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Relationships among Body Traits of African Giant Land Snail (Achachatina Marginata) at Different Age Groups

By Samuel Oladipo Kolawole Fajemilehin, Maria Kikelomo Adegun, Fagbuaro & Sola Sunday

Ekiti state University, Nigeria

Abstract- The experiment designed to investigate the various body parameters of African Giant Land Snail and their relationships was carried out at the Teaching and Research Farm, Ekiti state University, Ado – Ekiti between 21st of November 2011 and 2nd of January 2012 using a total of 182 snails of four different age groups defined as >2 years; >1 year < 2 years; >6 months < 1 year and <6 months. The variables examined include whole weight, whorl number, whorl length and shell opening. Data collected were subjected to ANOVA, correlation and regression analyses using SPSS statistical package. Results showed significant (p < 0.05) differences between age and all the parameters investigated except whorl number in all the age groups. The correlation between age and whorl length showed that there was significant effect (p < 0.05) among the variables. A negative correlation between the whorl number and shell opening (-0.14) was recorded. The regression of whole weight on whorl length and shell opening were highly significant (p<0.01) with R2 values of 0.67 in both cases while the regression of whole weight on whorl number was significant (p<0.05) with R2 value of 0.19.

Conclusively, age and weight of African Giant Snail have significant effects on the body measurements.

Keywords: shell opening, whole weight, whorl length, whorl number, correlation, regression.

GJSFR-D Classification : FOR Code: 070799
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Conclusively, age and weight of African Giant Snail have significant effects on the body measurements.

Keywords: shell opening, whole weight, whorl length, whorl number, correlation, regression.

I. INTRODUCTION

Achachatina marginata is one of the two most popular breeds of snails in Nigeria (Okon and Ibom 2011). Hunting of Achachatina marginata defined as gathering of snails from bush around homesteads, thick forest and cash crop plantations during clearing is an age long farming activity by both children and adults living in farming and rural areas of South Western Nigeria. The need for such farming activities arose probably out of inquisitiveness and pleasure derived by snail – gatherers, ease with which they are handpicked, provision of supplemental food for the household and the need to meet/supplement the hunters’ financial needs.

The initial aim of raising snails just for sustenance has changed. Snail farming is now an enterprising business in most parts of the world. This is probably because snails have numerous advantages over the conventional domesticated animal species. These advantages include; management ease; requirement for small rearing space; source of high quality animal protein (Ajayi et al 1998; Cobbinah 1998); its high contents iron and phosphorus; low content of sodium, fat and cholesterol (Akinnusi, 2002, Ejidike, 2002); its shell usefulness as calcium salt in animal formulated feeds, making ornaments, ashtrays, scouring powder and ceramic materials (Awesu 1980); its therapeutic values and the usefulness of the shell and the facial droppings as valuables in fertilizer production.

To ensure the sustainability of this enterprise, the productive capability of the animal must be improved optimally. Okon and Ibom (2011) asserted that genetic improvement of animal species can be achieved by quantitative measurements, correlation among performance traits and development of selection programme for effective planning. They opined that regression and correlation are the two most common techniques used to determine the relationships between and/or among two or more variables. This study is therefore designed to carry out a quantitative measure of the animal’s morphometric traits and to determine the interrelationships among the traits using correlation and regression techniques.

II. MATERIALS AND METHODS

a) Location and Housing

The experiment was carried out at the Teaching and Research Farm, Ekiti state University, Ado – Ekiti between 21st of November 2011 and 2nd of January 2012. The snails were reared in 3 movable cages with each cage measuring 180 x 120 cm in length and breadth respectively. Each cage was partitioned into six compartments and raised by 25 cm off ground with their legs placed in plastic bowls containing used engine oil to protect invasion by soldier ants and other insects. The cages were sheltered with wire mesh and mosquito nets with hinges and padlocks for each compartment. The floor of each of the compartments was covered with sack on which loamy soil was laced to a depth of 15 cm.

b) Experimental animal and Design

A total of 182 African Giant Land Snails (Archachatina marginata) of four different age groups as detailed in Table 1 below were used for the study. Each
age group was identified with a permanent Schneider made blue marker. Snails belonging to the different age groups were randomly allocated into the cages under Completely Randomized Design. Dry plantain and banana leaves were used to cover up the snails mainly to protect them from direct sun rays. The leaves were replaced 4 times in a month before the end of the experiment.

