FODDER PRODUCTION: RESPONSE TO SOWING DATES, PRUNING HEIGHTS AND CUTTING INTERVALS OF *Tephrosia* SPECIES IN THE WESTERN HIGHLANDS OF CAMEROON

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ABSTRACT

Fodder production responses to three Tephrosia species (T. candida, T. purpurea and T. vogelii) to sowing date of April, May, June, and July, pruning heights of 50cm and 75cm and cutting intervals of 8, 12 and 16 weeks were evaluated. The study was carried out at the Institute of Agricultural Research for Development Mankon - Station in the Western highlands of Cameroon. Experimental design was split-split plots with four replicates. Data were collected during two growing seasons on dry matter (DM) yields and subjected to analysis of variance. There was significant reduction in DM yield between April (1870kg/ha) and July planting seasons (679kg/ha) in the year of establishment. Forage DM yield doubled in all three species when cutting height was increased from 50cm to 75cm. Averaged over species, dry matter yield was significantly influenced by cutting height, with 1673kg/ha obtained at 75cm and 772kg/ha at 50cm. For proper establishment and adequate dry matter yield the three Tephrosia species should be planted when the rains are steady, between April and May, cut at 12 weeks interval at a height of 75cm above ground level for optimum DM production.
Keywords: *Fodder production, Gliricidia sepium, Leucaena leucocephala, Tephrosia species.*

INTRODUCTION

Browse refers to the palatable portion of woody vegetation viz leaves, seed, fruits and new twig which are consumed by animals (Le Houerou, 1980). They are Perennial deep rooted legumes that are available during the dry season, when animal feed is in short supply. Animal production is greatest with a high ratio of herbage to browse production. Regardless of whether they occur as scattered trees or in a plantation, browse plants represent a survival reserve. *Gliricidia sepium* and *Leucaena leucocephala* are two fast growing nitrogen - fixing trees, which are particularly promising as browse (Carew, 1983). They are very popular and widely used as browse in the low altitude tropics (Sumberg,

1983). In the western highlands of Cameroon, their growth is hampered by high elevation (1300 m.a.s.l.) and acid reaction of the soil (pH 5.3). Hence, there is a need to broaden the range of species of multipurpose trees and shrubs (MPTS) which are well adapted to the environment. Species of *Tephrosia* offer an alternative. They can be found naturally on hills, valleys and roadsides of the western highlands of Cameroon (WHC) and are relished by ruminants. *Tephrosia spp.* are easy to establish and regenerate rapidly after pruning. For any multipurpose fodder tree or shrub species to be of value to livestock, it should combine sustained productivity with persistence defoliation. Management factors that can affect tree productivity include age at first cutting, cutting height, cutting frequency and season of cutting.

Cutting can therefore be used to favourably manipulate the phenology of browse plants for fodder production. Time of cutting must therefore be defined in terms of weather patterns, plant phenological responses and constraints to preserving feed surpluses in the rainy season for use in the dry season (Ivory, 1990). A proper cutting management strategy is therefore important to ensure sustainable production of *Tephrosia spp.* for fodder feeds. It has also been observed that all tree forage systems in the humid tropics are productive in the wet than in the dry season. The study investigated the effect of: (i) sowing date on establishment of *Tephrosia spp;* (ii) cutting height on dry matter yield of *Tephrosia spp* (iii) and the effect of tree cutting intervals on dry matter yield of *Tephrosia spp.*

MATERIALS AND METHOD

The experiments were conducted at the Institute of Agricultural Research for Development (IRAD), Mankon Station, Bamenda in the western highlands of Cameroon (WHC). The station lies at an altitude of 1300m above sea level. The annual average rainfall ranges from 1500 to 2000mm with some places exceeding 3000mm. The average mean minimum and maximum temperatures at the experimental site were 10.6^{oC} and 25.1^{oC}, respectively. The zone is characterized by a unimodal rainfall pattern lasting from mid-March to October followed by a relatively cool dry season period (November to December) and a warm dry season (January to March). The WHC is characterized by ferralitic soils derived from basic rocks, the texture ranges from sandy clay to clay. They are classified as haplic ferralsols in association with rhodic ferralsols (Yerima and Ranst 2005). The soils are acidic (pH 5 - 6), low in organic carbon content and total Nitrogen (N), deficient in exchangeable Potassium (K) and available Phorsphorus (P) Three *Tephrosia* species were investigated. The Species were *T. candida* (Roxb.) D.C, *T. purpurea* (L) *Pers* and *T. vogelii* (Hemsley) A. Gray. Seeds were scarified to break dormancy by pouring four times their volume of boiling water (100^{0C}) and left immersed for one minute (IRAD, 1990).

