

Effect of Stage of Maturity the Chemical Composition and In Vitro Digestibility of Sorghum Grain — Year 2

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Story in Brief

Waxy (Dwarf Redlan), waxy bird resistant (1133), normal (Redlan) and normal bird resistant (Darset) varieties of sorghum grain were harvested at weekly intervals starting eight weeks preharvest (35 percent dry matter — DM) to determine the effect of maturity on chemical composition and IVDMD. Physiological maturity, measured by dry matter deposition (g/berry), was essentially complete by the time the grain reached 70 percent DM. At 70 percent DM, there was a range of 17 days in age, suggesting that the Darset and 1133, both bird resistant (BR) varieties, dried faster than the Dwarf Redlan and Redlan (non-BR). Percent starch increased through about 55 to 60 percent DM although starch deposition (g starch/berry) continued to increase through 70 percent DM. Similar trends were noted for protein. Tannin content of the BR sorghums decreased rapidly through 70 percent DM and continued to decrease, although more slowly, through harvest. *In vitro* dry matter disappearance (IVDMD) decreased throughout maturity, especially for the Redlan and Darset varieties. These studies suggest that variety dependent changes in chemical composition and IVDMD occur throughout maturity, and that these changes may alter the results obtained with high moisture harvested sorghum grain.

Introduction

Increased energy costs for processing sorghum grain have motivated cattle feeders to consider grain processing systems which are more energy efficient than steam flaking or micronizing. High moisture methods such as high moisture harvest require less energy than steam flaking yet produce similar animal performance. In order to fully utilize the potential benefits from high moisture harvest, the impact of many factors must be better understood. Different varieties of sorghum grain vary considerably in chemical composition and IVDMD when mature (12 to 15 percent moisture). These differences between mature sorghum grain varieties may be a reflection of variety specific changes in various kernel constituents that occur as the kernel matures. The magnitude of these varietal differences and their effect on IVDMD remains unknown. The objective of this study was to monitor changes in the chemical composition and IVDMD of several sorghum grain varieties as the grain matures.

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Materials and Methods

Waxy (Dwarf Redlan), waxy bird resistant (1133), normal (Redlan) and normal bird resistant (Darset) varieties of sorghum grain were grown under similar conditions at the Agronomy Research Station, Perkins, OK (Table 1). Six heads representative of each variety were selected at random and harvested at weekly intervals for eight weeks starting August 28. Sorghum heads were threshed and ground through a 1 mm screen in a Wiley mill with the aid of dry ice. Samples were frozen immediately to minimize drying and fermentation until analysis.

Crude protein was measured as Kjeldahl N \times 6.25 and starch as glucose polymers following an enzymatic digestion. Percent starch and protein were multiplied by berry size (dry weight/100 berries) to obtain amounts of starch and protein per kernel (g/berry). Tannin content (catechin equivalents/g) was determined with the vanillin — HCl assay. *In vitro* dry matter disappearance was measured after an 18-h digestion with strained and buffered rumen fluid obtained from a steer fed an 80 percent concentrate diet.

The data reported herein represent the second year of a study that was originally reported in the 1982 edition of this publication.

Table 1. Descriptive characteristics of sorghum grain varieties

Variety	Pericarp Color	Testa Layer ^a	Endosperm		
			Color	Starch	Classification
Dwarf Redlan	Red	Absent	White	Waxy	Waxy
1133	Brown	Present	Yellow	Waxy	Waxy - BR ^b
Redlan	Red	Absent	White	Normal	Normal
Darset	Brown	Present	White	Normal	Normal - BR ^b

^aTesta layer indicative of elevated tannin content.

^bBR = Bird resistant.

Results and Discussion

Initial collection of sorghum samples was initiated when the grain was approximately 35 percent dry matter (Figure 1). The Darset dried the fastest followed by the 1133, Dwarf Redlan and Redlan. As much as 17 days difference was noted between the Darset and the Redlan when each reached 70 percent dry matter. As maturity approached, dry seed weight increased until the grain was about 70 percent dry suggesting that physiological maturity (maximum dry matter deposition) was complete (Figure 1).

Percent starch increased through 50 to 55 percent dry matter for all but the Redlan (Figure 2). The Redlan peaked somewhat later (65 percent DM). Starch deposition (g/berry) continued to increase through about 70 percent DM which coincided with the peak in dry matter deposition. Increased starch deposition between 50 and 70 percent DM is probably a reflection of increased berry size because percent starch remained constant through this period.

