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Agriculture Intensive dans les Iles de la Caraibe : enjeux, contraintes et perspectives
Intensive Agriculture in the Caribbean Islands : stakes, constraints and prospects
Agricultura Intensiva en la Islas del Caribe : posturas, coacciones y perspectivas

CONTROL OF KUDZU THROUGH FREQUENT HARVESTING AND GRAZING

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ABSTRACT

The production of meat, milk and fiber by angora goats in Alabama is influenced largely by the quality of the animal's feed intake. On the other hand, kudzu *(Pueraria lobata),* a warm-season pervasive legume weed found in timberlands of the southeast United States, provides an excellent feed source during the summer months for angora goats. In order to take advantage of this feed source and control the plant, it was proposed that angora goats be used to control this weed. A study was initiated to look at the effects of clipping frequency and grazing cycles on the control of kudzu. Plants were randomly selected in fields and assigned clipping cycles of 0, 2 ,4 and 6-week intervals. In order to determine the resilience of the kudzu plants, crude protein, mineral content and total fresh and dry weights were recorded during the spring, summer and fall periods. Results showed that as clipping frequency increased there was a corresponding increase in total dry matter accumulation. However, this yield increase was arrested after four harvests when kudzu plants were clipped every two weeks. Fifty percent of the plants harvested at 2-week intervals were killed prior to cessation of fall growth. Plants harvested at four and six week intervals continued to increase in dry matter. The remaining plants that were harvested every two weeks did not successfully over-winter but all plants harvested at 6 week intervals survived the winter. As would be expected, leaf crude protein content was higher than stem crude protein. However, the crude protein content tended to decrease with length of time between harvest. It would appear that harvesting kudzu every two weeks will result in some degree of control.

INTRODUCTION

In most parts of the world, the most prevalent and economic means of producing meat, milk and fiber from ruminants is through the use of forages. The management of such systems is very important in order for producers to meet the needs of a growing human population. Because of this population increase and the resulting pressures that are placed on limited land and other resources, alternative cropping and management systems have to be evaluated in order to keep pace with the population increase at a cost that is acceptable to consumers.

Kudzu *(Pueraria lobata)* is a prolific-growing legume that poses a serious threat to the timber industry of the southern United States (Mc NABB, 1990). In a preliminary study conducted by BONSI *et al.*, (1991) they have indicated that angora goats are effective in reducing kudzu growth resulting in reduced applications of herbicides. SMALL *et al.*, (1991 a; 1991 b) reported that kudzu can adequately supply the nutritional needs of angora goats. In studying the biomass produced by kudzu, WOLDEGHEBRIEL *et al.*, (1992) and RHODEN *et al.*, (1992) have concluded that during its normal growth cycle, kudzu is capable of supplying the feed needed by angora goats without supplemental feed.

Control of Kudzu

Kudzu is perceived as a serious weed that has to be eradicated if not controlled in order to increase the amount of timber harvested. To this end, forestry programs have used combinations of treatments to control undesirable understory growth such as kudzu. One of the recommendations of Tuskegee University scientists working on the control of kudzu, is to use goats to reduce the effects of kudzu in timber stands, thereby reducing chemical applications. It is common for forestry personnel to use herbicides such as glyphosate, 2,4-D, hexazinone, and solfometron in their forest management programs. These herbicides are primarily geared towards weed control for site preparation and are sometimes combined with burning, and mechanical and biological weed control.

In order to reduce the risks associated with herbicide use, goats have been used to control kudzu growth in pine stands (BONSI *et al.*, 1991;

PEARSON, 1991; RHODEN *et al.*, 1991). While goats are very effective in the control of understory growth they also provide additional income to the farmer. Goats, because of their browsing habits (browsers vs. grazers), are considered environmentally friendly and are welcomed by ecologists. Because of the numerous advantages of kudzu (cited by several scientists in the Tuskegee University project), it was recommended that kudzu become a major component of the angora goats diet (CORLEY *et al.*, 1992; EDWARDS *et al.*, 1993). If farmers are convinced that kudzu would provide the level of nutrition demonstrated during this study the use of kudzu would also help to curtail the spread of this unwanted plant.

The objective of this study was to evaluate the effects of clipping frequency and grazing on forage production and quality of kudzu.

