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In sacco degradation kinetics of fresh and field-cured peanut (*Arachis hypogaea* L.) forage harvested at different maturities

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ABSTRACT

There is interest in growing peanut (*Arachis hypogaea* L.) for forage, but little is known about the nutritive value and forage quality of modern cultivars. The objective of this study was to compare the chemical composition and in sacco degradation kinetics of three cultivars of peanuts (cv. 'C99-R', 'Georgia-01R', and 'York') at either stage 2 or 8 maturities when fresh and field-cured. Herbage yield was at least 3000 kg DM/ha for all cultivars at both maturities. Crude protein (CP) was greater ($P < 0.0001$) at R2 stage than at R8 stage; whereas, neutral detergent fiber (aNDF), acid detergent fiber, and Lignin (sa) were greater ($P < 0.01$) at R8 than R2 maturity stages. Water soluble carbohydrate and acid detergent insoluble nitrogen was not different ($P > 0.07$) among cultivars, maturity stage, or harvest forms. In vitro true digestibility was greatest ($P < 0.02$) for C99-R and least for York. Undegradable intake protein concentration was greatest ($P < 0.04$) in York and least for C99-R. Maturity had a greater effect on the degradation kinetics than harvest form or cultivar. The dry matter (DM) and CP in the soluble wash fraction (A) and insoluble but degradable fraction (B) and the effective ruminal degradability were greater among all cultivars and both harvest forms of the R2 maturity stage than the R8. The undegradable DM, aNDF, and CP in the undegradable fraction were greatest ($P < 0.002$) for all three cultivars at R8 maturity. The rate of degradation of DM and CP in the B fraction was faster ($P < 0.001$) at R2 stage than at R8 stage; whereas, rate of aNDF degradation was not different ($P > 0.09$) among treatments. Lag of DM, aNDF, or CP degradation was not different ($P > 0.1$) among treatments. The cultivars C99-R and Georgia-01R are recommended for further feeding trials.

1. Introduction

Legumes have a greater protein concentration and less structural fiber concentration than grasses. This and the reticulate venation of leaves allows legumes to be degraded more easily and rapidly by ruminal microbes (Waghorn et al., 1989; Wilson, 1994; Jung and Allen, 1995; Dewhurst et al., 2003; Frame, 2005). Despite the nutritional benefits of legumes, warm-season legumes are not commonly used in the United States. Most of the available cultivars are annuals which require seed purchase,

Abbreviations: A, soluble wash fraction; ADF, acid detergent fiber; ADIN, acid detergent insoluble nitrogen; B, insoluble but degradable fraction; C, undegradable fraction; CP, crude protein; CV, cultivar; DM, dry matter; E, effective ruminal degradability; HF, harvest form; IVTD, in vitro true digestibility; k_d, fractional rate of degradation; k_p, fractional passage rate; L, lag time; Lignin (sa), lignin determined by sulfuric acid method; M, maturity; aNDF, neutral detergent fiber; aNDIN, neutral detergent insoluble nitrogen; NLIN, non-linear; UIP, undegradable intake protein; WSC, water soluble carbohydrates.

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land preparation, and planting each spring. There are very few warm-season perennial legumes in the southeast due to the length and high temperatures of the summer (Leep et al., 2002; Barnes and Nelson, 2003). One common summer legume crop is peanut (*Arachis hypogaea* L.), a crop grown on 0.5 million hectares in the United States and 1.7 trillion kilograms of peanuts are produced annually (NASS, 2007). Worldwide peanut is produced on 17 million hectares and it is the third most important oil seed crop after soybean and cotton (Singh and Singh, 1991). The use of fungicides preclude the feeding of peanut stover to ruminant animals in many countries, including the United States; however, seed is less expensive and more readily available compared to that of leguminous forage crops (Foster, 2008), planting is relatively easy and equipment readily available, and management practices are well documented.