**Table 1 : Number of snails examined according to age group**

<table>
<thead>
<tr>
<th>Age group</th>
<th>Number of animals/compartment</th>
<th>Number of compartments</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2 years</td>
<td>4</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>&gt;1year&lt;2years</td>
<td>4</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>&gt;6months&lt;1year</td>
<td>5</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>&lt;6months</td>
<td>5</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
<td><strong>182</strong></td>
</tr>
</tbody>
</table>

c) **Feeding**

The snails in all the age groups were uniformly fed with sliced unripe pawpaw, plantain peel and pawpaw leaf. The feeding was done once daily. The leftover feed was removed daily before fresh ones were served. Adequate amount of water was supplied by wetting them regularly because the study was conducted during dry season.

d) **Data collection**

Data were collected on the following variables at 2 weeks interval: whole weight, whorl number, whorl length and shell opening. The whole weight was measured using Harvard air sensitive weighing balance to the nearest gram; whorl number examined by counting the numbers of whorls (rings) on the shell; whorl length measured as distance from the apex to the end of each whorl using a thread and latter placed on a tape to the nearest centimetre and the shell opening was measured in a similar way the whorl length was measured. To enhance accuracy and objectivity, the average length of all the whorls measured on each snail was taken as the whorl length of that animal and the average of the vertical and horizontal lengths of the opened region of the foot was considered as the shell opening of each experimental unit.

e) **Statistical analysis**

The means of each body trait were obtained for each age group. After checking the normality of data distribution and the equality of variances, the traits were treated statistically like independent variables. The values of each trait were subjected to an analysis of variance using the SPSS (1990) statistical package to evaluate the significance of sources of variation affecting measurements of each animal. Where significant differences were obtained, DMRT (Duncan, 1995) was used to verify significant differences among the means of the different age groups. Regression and Correlation analyses were done using the Correlation and Regression procedures of the same package. The regression model used was \( Y = a + b \times \) where : \( Y \) = Dependent variable; \( a \) = Intercept on y-axis; \( b \) = Regression coefficient and \( x \) = independent variable.

III. **Results and Discussion**

Table 2 showed the effects of age on all the variables measured. A look at the table revealed significant differences (\( p<0.05 \)) in whorl length, whole weight and shell opening in all the age groups and periods examined with age Group 4 consistently showing superiority over all the other age Groups. However, the whorl number values showed that there were no significant (\( p > 0.05 \)) differences among all the age Groups. Interestingly, the whorl numbers were constant within the same age Groups in the four periods investigated. The ranges recorded were 145 g, 2.17 cm, 0.510 cm and 1.55 cm; 142 g, 1.76 cm, 0.510 cm and 1.38 cm; 132 g, 1.75 cm, 0.510 cm and 1.34 cm; 116 g, 1.75 cm, 0.510 cm and 1.32 cm for Whole weight, Whorl length, Whorl number and Shell opening for periods 1, 2, 3 and 4 and for age groups 1, 2, 3 and 4 respectively. Succinctly, it was observed that as the snail aged in the different periods the whorl length, whole weight and shell opening increased progressively. The implication of this is that growth occurred from age group 1 – 4. It is important to note from this result, that in age groups 1 - 3, there were increases in the values recorded for whole weight, whorl length and shell opening among the different periods the data were collected but in age group 4 they were the same. This is most probably because the matured body weight of the animal had been fully attained at this age Group and so no further increment could occur in the parts investigated.
**Table 2**: Effects of age on measured variables at periods 1 - 4

<table>
<thead>
<tr>
<th>Periods</th>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period 1</td>
<td>Whole weight (g)</td>
<td>178&lt;sup&gt;d&lt;/sup&gt;</td>
<td>194&lt;sup&gt;c&lt;/sup&gt;</td>
<td>291&lt;sup&gt;b&lt;/sup&gt;</td>
<td>323&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Whorl length (cm)</td>
<td>4.32&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.75&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.66&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Whorl number (cm)</td>
<td>4.96</td>
<td>5.00</td>
<td>5.00</td>
<td>5.47</td>
<td>0.15</td>
</tr>
<tr>
<td>Period 2</td>
<td>Shell Opening (cm)</td>
<td>6.24&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.59&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Whole weight (g)</td>
<td>181&lt;sup&gt;d&lt;/sup&gt;</td>
<td>195&lt;sup&gt;c&lt;/sup&gt;</td>
<td>292&lt;sup&gt;b&lt;/sup&gt;</td>
<td>323&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Whorl length (cm)</td>
<td>4.74&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.04&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.95&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.14</td>
</tr>
<tr>
<td>Period 3</td>
<td>Whorl number (cm)</td>
<td>4.96</td>
<td>5.00</td>
<td>5.00</td>
<td>5.47</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>Shell Opening (cm)</td>
<td>6.41&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.75&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Whole weight (g)</td>
<td>192&lt;sup&gt;d&lt;/sup&gt;</td>
<td>201&lt;sup&gt;c&lt;/sup&gt;</td>
<td>296&lt;sup&gt;b&lt;/sup&gt;</td>
<td>323&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12</td>
</tr>
<tr>
<td>Period 4</td>
<td>Whorl length (cm)</td>
<td>4.76&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.17&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Whorl number (cm)</td>
<td>4.96</td>
<td>5.00</td>
<td>5.00</td>
<td>5.47</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Shell Opening (cm)</td>
<td>6.46&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.79&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.48&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.80&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>Whole weight (g)</td>
<td>207&lt;sup&gt;d&lt;/sup&gt;</td>
<td>223&lt;sup&gt;c&lt;/sup&gt;</td>
<td>314&lt;sup&gt;b&lt;/sup&gt;</td>
<td>324&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Whorl length (cm)</td>
<td>4.76&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.18&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.16&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Whorl number (cm)</td>
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<td>5.00</td>
<td>5.00</td>
<td>5.47</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>Shell Opening (cm)</td>
<td>6.48&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.80&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.50&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.80&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<sup>a</sup>,<sup>b</sup>,<sup>c</sup> means on the same row with different superscripts are significantly (p<0.05) different.

