Influences on Nutritive Value of Cereal Crop Residues

The relationship between the phenolic contents of sorghum stover and the influence of environment and storage on its nutritional value provide a sound basis for the development of bird-resistant varieties of sorghum which are more easily digested. This could lead to the production of crop residues of better nutritional quality, thereby resulting in improved ruminant feeds.

Sorghum grain is used for human consumption in many African countries but the crop residues are an important source of livestock feed.

Background

Sorghum and pearl millet are dual-purpose cereal crops of great importance in the semi-arid tropics and subtropics. In agricultural systems based on smallholder cereal production in many African countries, sorghum grain is used for human consumption, and the crop residues (or stover) are an important source of ruminant feed. Intensive plant breeding programmes have increased yields of sorghum grain but little attention has been paid to the nutritional quality of the crop residues. In developing countries, livestock form a valuable and often vital component of farming systems and the value of livestock products, from feeding crop residues, often exceeds that of grain for human consumption. Farmers are being encouraged to plant new varieties of sorghum which are more resistant to birds than traditional varieties. Unfortunately, these bird-resistant varieties are known to contain complex mixtures of phenolic (polyphenolic) compounds which often have adverse effects on intake and digestion by ruminants. The project examined the major factors responsible for decreasing the nutritive value of different species of sorghum crop residues. The effects of environment and traditional methods of storage and utilisation on the phenolic content of sorghum stover were also studied.

Research highlights

Improved methods were developed for analysing complex mixtures of phenolic compounds. These markedly increased the ability to separate and identify individual components distributed throughout the leaves and stems of sorghum plants.

In tests to compare bird-resistant and non-bird-resistant varieties of sorghum grain, greater amounts of polyphenolic compounds were present in the leaves of the bird-resistant varieties. However, leaf blades and sheaths containing more phenolic compounds showed strong negative correlation in relation to laboratory-based *in vitro* digestibilities.

When residues from bird-resistant (MW5020) and non-bird-resistant (Melkamash) sorghum varieties were fed to Ethiopian sheep, the total dry matter (DM) intake was higher for the

Intake of non-bird resistant and bird resistant sorghum stover by Ethiopian Lowland rams

	Melkamesh (non-bird resistant)			MW 5020 (bird resistant)		
Offer-rate (g/kg LW/day)	25	50	75	25	50	75
Stover intake (g DM/kg LW/day)	22.4	28.6	29.3	24.4	30.0	30.7
Stover refused (% of intake)	10.3	42.8	60.9	2.6	40.1	59.1
Growth (g/day)	35.5	63.4	76.7	45.4	70.2	76.7

LW = live weight; DM = dry matter

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bird-resistant variety. This was because the bird-resistant varieties have more leaves – and the animals prefer leaves to stems. However, digestibility – expressed in terms of nitrogen and as a ratio of ADF/NDF (acid detergent fibre/neutral detergent fibre) – was significantly lower in the bird-resistant variety due to the higher polyphenolic content.

Chemical composition and nutritive value of 24 varieties of Indian millet indicated that overall digestibility of millet crop residues was lower than that of sorghum.

Uptake

Environmental factors such as light, temperature and altitude, and stress factors such as lack of water and pest incidence increase the production of phenolic compounds in sorghum crops. Particular varieties responded differently to a range of conditions. Selection of specific varieties for particular conditions could lead to the production of crop residues of better nutritional quality, thereby resulting in improved ruminant feeds.

Linkages

A plant breeding strategy for selecting bird-resistant varieties with improved digestibility is suggested. Methods of improving the low nutritive value of non-bird-resistant sorghum stover have been investigated in another project (R5188). As part of a strategy for improving the sustainable utilisation of forage, a non-bird-resistant sorghum variety grown in Ethiopia has been studied to investigate the influence of the amount offered and the effects of chopping on intake and selection of the stover by sheep and cattle.

Follow-up studies have investigated the DM digestibility of forages, using *in vitro* gas production, as part of a forage development programme in the Ethiopian Highlands. In other follow-up studies the effect of phenolic compounds in bird-resistant sorghum crop residues on the growth of specific rumen bacteria was examined using the pressure transducer technique (PTT) to measure *in vitro* gas production. Leaf blade, leaf sheath and stem fractions of bird-resistant and non-bird-resistant sorghum varieties differed in their polyphenolic chemistry.

Relevance to sustainable livelihoods

Project findings on the relationship between the phenolic content of sorghum stover and the influence of environment and storage on its nutritional value provide a sound basis for the development of bird-resistant varieties of sorghum which are more easily digested. Improved livestock production from feeding higher quality ruminant feeds will make a positive contribution to increasing the income of resource-poor smallholder farmers in Ethiopia and other African countries. Their present practice of planting bird-resistant varieties of sorghum has an adverse effect on intake and digestibility of crop residues leading to low animal productivity.

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