Benefits of Intercrops as Feed Sources for Livestock

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Intercropping is a husbandry system by which different crops are grown at the same time on the same area of land. As a cultural practice, intercropping promotes yield stability because all the crops in a mixed cropping system are not likely to be equally affected by weather variations. Crops with different growth habits may vary in their environmental requirements with complementary canopies and rooting systems. In some instances they are able to exploit light, nutrients, and water more fully than monocultures.

There is evidence that total productivity can be improved when using intercrops as feeds for animal production. Certain management practices are needed to maximize the benefits of an intercropping system for the production of crops and animals. The purpose of this article is to review intercropping strategies in terms of yield and nutritional value for livestock.

Nutritional Values from Intercropping

Intercropping has been practiced in many parts of the world in a variety of ways depending on the producer's need, i.e., hay, silage, graze, or green chop. One of the main reasons to adopt such a system is to provide a balanced feed supply for various livestock production purposes. According to Beets (1982) it is sufficient to consider only energy and protein production since these factors are of primary importance in most livestock diets. The balance between energy, protein, and the constituent amino acids of the protein must also be considered.

There are several ways to measure the energy and protein production of cropping systems. These depend on the ultimate use of the feeds by livestock. Crop yields are separated to their constituent species and then converted to energy units. The gross energy does not necessarily represent the maximum value of the cropping system. The quality of the protein within the feed varies. The combination of two or more feeds in a particular proportion may have higher biological value than would be expected from the gross energy yield. This point is illustrated in Figure 1, which compares the yields of a mixed cropping system of corn and soybean. On the basis of mass or energy, the corn monocultures gave the highest yields followed by the corn-soybean mixtures and the soybean monocultures. The highest yields of fat, protein, and methionine were with the corn-soybean mixtures. The soybean monoculture yielded more lysine than the intercrop and the corn monoculture. Similar results were obtained by Tarhalker (1975) with sorghum and soybean mixtures. The yield of lysine in the intercrop was increased by 219% compared to that of the sorghum.

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The increased production of quality protein and essential amino acids by intercropping is of special importance to the nutrition of all classes of farm animals. Ruminant animals are thought to be less sensitive than other animals to protein quality and some essential amino acids, such as lysine and methionine. They are capable of synthesizing these in the rumen. However, evidence from high-producing animals, such as dairy cows, suggests that optimum productivity cannot be obtained with low quality protein diets (Church 1986). This may be particularly true in areas known to be protein deficient, such as many tropical and subtropical regions. The greatest potential for inter-cropping may be found in these areas.

In terms of conserved forages, Garcia et al. (1985) reported that corn-soybean silage was similar to corn silage in dry matter yield and digestibility and had a higher protein content. McCullough (as cited by Bolsen 1978) ensiled an inoculated mixture of wheat and ryegrass. The resulting silage was well preserved and had high dry matter, energy, and carbohydrate digestibilities. In a study by Valdez et al. (1988), an intercropping of corn and sunflower as silage for dairy cattle produced increased protein and fat contents. Dry matter and protein digestibilities of the intercropped silage were improved over the

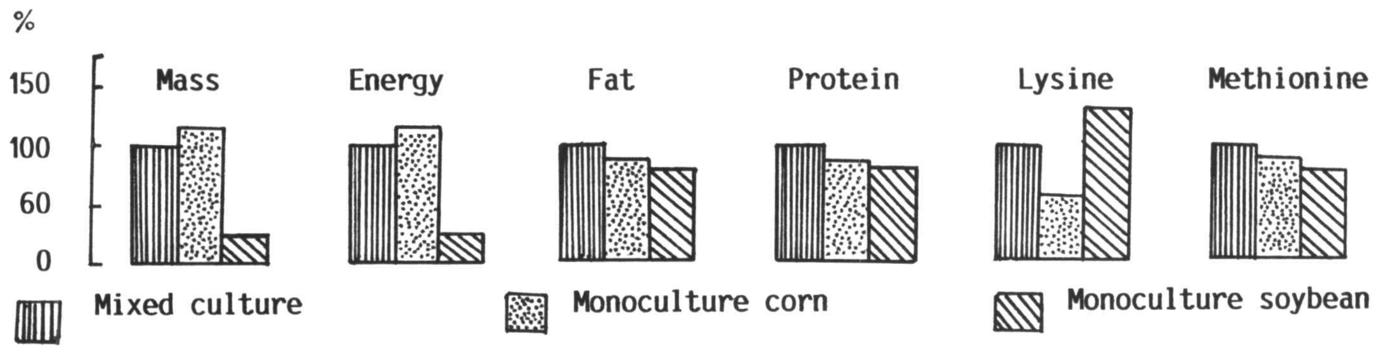

Fig. 1. *Comparison of yields of a multiple cropping system and their monoculture check (Adapted from Beets 1982).*