1 = Age group <6months; 2 = Age group > 6months < 1 year; 3 = Age group > 1year < 2years and 4 = Age group > 2 years. Period 1 = First fortnight, Period 2 = Second fortnight, Period 3 = Third fortnight and Period 4 = Fourth fortnight.

Table 3 showed the results of phenotypic correlations between morphometric traits of the snails evaluated in periods 1 and 2. The results indicated positive and high significant phenotypic correlations ($r_p$) between whole weight and whorl length ($r=0.55$) and between whole weight and shell opening ($r=0.41$) in the upper matrix and between whole weight and whorl length ($r=0.49$) in the lower matrix. Positive and significant phenotypic correlations ($r_p$) were recorded between whole weight and whorl number ($r=0.25$), between whorl length and whorl number ($r=0.12$) and between whorl length and shell opening ($r=0.07$) in the upper matrix and between whole weight and whorl opening ($r=0.37$), between whorl length and whorl number ($r=0.16$) and between whorl length and shell opening ($r=.11$) in the lower matrix. Negative and significant phenotypic correlations ($r_p$) were recorded between whorl number and shell opening ($r=-0.14$) in the upper matrix and between shell opening and whorl number ($r=-0.12$) in the lower matrix.

Table 4 showed the results of phenotypic correlations between morphometric traits of the snails studied at periods 3 and 4. The results revealed positive and significant phenotypic correlations ($r_p$) between whole weight and whorl length ($r=0.15$), between whole weight and shell opening ($r=0.37$) and between whorl length and whorl number in the upper matrix and between whole weight and whorl length ($r=0.40$) and between whorl number and whorl length ($r=0.19$) in the lower matrix. Negative and significant phenotypic correlations ($r_p$) was recorded between whorl number and whorl length ($r=0.20$), between whole weight and shell and shell opening ($r=0.15$) only in the lower matrix.

**Table 3**: Correlation of Whole weight and body dimensions of African Giant Land Snail (*Achatina marginata*) for Periods 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>Whole weight</th>
<th>Whorl length</th>
<th>Whorl number</th>
<th>Shell opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole weight</td>
<td>-</td>
<td>0.55**</td>
<td>0.25*</td>
<td>0.41**</td>
</tr>
<tr>
<td>Whorl length</td>
<td>0.49**</td>
<td>-</td>
<td>0.12*</td>
<td>0.07*</td>
</tr>
<tr>
<td>Whorl number</td>
<td>0.20*</td>
<td>0.16*</td>
<td>-</td>
<td>-0.14*</td>
</tr>
<tr>
<td>Shell opening</td>
<td>0.37*</td>
<td>0.11*</td>
<td>-0.12*</td>
<td>-</td>
</tr>
</tbody>
</table>

Upper matrix = Period 1; Lower matrix = Period 2

** = (P<0.01) and * = (P<0.05)
Correlation, a dimensionless quantity having values ranging from -1 to +1 is a measure of the intensity of association. A positive correlation means that the values of both variables rise or fall together while negative coefficient implies that an increase in one variable associates with a decrease in the other. The magnitude of the coefficient is an indication of how closely linear the variables are. In the present study, low positive relationships among the traits measured were recorded. This suggests that the traits affected are likely to be weakly under the effect of same gene action meaning that selection for an improvement of one trait will lead to a marginal positive improvement in the other traits. The proportional relationships with age reported in this study is in agreement with the work of Ojo (2011) who reported low proportional relationships with age for whorl length, whorl number, whole weight and shell opening in matured Achachatina marginata. Also, similar weak relationships have been reported by few authors in chicken (Tamer et al 2011) between live weight and head length and Sheila et al (2009) who investigated the relationships of body weight to external body measurements among the variables were generally low. Also, weight of the examined snails can be predicted with reasonable accuracy from Whorl length and Shell opening.