Percent crude protein (N \times 6.25) generally decreased through 55 to 60 percent DM (Figure 3). Similar to starch deposition, however, protein deposi-

tion (g/berry) continued to increase through 65 to 70 percent DM. As with starch, the increased protein deposition between 55 and 70 percent DM is probably due to increased berry size.

Tannin content (catechin equivalents/g) of the Darset increased rapidly in early maturity (Figure 4). During this same period, tannin content of the 1133 had begun to decline from an early peak. Both bird resistant varieties decreased in tannin concentration through about 60 percent DM after which tannin concentration remained relatively constant. High tannin content early in maturity may serve to discourage bird predation when the sorghum kernel is young and immature.

In vitro dry matter disappearance decreased as maturity progressed (Figure 4). The most dramatic change was observed for the Redlan and Darset varieties. Decreased IVDMD throughout maturation corresponded to increased protein content. As protein increases, the quantity of starch shielded from fermentation may also increase thus decreasing IVDMD. Changes in IVDMD in this study may appear contradictory to changes in tannin concentration. The tannins present in early maturity are probably composed of numerous small molecules that gradually polymerize during maturity to form more efficient protein binding complexes. Consequently, although tannin content in early kernel development may be high, the protein binding capacity is probably low resulting in little effect on IVDMD.

Most high moisture grain is normally harvested between 65 and 70 percent dry matter. Although digestibility (IVDMD) decreased throughout maturity, these studies reinforce the premise that the grain must reach 65 to 70 percent DM before dry matter yield is maximized. Substantial changes in chemical composition were observed as maturity progressed. The magnitude of these changes was highly dependent on variety which may affect the utilization of high moisture grain by beef cattle. Wise decisions about variety and harvest time should enhance the nutritional quality of high moisture harvested sorghum grain for ruminants.