MATERIALS AND METHODS

This study was conducted at the George Washington Carver Agricultural Experiment Station, Tuskegee University in Alabama, USA. During the experimental period, the mean maximum and minimum temperature were 30.4 °C and 19.3 °C, respectively. Rainfall averaged 126.4 mm/month, daily pan evaporation was 5.46 mm/day and the soil type was a Norfolk sandy loam (Typic Paluedult) with a slope of 1-2%. The pH of the soil was 5.8 and the field was originally seeded with bahiagrass *(Paspalum notatum)* in 1986 (6 years) and has since been invaded by kudzu.

The clipping frequency (treatment) was initiated on June 20, 1992 and the experiment was terminated on September 12, 1992. This represented the major portion of the growing period of kudzu (WOLDEGHEBRIEL *et al.*, 1992). The kudzu plants used in the experiment were randomly selected in the field and were assigned clipping frequencies of:

a. no clipping
b. clipped every two weeks
c. clipped every four weeks
d. clipped every six weeks

Harvested plants were separated into vines and leaves and data collected for analysis included percent ash, fresh and dry weight of plant material as well as percent crude protein. All treatments were monitored for rate of recovery from clipping and on how well they over-wintered. Stem and leaf samples were dried at 70 °C for 72 hours and were ground using a Wiley mill (1 mm mesh). Samples were ashed at 550 °C according to the AOAC method (1984). Crude protein content was determined from composite samples using the KJELDAHL procedure (AOAC, 1984).

Differences for leaf to stem ratio, ash content and crude protein were analyzed using analysis of variance (AOV) procedure. Whenever significant ($P< 0.05$) effects were detected among treatment means, they were subjected to the Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

Clipping Frequency

Kudzu plants clipped every two weeks had significant increases in fresh and dry weights for the first four harvest periods (Figs. 1 and 2). However, as harvest was prolonged there was a decrease in the amount of vegetation harvested. One possible reason for this decrease in both fresh and dry matter accumulation was the inability of the plants to recover from the increased clipping in such a short period of time. This is evident by the response of the plants clipped every two weeks because after six harvests two of the four plants died.

Percent dry matter in kudzu decreased with increased clipping frequency (fig. 3). Stem, leaf and total plant percent dry matter significantly decreased from the first to the third harvest. Thereafter, percent dry matter remained constant at approximately 19%. At the same time, leaf to stem ratio both on a fresh as well a dry weight basis remained constant throughout the harvest period (Fig. 4). It should be noted that 2 weeks clipping interval of kudzu resulted in increased dry weight but had a decrease in percent dry matter. This is therefore responsible for the constant leaf to stem dry weight ratio. It would appear that kudzu plants harvested with such frecuency are incapable of

photosynthesizing adequate amount of carbohydrates and are therefore depleting their root reserves. As a result, 50 percent of the plants harvested at two-week intervals died after the sixth harvest and the others do not over-winter.

Plants harvested every four weeks for four consecutive harvests accumulated more fresh and dry matter (Figs. 5 and 6). Like plants exposed to 2 week clipping intervals, plant percent dry matter decreased within the first four weeks of the initiation of harvest. However, plants harvested every four weeks reversed this trend and percent dry matter increased for the next two harvest periods (Fig. 7). Plant dry matter decreased from a high of 20 percent at the initial harvest to 18.4% after four weeks. This pattern was reversed with subsequent harvest periods and after eight weeks averaged 19.0 percent. Leaf to stem ratio of kudzu plants harvested every four weeks showed a significant increase as harvest period was extended (Fig. 8). In comparing the leaf to stem ratio of fresh versus dry material, it was noted that this parameter was consistently and significantly higher for the fresh material. As would be expected, kudzu leaves had a higher moisture level than stems and would therefore account for the higher leaf to stem ratio in dried material.

The increased accumulation of dry matter in kudzu after four weeks of harvest would indicate that four weeks are adequate for kudzu to fully recover from clipping. This information would indicate that kudzu might be grazed and successfully managed if the rest period is approximately four weeks. Based on this study it appears that in order to reduce kudzu plants' ability to compete effectively, it should be defoliated within four weeks.