Table 4: Correlation of Whole weight and body dimensions of African Giant Land Snail (Achachatina marginata) for Periods 3 and 4

<table>
<thead>
<tr>
<th>Variable (X)</th>
<th>Y = a + bx</th>
<th>R²</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whorl length</td>
<td>Y = -175 + 74.76x</td>
<td>0.67</td>
<td>**</td>
</tr>
<tr>
<td>Whorl number</td>
<td>Y = -318 + 107x</td>
<td>0.19</td>
<td>**</td>
</tr>
<tr>
<td>Shell opening</td>
<td>Y = -401 + 91.01x</td>
<td>0.67</td>
<td>**</td>
</tr>
</tbody>
</table>

** means p<0.01

IV. Conclusion

The results obtained in this study revealed that age and weight of African Giant Snail had significant effects on the body measurements. The correlations among the variables were generally low. Also, weight of the examined snails can be predicted with reasonable accuracy from Whorl length and Shell opening.

References


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Acaricidal Effect of Foam Soap Containing Essential Oil of Ocimum gratissimum Leaves on Rhipicephalus lunulatus in the Western Highland of Cameroon


University of Dschang, Cameroon

Abstract-Acaricidal effect of foam soap containing essential oil of Ocimum gratissimum leaves was tested on Rhipicephalus lunulatus in western highland of Cameroon. Five doses of essential oil (0.00; 0.04; 0.06; 0.08; 0.10μl/g) with four replications for each dose were tested in vitro. Each replication consisted of 10 ticks in Petri dish with filter paper impregnated uniformly with the foam soap on the bottom. Four of those doses (0.00; 0.06; 0.08; 0.10 μl/g) in three replications were used in vivo. In this case, each replication was made up of 10 naturally ticks infested goats. Results of this study indicated that foam soap containing essential oil of O. gratissimum leaves is toxic to R. lunulatus. The in vitro mortality rate was observed to vary from 0 to 30.00% during the treatment with the controls as compare to 80.00% with the lowest dose (0.04μl/g) on day 8 and 100.00% with the highest dose on day 6. Meanwhile, the in vivo mortality rate was observed to be 22.69% with control on day 8 after treatments whereas the highest dose killed 93.87% of the tick by this day 8. The LD50 of the foam soap containing essential oil was 0.061μl/g for in vitro and 0.066μl/g for in vivo on day 2.

Keywords: foam soap, essential oil, ocimum gratissimum, rhipicephalus lunulatus, cameroon.

GJSFR-D Classification : FOR Code: 079999
Acaricidal Effect of Foam Soap Containing Essential Oil of Ocimum gratissimum Leaves on Rhipicephalus lunulatus in the Western Highland of Cameroon

Miégoué E a, Tendonkeng F b, Khan Payne V c, Lemoufouet J b, Kouam K. M v, Boukila B f & Pamo Tendonkeng E g

Abstract- Acaricidal effect of foam soap containing essential oil of Ocimum gratissimum leaves was tested on Rhipicephalus lunulatus in western highland of Cameroon. Five doses of essential oil (0.00; 0.04; 0.08; 0.10 µl/g) with four replications for each dose were tested in vitro. Each replication consisted of 10 ticks in Petri dish with filter paper impregnated uniformly with the foam soap on the bottom. Four of those doses (0.00; 0.06; 0.08; 0.10 µl/g) in three replications were used in vivo. In this case, each replication was made up of 10 naturally ticks infested goats. Results of this study indicated that foam soap containing essential oil of O. gratissimum leaves is toxic to R. lunulatus. The in vitro mortality rate was observed to vary from 0 to 30.00% during the treatment with the controls as compare to 80.00% with the highest dose on day 6. Meanwhile, the in vivo mortality rate was observed to be 22.69% with control on day 8 after treatments whereas the highest dose killed 93.87% of the tick by this day 8. The LD50 of the foam soap containing essential oil was 0.061 µl/g for in vitro and 0.066 µl/g for in vivo on day 2. This indicates that this medicated soap is potentially highly efficient on this parasite.

Keywords: foam soap, essential oil, ocimum gratissimum, rhipicephalus lunulatus, cameroon.

I. INTRODUCTION

Breeding of ruminants constitutes one of the main productions activities in many African regions in general and in particularly in Cameroon (Pamo et al., 2002). In Cameroon, small ruminants are used as source of income and for many other purposes almost every where in the country (Pamo et al., 2001; Pamo et al., 2004). Specifically, goats for breeders are easily mobilizable investment, having a very short development cycle (Lhoste et al., 1993). Following these considerations, it appears necessary to set interested in the breeding condition of goats in this zone where the demographic and hygienic conditions are not favorable for breeding activities.