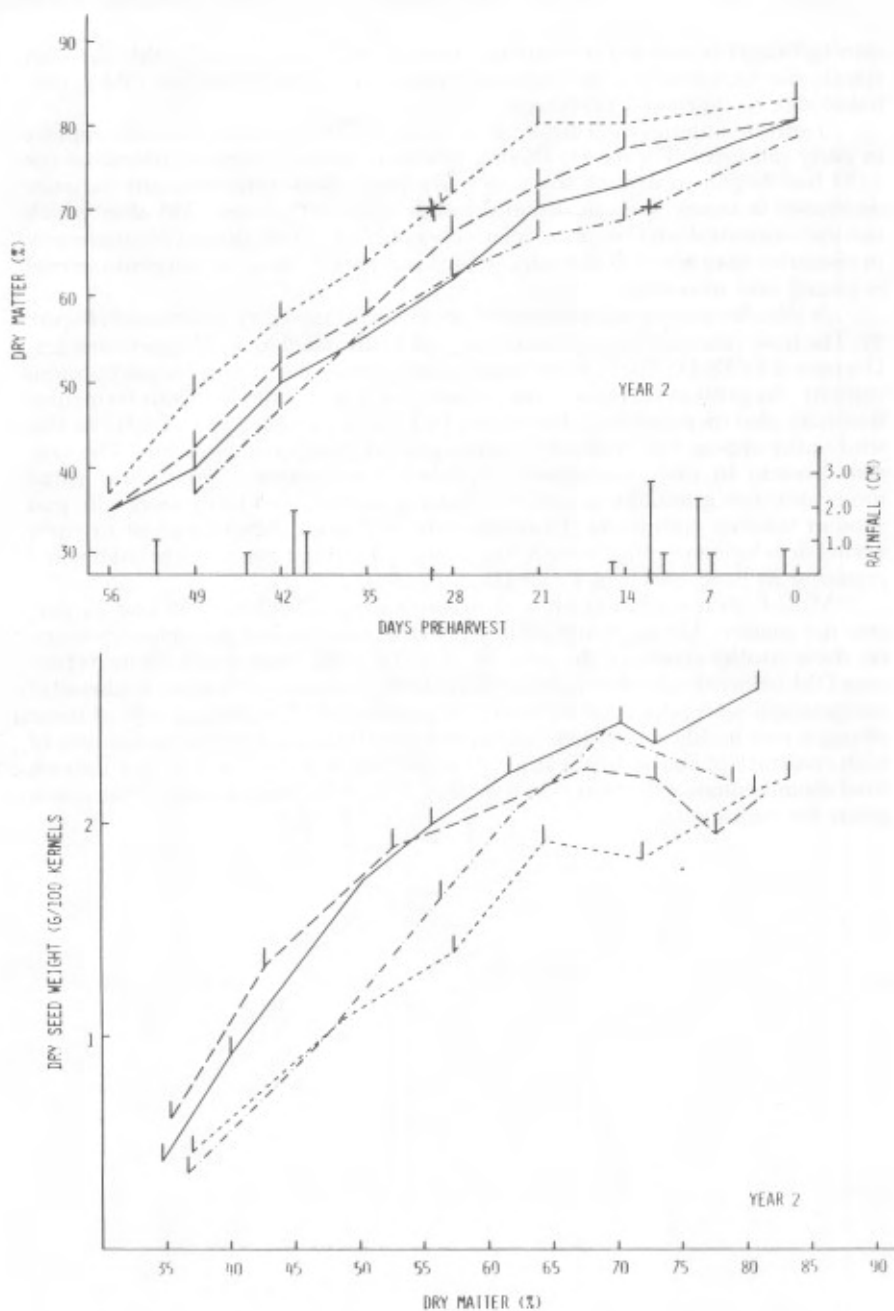


Figure 1. Dry matter content and dry seed weight of maturing sorghum grain (- Dwarf Redlan, -- 1133, -·-· Redlan, --- Darset).

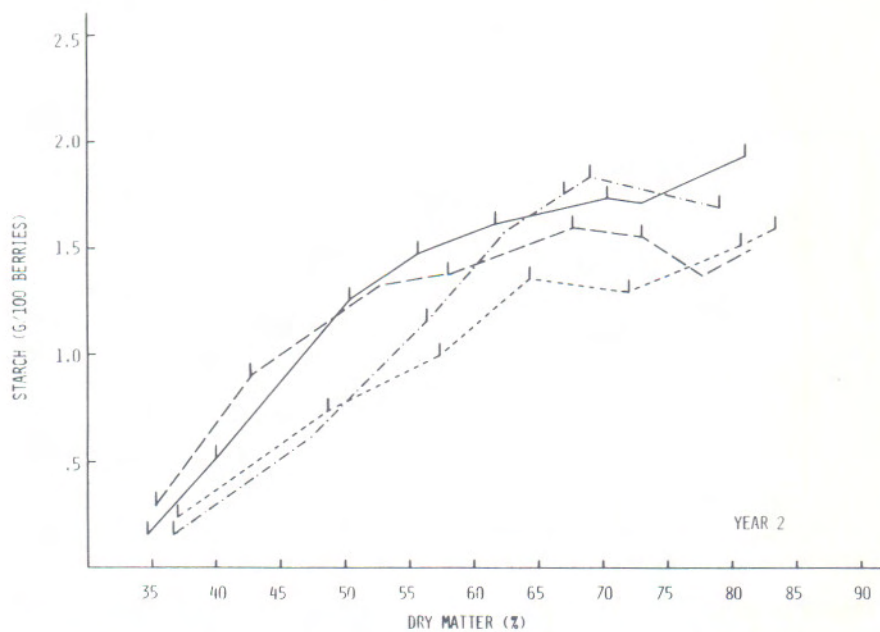
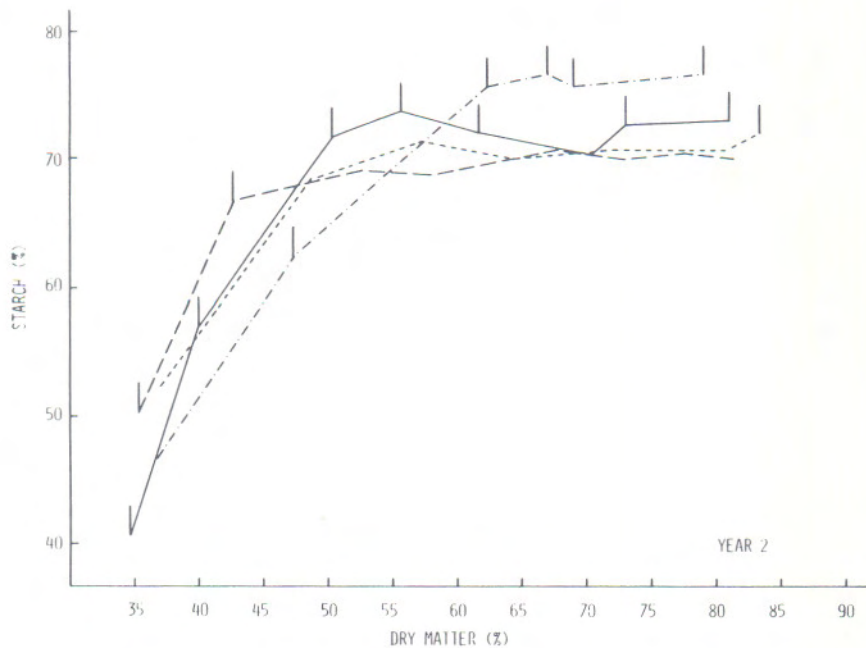