Kudzu plants allowed to grow for six weeks before clipping showed a significant increase in the amount of fresh and dry matter that the plants were able to accumulate (Figs. 9 and 10). There was a linear increase in fresh and dry weights of kudzu leaves and stems. It should also be noted that for both fresh and dry matter there was a greater increase in leaf weight compared to stems. Leaf dry matter was 22.3% at initial harvest and increased to 24.5% and 23.4% respectively, for the second and third harvest periods (Fig. 11). Stem percent dry matter, on the other hand, was only 18.9% at initial harvest and increased to 20.1% after the second harvest. The difference noted in both the accumulated fresh and dry weights of kudzu leaves and the resulting low dry matter

content of kudzu stems might account for the lower leaf to stem ratio noted at six-week clipping interval (Fig. 12).

Leaf crude protein content was significantly affected by the age at which kudzu was harvested (fig 13). As harvested kudzu leaves matured, the percent crude protein declined from 18.7% at two weeks to 16.1% at the six-week harvest. Crude protein of kudzu stem, although it followed a similar trend as leaves, did not decrease as rapidly. However, crude protein content of kudzu leaves remained much higher than those of kudzu stems.

Ash content, a measure of the mineral composition of the forage, is not usually meaningful since it is not specific for each mineral present in the forage. However, ash content does give an indication of the organic matter content of the forage under investigation. Unlike crude protein content, ash content of kudzu increased with clipping age (Fig. 14). When kudzu leaves were harvested at two-week interval the ash content was 5.2% which increased to 5.8% at six-week harvest. Stem ash content was significantly higher than leaf ash content but this factor was not influenced by harvest period.

This work further supports the work of RHODEN *et al* (1992) showing that kudzu is capable of supporting the nutritional needs of small ruminants and that the forage obtained from kudzu is comparable with most other foodstuffs on the market. However, kudzu is readily available and provide grazing during drought periods when other forages are not productive. This plant is very vigorous and is considered a threat to the timber industry of the southeastern United States and any biological method of control would be welcomed. It would appear that harvesting kudzu on a regular basis (two-week interval) would deplete its root storage capability and cause the plant to regenerate very slowly. Should farmers however choose to clip kudzu at longer periods (four and six weeks) these plants are capable of withstanding such harvest pressures, will produce adequate forage, will over-winter and persist on the site for a long time.

Data obtained from the past two growing seasons suggest that frequent harvests weakens the kudzu plants. At the same time, frequently harvested kudzu plants (two-week intervals) do not over-winter successfully. It can be concluded that when kudzu is grazed intensively (RHODEN *et al.*, 1992) or clipped frequently such treatments will result in the death of kudzu.

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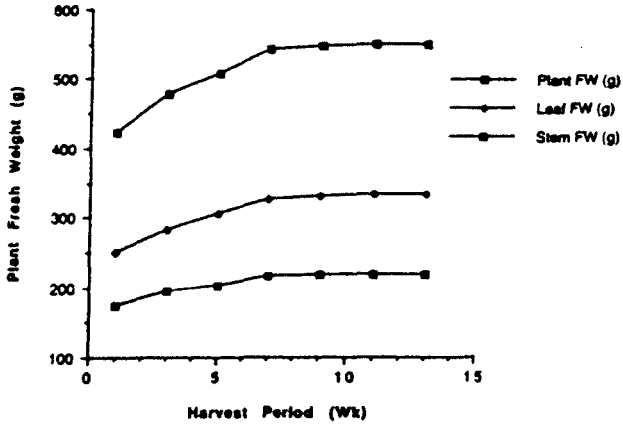