Goat breeding is slowed down by various factors including nutrition; diseases and also ticks infestation which are the most important (Pamo et al., 2005; Tendonkeng et al., 2010). This Rhipicephalus lunulatus tick has been reported to be a common ectoparasite of goats in Cameroun and the surrounding countries (Pamo et al., 2005).

In fact, ticks in general and Rhipicephalus lunulatus are one of the main causes of mortality in farm animals (IEMVT, 1989). They are also responsible for secondary infections which could be bacterial, viral or protozoa related (Souslb, 1982). Furthermore, each of the conventional methods of tick control is quite costly and environmentally unfriendly (Pamo et al., 2005). Attention is then shifted towards natural substances with therapeutic properties like essential oils extracted from some plants. Indeed, a substantial part of plants (leaves, fruits, flowers, stems and roots) contain antiseptic, anti-inflammatory, insecticidal, bactericidal healing substances (Kuiate, 1993). The acaricidal effect of essential oils of many plants has been documented in many studies (Pamo et al., 2002; Pamo et al., 2003; Pamo et al., 2005). An important example is Ocimum gratissimum whose leaves were shown to contain essential oils which make them to be sometimes irritating and toxic (Daget & Godron, 1995; Tapondjou et al., 2002; Pamo et al., 2002). Those previous studies then bring up the problem of conditioning theses essentials oils in better way for their efficient utilization for on farm ticks control. This study is therefore aimed at finding an efficient, cheap and easily applicable method of using essential oils to fight against ectoparasites in general and ticks in particular.

II. MATERIALS AND METHODS

a) Extraction of O. gratissimum essential oil

Fresh leaves of O. gratissimum were harvested and sun dried for 3 days. Extraction of essential oil was done by hydrodistillation (Kuiate, 1993). Two kilograms...
of dried leaves were soaked in 6 l of water and boiled for 10h in the modified Clavenger vendor. The evaporate was collected in an open mouth bottle and filtered.

The yield of essential oil was calculated using the following formula:

\[
\text{yield} = \frac{\text{weight of essential oil}}{\text{weight of } O. \text{ gratissimum leaves}} \times 100
\]

b) Collection and identification of ticks

Male and female R. lunulatus ticks, frequently found on ruminants in the highlands of west Cameroon, were collected by manual removal without breaking their rostrum. These ticks were fixed in ethyl acetate and identified as R. lunulatus according to Walker et al. (2002). To have an uninfested goat population, 10 West African dwarf goats were examined and all ticks removed. Another manual removal of ticks was done 30 days later. A total of 72 ticks were collected from the 10 goats. The average weight of engorging ticks was 0.5±0.1g and the average length was 6.5±0.4 mm. These two parameters (weight and length) were used in the tests.

c) Preparation of medicated soap

Palm oil liquid soap was used as vehicle for the essential oil. A volume of 900µl of essential oil was added to 450 g of liquid soap to obtain a concentration of 2µl/g base on which all doses were prepared. The solution was poured into the molds and allowed to solidify.

d) In vitro study

R. lunulatusticks were collected from various West African Dwarf goats and identified. A disc of N°1 Whatman filter paper measuring 62.63 cm² surface area was soaked with soap of various concentrations of the essential oil (0.00; 0.04; 0.06; 0.08; 0.10 µl/g) and placed in clear dry Petri dishes with four replicates each at room temperature (24°C, humidity 70%). Ten ticks randomly placed in each Petri dish and covered. The plates were examine each morning during 8 days and dead ticks, if any, were counted and removed. One soap sample without essential oil served as control. The mortality rate of the tick was calculated as described by Abott (1925), and lethal dose 50 (LD50) was calculated according to Valette (1972).

\[
\text{LD50} = \frac{\text{M0} - \text{Mt}}{100 - \text{Mt}} \times 100
\]

Where: M0 is the accrued and corrected death rate, M0 the death rate in Petri dishes treated and Mt the death rate in the control Petri dish (natural mortality).

e) In vivo study on the acaricide property of essential oil

The number of R. lunulatus ticks was counted at the preferential sites (ears, tail and head) (Tenekeu, 2002) on each of the 40 goats selected in this study. Soap with four concentration of essential oil selected through an anhydrous sodium sulphate column to eliminate the trace of water present in the essential oil. The oil was stored in the dark at room temperature, after in vitro test (0.00; 0.06; 0.08; 0.10 µl/g) was applied on batches of 10 goats. The preferential sites were examined for the number of live/dead ticks every 24h for 8 days. Three replicates of 10 goats/group/dose (120 goats) were carried out during on-farm trial. Ticks removed by engorgement were not taken into consideration during analysis.

f) Statistical analyses

The cumulative and corrected mortality percentages were submitted to analysis of variance (Mc Clave and Dietrich, 1979) and the differences between the treatments were analyzed by student’s t-test.