Figure 2. Starch content (%) and deposition (g/100 berries) of developing sorghum grain (—Dwarf Redlan, -- 1133, -.-Redlan, ---Darset).

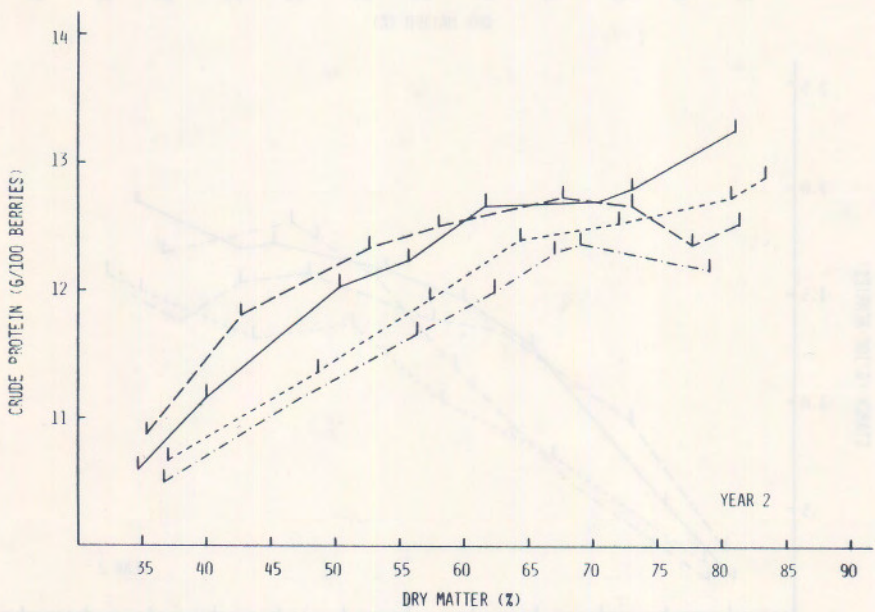
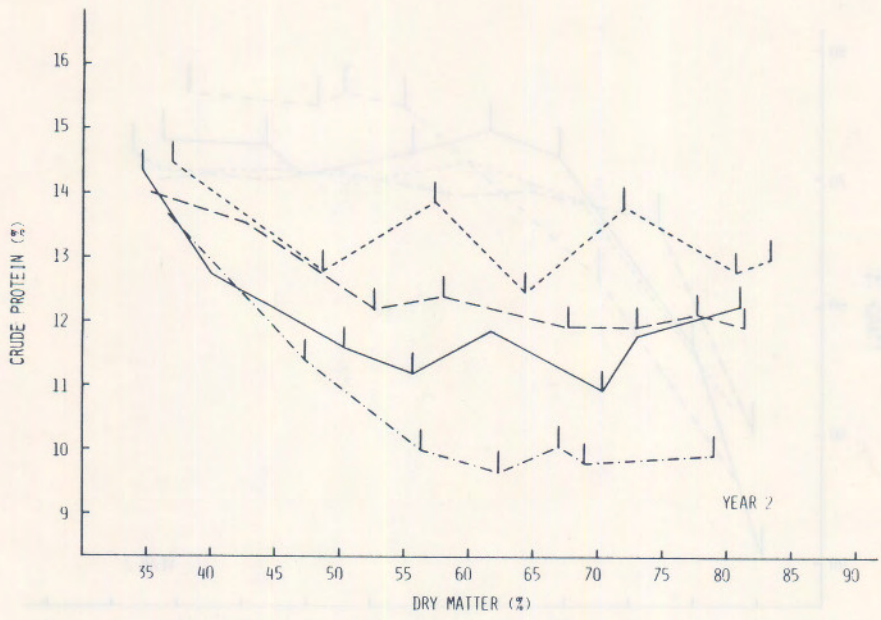


Figure 3. Crude protein content (%) and deposition (g/100 berries) of maturing sorghum grain (—Dwarf Redlan, ---1133, -·-·-Redlan, ····-Darset).