Fig. 1 Effect of 2-week clipping on forage accumulation in kudzu

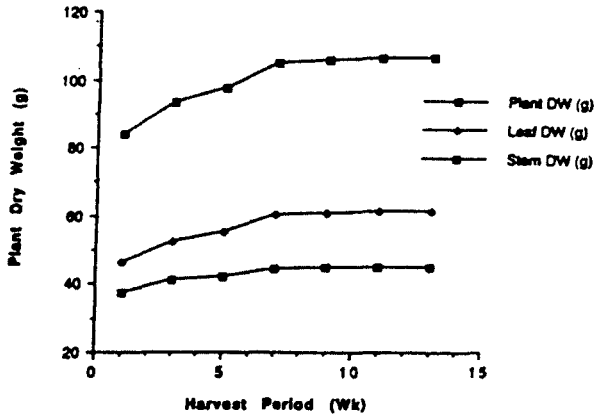

Fig. 2 Effect of 2-week clipping on dry matter in kudzu

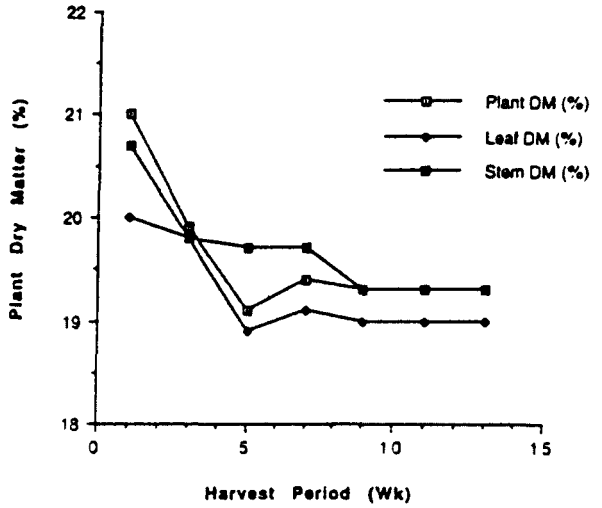

Fig. 3 Effect of 2-week clipping on percent dry matter in kudzu

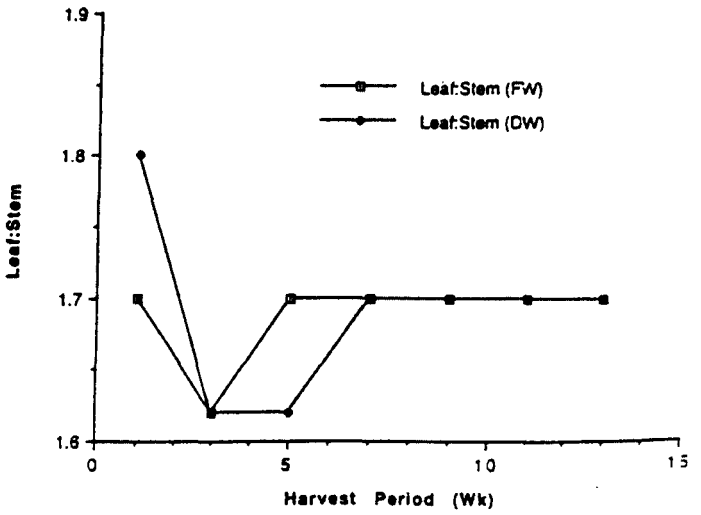

Fig. 4 Effect of 2-week clipping on leaf:stem of kudzu

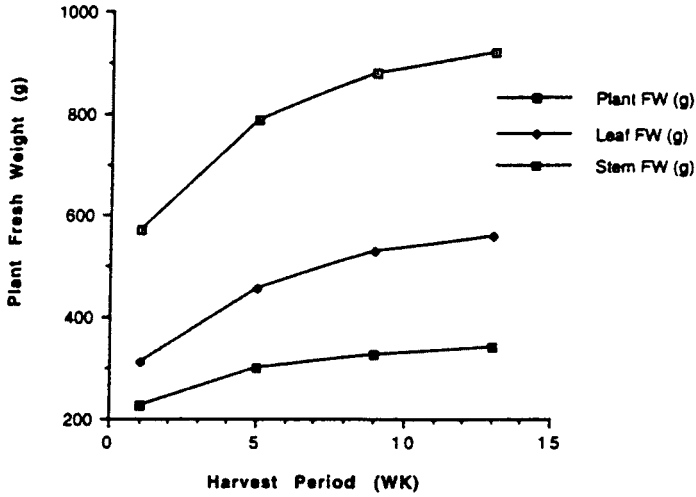

Fig. 5 Effect of 4-week clipping on forage yield of kudzu