Fig. 2. *Soybeans are severely shaded by the sorghum plants under the drilled method.*

Fig. 3. *Sufficient sunlight is available to the soybeans when planted in alternate rows with sorghum plants.*

sunflower silage, and were comparable to those of corn silage. Digestibilities of fiber and cellulose were higher for corn and corn-sunflower silages as compared with sunflower silage. Although there was an increase of fat content of the intercropped silage, there was no adverse effect on either dry matter intake or digestibility or other nutrients.

Problems Associated with Intercropping

Competition and unequal use of environmental resources, such as light and water, are problems often experienced on some mixed crop communities. These imbalances may have negative effects on crop performance and, hence, on animal productivity.

1. Competition for Light

The unequal capture of light by one crop over another seems to account for part of the dominance in mixtures. Soybean is usually the dominated crop because of its agronomic characteristics and sensitivity to shade. Chui and Shibles (1984) reported that intercropping soybeans with corn reduced the number of soybean leaves by 58% and the leaf area index by 75%. The taller corn plants increased the amount of shade on the soybean plants, which reduced soybean yields. Similar reduction in soybean yields occurred when combined with taller sorghum plants (Elmore and Jackobs 1984). Since leaves are the main storage of plant proteins, it is suggested that a decrease in the protein content of soybeans may have occurred simultaneous to the reduction in crop yields.

Alleviation of Shading Effects

Selection of short corn or sorghum cultivars is one way of alleviating the shade effect on the soybean and, hence, improving its contribution to the crop mixture (Davis and Garcia 1983). There may be a reduction in the total yields. However, considering the nutritional importance of the biological value of an intercrop over its total energy mass (Beets 1982), the selection of short cultivars of sorghum or corn appears to be the most appropriate for intercropping. This may be particularly true with shade-sensitive plants, such as soybeans.

Competition for light between intercrops could also be minimized by proper spatial arrangement. Willey (1979) indicated that with a close row arrangement of sorghum genotypes with different heights, the short genotypes grew poorly and the overall yield decreased. In a more widely space arrangement, the shorter genotypes exhibited yield advantages. Willey et al. (1982), in a review of research on sorghum and soybeans, reported an increase of 8% to 25% in soybean yields when alternate rows were planted with sorghum. Esmail (1988) evaluated interseeded grain sorghum and soybean as a silage crop for growing beef cattle. When the intercrops were drilled, the mixture provided 13% crude protein and the maximum yield occurred at the late-dough stage of the sorghum kernels. When the intercrops were planted in alternating 38-cm rows, the crude protein content of the mixture increased to 17% at the same stage of sorghum maturity.

The increased soybean performance, in terms of protein content, using alternate rows is probably a function of two different mechanisms. The first is the better stand establishment early in the plant life-cycle due to the reduced competition for underground resources (Hodges et al. 1983). The other is the greater utilization of light at more advanced maturity stages (Willey 1979).

2. Competition for Water

Water is an important competitory factor which interacts with other environmental resources in intercropping communities. Pavlish et al. (1983) reported that with soybean and sorghum mixtures under dry land conditions, the sorghum was better adapted for removal of the available water than soybeans. This slowed the soybean canopy development, making the crop more sensitive to shade. When adequate water was supplied, sorghum had little effect on the soybeans, and soybean canopy development was greater than under dry land conditions. In situations where dry weather is persistent, intercropping or soybeans with other crops may not be beneficial due to poor stand establishment.

Summary and Conclusion

Both ccmponents in intercrop communities compete with each other for various environmental resources. Dominance may occur with either crop depending on the species, plant height, interaction between resources under different cropping situations, and on specific nutrient/water requirements at different stages of development. Minimizing competition between intercrops should be the primary objective in management of such systems. Proper cultivar selection, appropriate spatial arrangement, and adequate water supply all help alleviate competition effects and enable the maximum benefits of intercrops as feed sources for livestock to be achieved. With good management, intercropping systems should provide higher biological value of feeds compared to monoculture systems. Using well-managed intercrops, the quality and quantity of protein and essential amino acids can increase to meet animal requirements and support high levels of production.

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