Experiment 1: *Effects of sowing dates and pruning heights on DM yields:* The experiment was laid out in a split-split plot design with month of planting as main plot. There were four planting months viz. April, May, June and July. Species were in sub-plots and consisted of *T. candida*, *T. purpurea* and *T. vogelii* while cutting height was the sub sub-plot factors with 75cm and 50cm cutting heights. The treatments were replicated four

times. The seeds were drilled at the rate of 20kg/ha seed in row 0.5m apart. The plots were weeded manually when necessary. One year after sowing, plants of species under investigation were cut back to heights of 50cm and 75cm above ground level and the herbage discarded out of the experimental site for uniform growth to occur. Regular 12-weekly harvest commenced for the two growing seasons. Six harvests were taken in the two growing season under each planting month. Harvesting was done manually using a machete.

Experiment 2: *Effect of cutting intervals on dry matter yield:* The experiment was a 3 x 3 factorial in a split-plot design replicated 4 times. Species (*T. candida*, *T. purpurea*, *T. vogelii*) constituted the main plot factor. Cutting interval was the sub-plot factor with three cuttings intervals i.e. cutting at 8, 12 and 16 weeks above ground level. Randomization was done at the levels of the main plots and sub plots. During planting, three seeds were sown in each planting hole and two to three weeks later; seedlings were thinned to one plant per stand. Weeding was carried out manually as necessary during the establishment period. The plants were allowed to establish for eight months, after which the plants were then cut back to 75cm above ground level and cut herbage was discarded. Subsequent regrowth was harvested by cutting at 75cm above ground level at the designated intervals of 8, 12 and 16 weeks. Harvesting was done manually using a machete. At each harvest, total fresh herbage yield per plot was recorded. Fresh sub samples from each plot were sorted into subsamples of edible forage i.e. leaves together with stems of less than 6mm diameter (Tarawali et al., 1995). The samples were oven dried at 60^{oC} to constant weight for the determination of dry matter (DM).

Statistical Analysis: Data generated was subjected to analysis of variance using the general linear model procedure of statistical analysis (SAS 1995). Statistical differences among treatment means were declared at 5% level of significance. Means were separated using Duncan multiple range test.

RESULTS AND DISCUSSION

Effect of sowing date on dry matter yields of *Tephrosia* species: Table 1 shows the forage DM yield of the three *Tephrosia spp.* at different sowing dates and different cutting heights. When averaged over species, DM yields declined with later sowing. However, *T. vogelii* recorded its highest yield from the second planting in May while the other two species produced their highest yields from the first planting date in April. This difference in response is reflected in the significant species x sowing date interaction.

Effects of height of cutting and dry matter yields of *Tephrosia* species: Table 2 shows the effect of height of cutting above ground level on the three *Tephrosia spp.* Forage DM yields nearly doubled or actually doubled in all species when cutting height was increased from 50cm to 75cm. Similarly, averaged over planting dates, forage DM yield was doubled with increase in cutting height from 50cm to 75cm (Table 3). DM yields were highest (2443.61kg/ha) on average, when Tephrosia spp. were planted in April and cut at a height of 75cm above ground level and lowest 418.06kg/ha when planted in July

and cut at a height of 50cm above ground level. The difference in DM yields with respect to cutting height was significant. The dry matter (DM) yields of the *Tephrosia* spp. at various cutting intervals are presented on Table 4. The species differed significantly in DM yields. Forage DM yields increased with increasing cutting interval from 8 to 12 weeks and decreased thereafter at 16 weeks for *T. candida* and *T. purpurea*. For *T. vogelii*, forage DM yield continued to increase with increasing cutting interval. Averaged over species, higher DM yields were obtained at the 12 and 16 weeks harvest intervals relative to the 8-week interval (Table 4) and these differences were significant.

In agreement with other reported results, the DM yields of *Tephrosia spp.* planted early in the rainy season in April were the highest. April-sown plants would have had maximum access over a longer period to required environmental factors such as rainfall and sunlight than plants planted at later dates as also observed by (Otsiyina et al. 1998), (Tripathi and Psychas 1992) and (Tarawali et al. 1995). This is reflected in the conclusions of (Adejumo 1992) who worked with *Gliricidia sepium* in Southern Nigeria that *Tephrosia spp.* should be planted early in the year as soon as the rains are steady such as in April and May in the Western Highlands of Cameroon but not when there is heavy or torrential rain later in the year such as in June or July, because establishment will be difficult under such conditions. The DM yields of *Tephrosia spp.* in the present study were influenced by cutting height and cutting intervals. Increased DM yields with increasing cutting intervals are related to better root development and higher photosynthetic area for light interception of the plants (Ezenwa et al 1995). The increase in fodder yields in response to increased cutting height has also been reported for *G. Sepium* (Erdmann, Nair and Khan., 1993).