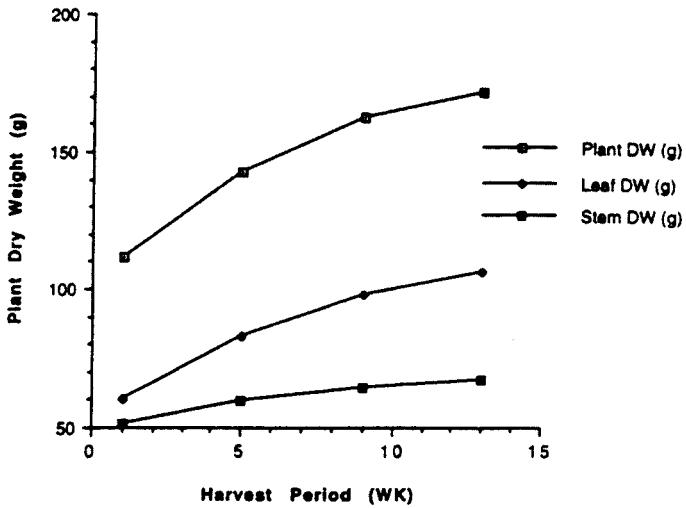

Fig. 6 Effect of 4-week clipping on dry matter of kudzu

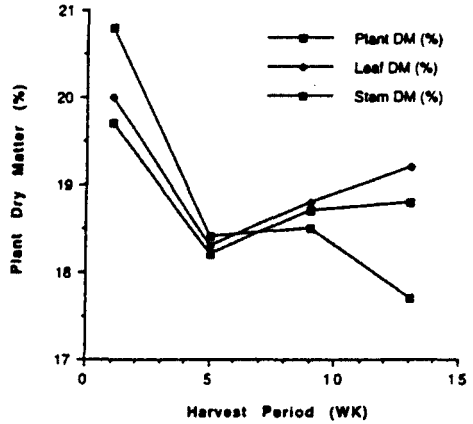

Fig. 7 Effect of 4-week clipping on dry matter of kudzu

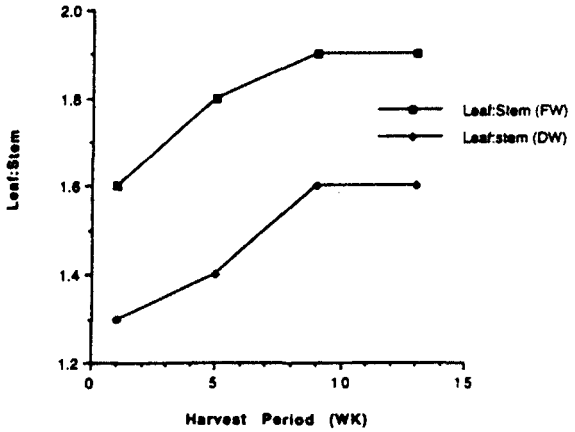

Fig. 8 Effect of 4-week clipping on leaf:stem of kudzu

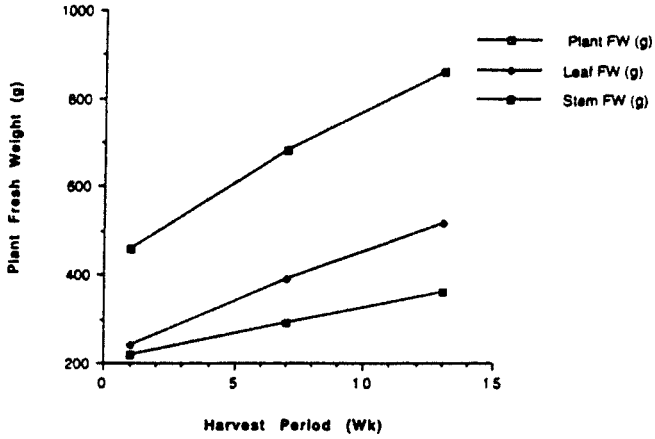

Fig. 9 Effect of 6-week clipping on cumulative forage yield of kudzu

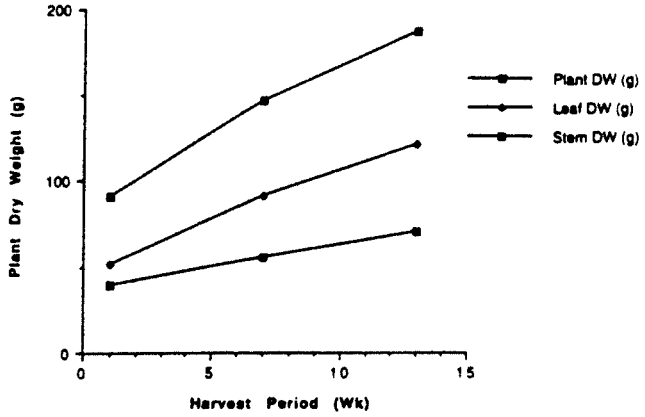