III. Results and Discussion

a) In vitro study

The yield of the oil extraction was 0.62 %. This yield was higher than that obtain by Pamo et al. (2003) which was 0.50 %. This difference can be explained by many factors including the distillation method and the period during which the plant was harvested.

All the three concentrations tested in the study showed some acaricidal effect on R. lunulatus. Efficiency increased as the concentration of essential oil increased and with the duration of exposure. The highest dose (0.10 µl/g) killed all ticks by day six of exposure while, the lowest dose (0.04 µl/g) caused 80 % of mortality within the eighth day of the trial. By the end of the study, control dose killed only 30% of ticks (Figure 1). This study established that the essential oil obtained from O. gratissimum, and incorporated in soap as carrier was toxic to ticks, and toxicity was directly proportional to the concentration of the essential oil in the soap. The toxicity of these soaps containing essential oil can be mainly attributed to the predominance of Phenolics and Terpenoids compounds present in the essential oil. The main compound of this essential oil is Thymol. This compound is a highly selective chemical substance attacking specific aspects of the endocrine system of insect, thus inducing a toxic effect (Ojimelukwe and Alder, 1999). The high toxicity of this essential oil suggest, that Thymol, known for his insecticidal and acaricidal effect (Tapondjou et al., 2003; Tapondjou et al., 2005; Ndomo et al., 2009) react in synergy with other monoterpenes like γ-terpinen, p-cymen, terpenoids like β-caryophyllen, and eugenol which insecticidal activities have been documented (Tchoubougnang, 1996; Obeng-Ofory et al., 1997; Tapondjou et al., 2005; Ndomo et al., 2009). Action of phenolics compound such as linalool and γ-terpinol is also important. These substances are recognized as important insecticides, fungicides and bactericides (Hassanali et al., 1990; Obeng-ofory et al., 1997). This reality was confirmed by Pamo et al. (2003)
who demonstrated the acaricidal effect of crude essential oil from O. gratissimum leaves. Finding from these studies showed that these essential oils which were mainly rich in monoterpen in general and in thymol in particular can induce not only toxic effect but also metabolic disorder in R. lunulatus that may impact their development and reproductive process. The high mortality record in the control group can be explained by other soap components such as soda. The regression equation derived by comparing the average cumulative mortalities with the concentration of essential oil (Y=656.25X+11.455; R²=0.9213; Figure 2) revealed that 97.96% of the correlation with mortality doses could be assigned to the concentration of the essential oil.

The adjustment of the average cumulative mortality percentages with doses in time led to the regression equation: Y= 656.25X +11.455 (R²=0.9213).

Following the transformation of the mortality percentages to probits at the end of the second day of exposure, the regression line Y=5.1015X+10.19 (R²=0.9621) showed that after 2 days of exposure, the LD₅₀ was 0.061µl/g. These confirm the degree of toxicity of soap containing essential oil of O. gratissimum on R. lunilatus.

b) In vivo study

The cumulative mortality of ticks was significantly higher in all treatment groups than the control by third day after treatment. This continued to increase with time in each group. By the end of study, the mortality was almost more than three time higher in group 2 and 3 and four time in group 4 as compared to control (Figure 3). Accordingly, soap containing essential oil at the rate of 0.10µl/g would be effective in completely eliminating the R. lunilatus ticks on goat within a week.

The regression equation (373.63X+5.473, R²=0.999) on mortality versus concentration of essential oil suggests that increasing concentration of essential oil in the soap had increasing effect on ticks.

Similarly, the regression line (Y=3.0771X+6.5929, R²=0.9868) suggest that by the second day of the treatment, the LD₅₀ was 0.066µl/g. There was no appeared side-effect of the medicated soap application on behaviors and/or health of goats. The in vivo mortalities were relatively lower as compared to those achieved in vitro with LD₅₀ of 0.061µl/g. This could be due to the fact that on-farm, the application of medicated soap was carried out on ticks that were allowed to continue feeding. In the laboratory the ticks were not fed, and thus were under stress. This could have weakened them with regard to synergetic activity of the ingredients of the medicated soap.

IV. Conclusion

The essential oil of O. gratissimum is toxic to R. lunilatus ticks, both in vitro and in vivo. The toxic effect of the medicated soap containing the essential oil on ticks increased as the concentration of essential oil increased and persisted during the entire period of the study. A low LD₅₀ (0.061µl/g for in vitro and 0.066µl/g for in vivo application) of the essential oil suggests that it bar potential or acaricidal agent for R. lunilatus ticks. Further studies on the chemical nature of the components of essential oil as well as the separation of the different fractions would improve our Knowledge and understanding. Identification of the active ingredient in the essential oil would improve quality and efficiency of the product. The effects of this essential oil on other tick species need to be studied. Likewise, the effect of repeated application of the medicated soap on adults ticks and their others life stage needs some evaluation.

