understood, these mutualistic interactions are thought to be common in plant communities and can potentially be recreated in our pastures.

So, while research may never fully document the value of complex mixtures for pasture production, they may be a key to greater productivity and long-term stability. Knowing some of the ecological principles at work in our pastures, as well as the unique qualities of the species we're working with can help us manage in ways that take advantage of these processes, maximize yield, and improve our bottom line. Next time, we'll talk about the characteristics of different pasture grasses and how we can create pasture mixtures that capitalize on their qualities.