Cutting stimulates the growth of side branches and subsequent production of leaves (Pegorie, 1990). Plants cut do not flower but produce substantial regrowth. Although more frequent harvests favour increased proportion of foliage (Duguma, Khan and Okli et al., 1988), frequent harvests affect the regrowth potential adversely (Ezenwa and Atta-Krah, 1992; Ezenwa, et al 1995). The decrease in biomass with more frequent cuttings in the present study may also be due to poor regenerative regrowth ability of the species. In the humid lowland of Cameroon, (Duguma and Tonye 1994) report similar results with fast growing *Paraserianthes falcataria* and *Acacia auriculiformis* which, though fast growing, exhibited poor regrowth when cut.

The results indicate that 12-weekly cutting meet the need for high DM yields as well as more even distribution of herbage production during the year. Thus, 12 weeks appears to be a sustainable cutting interval. (Ezenwa 1999) also report highest yields of foliage and total biomass by cutting Enterolobium cyclocarpus every 12 weeks at 50cm above ground level. In the present study, cutting every 8 weeks does not appear to allow for enough time for biomass accumulation and reserve substances needed for regrowth. The 16-week interval can be adopted if biomass is to be converted to silage due to the high herbage yield at the first harvest but if a continuous supply of herbage is needed to feed livestock, then the best cutting interval is 12 weeks. Germination was lowest (58%) for *T. candida* and highest (93%) for *T. purpurea* with *T. vogelii* registering 90% germination.

CONCLUSION

This study was designed to experiment the response to sowing dates, pruning heights and cutting intervals of fodder production (*Tephrosia* species) in the Western Highlands of Cameroon. It has been observed that all tree forage system in the humid tropics are productive in the wet than in the dry season. The 16-week interval can be adopted if biomass is to be converted to silage due to the high herbage yield at the first harvest but if a continuous supply of herbage is needed to feed livestock, then the best cutting interval is 12 weeks. Germination was lowest (58%) for *T. candida* and highest (93%) for *T. purpurea* with *T. vogelii* registering 90% germination. A proper cutting management strategy is therefore important to ensure sustainable production of *Tephrosia* spp. for fodder feeds. For proper establishment and adequate dry matter yield the three *Tephrosia* species should be planted when the rains are steady, between April and May, cut at 12 weeks interval at a height of 75cm above ground level for optimum DM production.

Table1: Dry mater yields of three *Tephrosia* species when sown on different dates and cut at different heights above ground level averaged over two years

Species	**Sowing date**	**Cutting height (cm)**	
		50kg/ha	**75**kg/ha
T. candida	April	1684cd	2066c
	May	440 hi	1086ef
	June	532 hi	1492de
	July	283 i	1017fg
T. purpurea	April	1151ef	2591b
	May	541hi	1247def
	June	446hi	1086fg
	July	224i	313i
T. vogelii	April	1057ef	2552b
	May	1614d	3593a
	June	569hi	1438def
	July	749gh	1492de

Values with the same letters in rows and columns are not significantly different (p < 0.05)
Species x sowing date; Species x cutting height*; Sowing date x cutting height*; Species x sowing date x cutting height*; *Significant (P<0.05)*

Table 2: Effects of cutting height on DM yield of *Tephrosia* species

	Cutting height (cm)		
Species	**50kg/ha**	**75kg/ha**	**Mean**
T. candida	732.60e	1453.13b	1092.87b
T. purpurea	590.63 f	1296.67c	943.65c
T. vogelii	996.67d	2268.96a	1632.82a
Mean	773.30b	1672.92a	

Values with the same letters in rows and columns are not significantly different (p < 0.05)
Means in a row or column with the same letters are not significantly different (p < 0.05)

Table 3. Effects of sowing date on DM yield of Tephrosia species

Time of	**Cutting height (cm**		
sowing	**50kg/ha**	**75 kg/ha**	**Mean**
April	1297.08c	2443.61a	1870.35a
May	869.58d	1975.56b	1422.57b
June	504.47 e	1331.67c	918.07c
July	418.06 e	940.83d	679.45d
Mean	772.30 b	1672.92a	

Values with the same letters in rows and columns are not significantly different (p < 0.05)
Means in a row or column with the same letters are not significantly different (p < 0.05).

Table 4: Effects of cutting interval on DM yields of *Tephrosia* spp.

Species	Cutting intervals in weeks (kg/ha)			
	8	12	16	Mean
T. candida	518.33g	1296.33de	872.83 fg	895.83c
T. purpurea	1643.67cd	2271.17a	2080.17ab	1998.34a
T.vogelii	798.50fg	1066.25ef	1806.00bc	1223.59b
Mean	986.83b	1544.58a	1586.33a	

Values with the same letters in rows and columns are not significantly different at the 5% level. Means in a row or column with the same letters are not significantly different at the 5% level.

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