References Références Referencias

Figure 1: Cumulative ticks mortality (%) following in vitro treatment with soap containing different doses of O. gratissimum leaves essential oil.

Figure 2: Regression line of the cumulative mortality of R. lunulatus and concentration of essential oil. The equation of the regression line is $Y = 656.25X + 11.455$ with $R^2 = 0.9796$.

Figure 3: Cumulative ticks mortality (%) following in vivo treatment with soap containing different doses of O. gratissimum leaves essential oil.
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Seasonal Productivity of Flemingia Macrophylla under Different Defoliation Frequencies

By Ram Prasad Ghimire, Naba Raj Devkota & Megh Raj Tiwari

Abstract- Flemingia macrophylla is introduced and established with the aim of helping to mitigate the dry season fodder deficit in many developing countries. A study was carried out to assess the effect of season and defoliation frequency on the fodder yield and the chemical constituents of F. macrophylla. The experiment was conducted using a Randomized Complete Block Design (RCBD) with 2 x 2 factorial arrangements of treatments for four-years-old mature stands of F. macrophylla. Dry and wet were the levels of season factor and three months and six months defoliation intervals were the levels of defoliation frequency. Each treatment was replicated for five times. The nutrient contents of fodders were determined using proximate analysis. The results showed that the plants harvested on wet season had higher (p<0.01) dried fodder yield than the plants harvested in dry seasons. The plants defoliated in three months interval had yielded higher (p<0.001) annual fodder biomass than the plants defoliated in six months interval. Likewise, the fodder harvested in the wet season had better nutrient composition compared to the fodder harvested in dry season. Similarly, the fodder harvested in three months defoliation interval had better nutrient composition than the fodders harvested in six months defoliation. The results revealed that the seasonal variation in dry and wet season yields of F. macrophylla was prominent, and harvesting of the fodder in three months defoliation interval could be the better practice in comparison to defoliation in six months interval in order to produce higher fodder yield with better nutrient composition.

Keywords: season, defoliation frequency, fodder yield, nutrient composition.

GJSFR-D Classification : FOR Code: 079999

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Seasonal Productivity of Flemingia Macrophylla under Different Defoliation Frequencies

Ram Prasad Ghimire \(^a\), Naba Raj Devkota\(^a\) & Megh Raj Tiwari \(^\rho\)

Abstract- Flemingia macrophylla is introduced and established with the aim of helping to mitigate the dry season fodder deficit in many developing countries. A study was carried out to assess the effect of season and defoliation frequency on the fodder yield and the chemical constituents of F. macrophylla. The experiment was conducted using a Randomized Complete Block Design (RCBD) with \(2 \times 2\) factorial arrangements of treatments for four-years-old mature stands of F. macrophylla. Dry and wet were the levels of season factor and three months and six months defoliation intervals were the levels of defoliation frequency. Each treatment was replicated for five times. The nutrient contents of fodders were determined using proximate analysis. The results showed that the plants harvested on wet season had higher \((p<0.01)\) dried fodder yield than the plants harvested in dry seasons. The plants defoliated in three months interval had yielded higher \((p<0.001)\) annual fodder biomass than the plants defoliated in six months interval. Likewise, the fodder harvested in the wet season had better nutrient composition compared to the fodder harvested in dry season. Similarly, the fodder harvested in three months defoliation interval had better nutrient composition than the fodders harvested in six months defoliation. The results revealed that the seasonal variation in dry and wet season yields of F. macrophylla was prominent, and harvesting of the fodder in three months defoliation interval could be the better practice in comparison to defoliation in six months interval in order to produce higher fodder yield with better nutrient composition.

Keywords: season, defoliation frequency, fodder yield, nutrient composition.

I. Introduction

Fodder production is the integral part of the ruminant production system. The ruminant animals are more dependent on the forage based system, especially in the developing countries. In this context, cultivation of different species and cultivars of fodders to feed livestock is a common practice. But, fodder deficit, especially in the dry seasons, is one of the major problems in many of the Asian, African and Latin American countries (Egan, 1997; Upreti and Shrestha, 2006; Pariyar et al., 2013). In order to mitigate the fodder deficit situations, many fodder species are being introduced and established with the aim of year round fodder production. Most of the established species and cultivars are more productive in wet seasons but the fodder yield drastically reduced in winter. The yield of the perennial fodder legumes, like other non-leguminous species, is more often influenced substantially by the season and defoliation frequency (Smith, 1992).