There is interest in growing peanut for hay, haylage, or silage. In north Florida, a stand of peanut was planted for forage and maintained forage production through self reseeding for 7 years (Foster et al., 2009a,b). There may be as large of a variation in forage nutritive value among cultivars as there is among species (Jung et al., 1997). Digestibility and intake by lambs was increased when cultivar ‘Florida MDR 98’ was stored as hay or haylage and supplemented to bahiagrass (*Paspalum notatum* Flügge) hay or haylage (Foster et al., 2009a,b). There is a need to evaluate and compare the nutritive value of peanut cultivars so that those with potential could be identified and evaluated for their use as a self reseeding forage crop. Three cultivars with potential as forage types in the southeastern US are ‘C99-R’, ‘Georgia-01R’, and ‘York’. All three are late maturing (150–155 d), runner type peanuts with an upright central stem and prostrate growth habit (Gorbet and Shokes, 2000; Branch, 2002; Wehtje and Grey, 2004). All three cultivars have resistance to tomato spotted wilt virus and to leafspot.

The objective of this study was to compare the chemical composition and in sacco degradation kinetics of three cultivars of peanuts at two different maturities when fresh and field-cured.

2. Materials and methods

2.1. Materials and experimental site

Three peanut cultivars, C99-R (Gorbet and Shokes, 2000), Georgia-01R (Branch, 2002), and York, were established at North Florida Research and Extension Center (30°48′N, 85°12′W; 33 m above sea level) near Marianna, FL, USA. Temperature and precipitation monthly averages during the experiment and 30-year average are presented in Fig. 1. Two rows of each cultivar were planted in 0.91 m row spacings in 42.5 m long plots on 3 June, 2008 with border rows on each side. Fields were managed according to Florida Cooperative Extension Service recommendations for peanut including overhead irrigation, however, no fungicide was applied.

At R2 [beginning peg (one elongated gynophore); 21 Aug 2008] and R8 (harvest maturity; 21 Oct 2008) maturity stages (Boote, 1982), samples were collected from the two center rows (0.25 m^2 quadrat) to a 5 cm stubble height. Samples were weighed, dried at 55 °C until weight loss ceased, and weighed again for dry matter yield determination. Additional samples were taken randomly within the plots at R2 maturity stage. These samples were placed on plastic sheeting and allowed to sun-cure. At R8 maturity stage peanuts were harvested from the plots with a K.E.W. peanut plot combine (Kingaroy Engineering Works, Kingaroy, Queensland, Australia). Vegetative material was collected from the machine and placed on plastic sheeting to sun-cure. Dried fresh (R2 and R8) and sun-cured (R2 and R8) material was ground to at least 3 mm in a Wiley mill (Arthur H. Thomas Company, Philadelphia, PA) for in sacco incubation. A sub-sample (250 g) was then ground to 1 mm for laboratory analysis.

2.2. In sacco incubations

Approximately 4.5 g of sample as fed was weighed into 10 cm × 20 cm polyester bags (53 ± 10 μm pore size; Bar Diamond, Inc., Parma, ID) in triplicate. Bags were heat-sealed and incubated in the ventral rumen of each of 3 mature Brangus steers

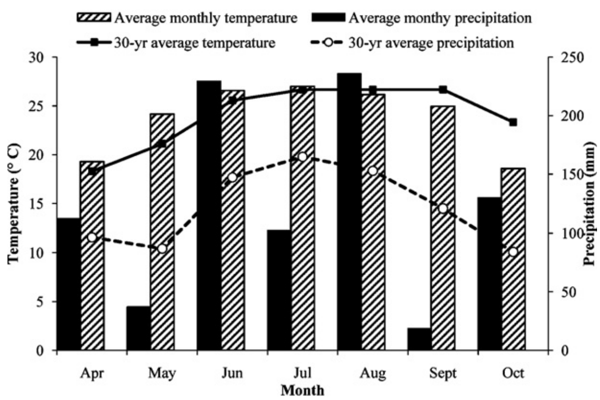

Fig. 1. Temperature and precipitation monthly averages during the experimental period in 2008 and 30-year monthly averages.