Fig. 10 Effect of 6-week clipping on kudzu dry matter accumulation

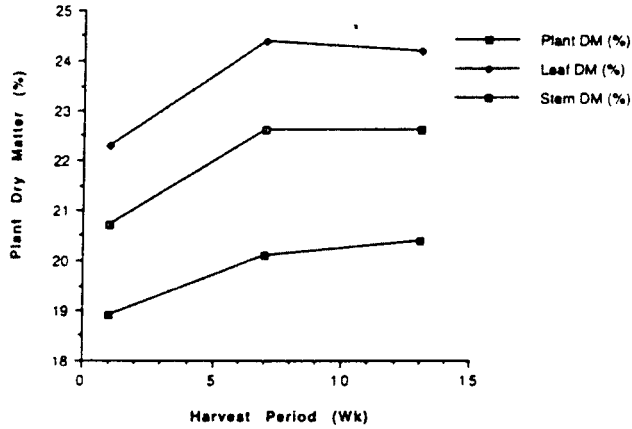

Fig. 11 Effect of 6-week clipping on dry matter percentage in kudzu

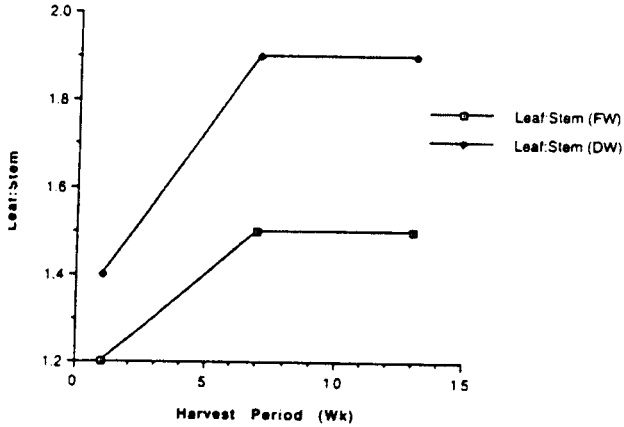

Fig. 12 Effect of 6-week clipping on leaf:stem of kudzu

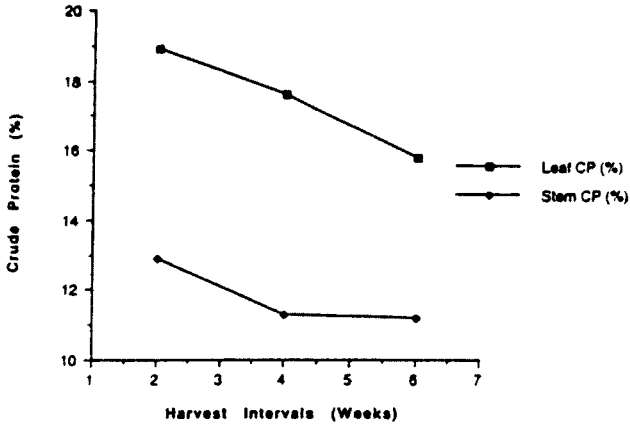

Fig. 13 Effect of harvest interval on crude protein content

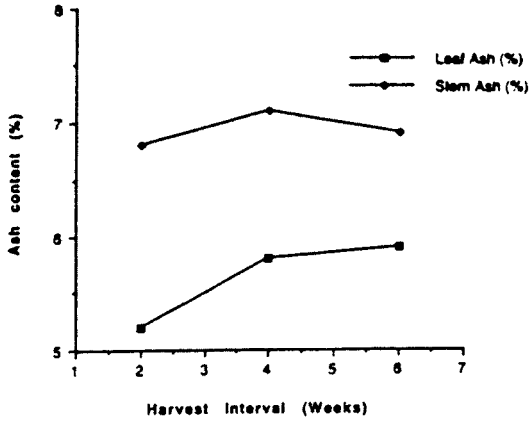

Fig. 14 Effect of harvest interval on ash content of kudzu