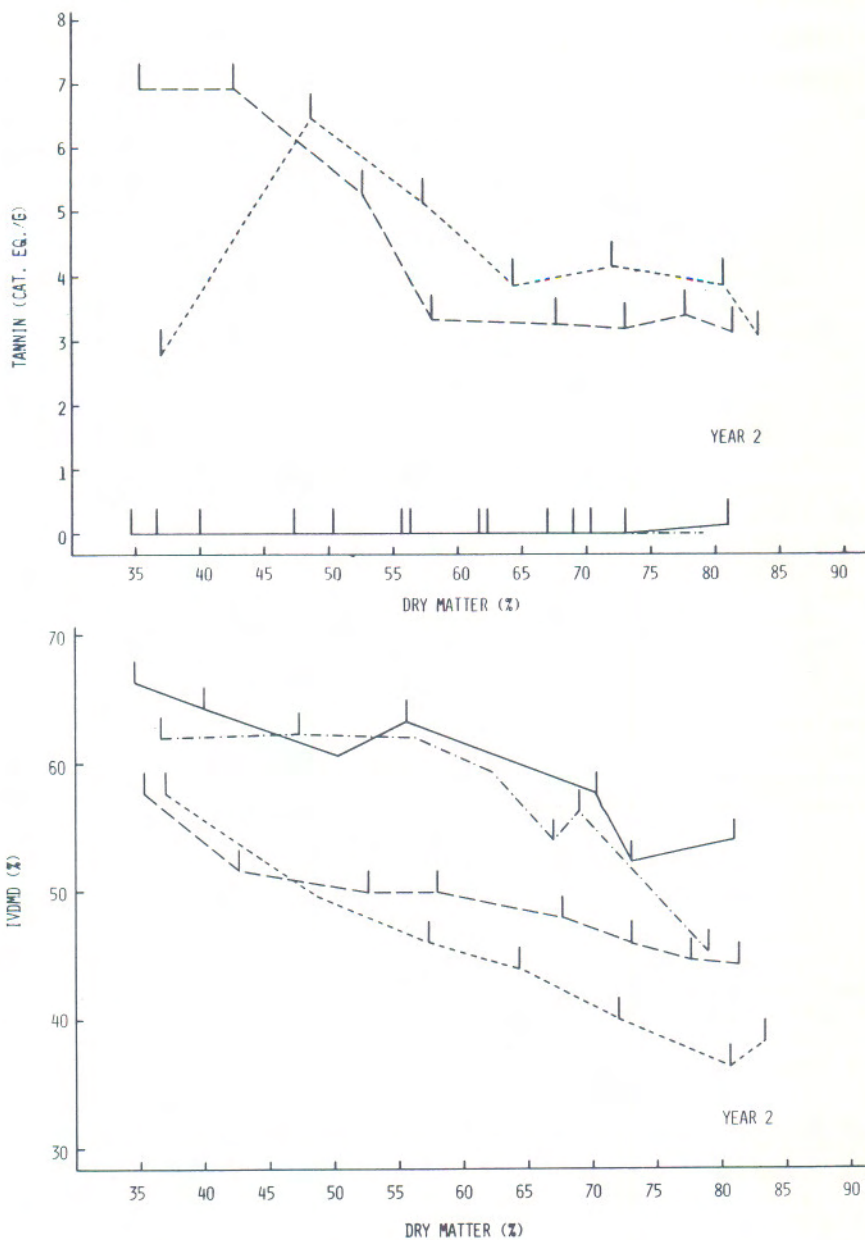


Figure 4. Tannin content (catechin eq./g) and *in vitro* dry matter disappearance of maturing sorghum grains (—Dwarf Redlan—1133, - - -Redlan, - · - · -Darset).