Use of shrubs and tree fodders for the sustainability of the year round fodder production is one of the accepted methods of overcoming the problems of dry season fodder deficit (Raynolds, 1995). Flemingiamacrophylla is a multipurpose perennial fodder legume species, especially popular for dry season fodder (Budelman and Siregar, 1997) with excellent coppicing capacity and re-growth after defoliation (Anderson et al., 2002). It is high biomass yielding and higher crude protein containing species of fodder shrubs which improves the soil fertility (Dung et al., 2005). This species had yielded higher fodder biomass with the defoliation interval of three months while compared with two months interval in the previous experiment (Kayastha, 2004). This study was carried out to identify the appropriate defoliation frequency in different seasons for the fodder yield and chemical composition of F. macrophylla aiming to generate suitable defoliation practices.

II. Materials and Methods

The experiment was conducted at the Livestock Farm of Institute of Agriculture and Animal Science, Chitwan, Nepal from July 2008 to June 2009. Geographically, it is located at 27°40′ N (latitude) and 84°19′ E (longitude) with an altitude of 228 masl. The soil was sandy loam and fairly well drained. The mean soil pH, organic matter, nitrogen, phosphorus and potash contents were 6.17, 2.09 %, 0.14 %, 40.6 kg ha\(^{-1}\) and 146.0 kg ha\(^{-1}\), respectively. Average monthly maximum and minimum temperatures and monthly total rainfall of the experimental duration is presented in Figure (1).

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The experiment was conducted using a Randomized Complete Block Design (RCBD) with 2×2 factorial arrangements. Four treatment combinations of two levels of season (dry and wet) and two levels of defoliation frequency (six months and three months interval) were employed. Each treatment was replicated five times. The experimental plants of four-years-old mature stands of F. macrophylla were used after maintaining the uniform defoliation height of 75 cm and uniform spacing of 90×70 cm. Each experimental plot was of 7.56 m² consisting of 12 plants plot⁻¹. The number of branches plant⁻¹ for different treatments at the beginning of the experiment were also similar (11.32±1.26).

Fresh and dry biomass assessment and sample collection were done at three and six months defoliation interval in both of the seasons. The harvestings were taken twice on wet (June 15 and September 15) and dry season (December 15 and April 15) for three months defoliation interval and once in wet season and once in dry season for six months defoliation interval. Harvesting of fodder was done by defoliating all the experimental plants (12 plants plot⁻¹) at 75 cm from the ground level. The leaves with their petioles were detached from the non-edible parts of branches and weighed separately, and the leaf and stem ratio was calculated. The numbers of branches were counted at the defoliation height in every harvesting.

a) **Laboratory Analysis**

Collected samples of fodders were dried at constant heat in hot air oven at 72°C for 24 hours and dry matter (DM) was estimated. Nitrogen content was determined by Micro Kjeldal method and crude protein (CP) content was calculated (AOAC, 1990). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined using the method developed by Van Soest et al. (1991).

b) **Statistical analysis**

The data were analysed by using Analysis of Variance (ANOVA) technique. The statistical analyses were carried out by using GenStat Discovery Edition (2011). Alpha level was set as 0.05

### III. Results and Discussion

a) **Fodder yield**

The effect of season and defoliation frequency was significant on the annual fodder yield of F. macrophylla (Table 1). The number of branch plant⁻¹ was similar (p>0.05) for both the seasons, dry and wet. Likewise, the effect of defoliation frequency was similar to the number of branch plant⁻¹. Branch heights were also similar (p>0.05) for the dry and wet seasons. But, the plants defoliated in six months interval had attained taller branch height than the plants defoliated in three months interval. The leaf and stem ratio was better (p<0.05) in the wet season compared to dry season. The fodder dry matter yield in the wet season was higher (p<0.01) than the yield during dry season (5.93 t ha⁻¹ Vs 4.31 t ha⁻¹). Likely, the plants defoliated in three months interval had yielded higher (p<0.001) fodder dry matter (6.39 t ha⁻¹) compared to the plants defoliated in six months interval (Table 1).
Table 1: Effect of season and defoliation frequency on the fodder yield and yield attributing characters

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of branch plant(^{-1})</th>
<th>Average branch height (cm)</th>
<th>Leaf:stem ratio</th>
<th>Fodder yield (DM, t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Season</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>13.74</td>
<td>134.3</td>
<td>1.55</td>
<td>4.31</td>
</tr>
<tr>
<td>Wet</td>
<td>14.87</td>
<td>141.7</td>
<td>1.91</td>
<td>5.93</td>
</tr>
<tr>
<td>SEM</td>
<td>0.86</td>
<td>3.70</td>
<td>0.13</td>
<td>0.43</td>
</tr>
<tr>
<td>F-Probability</td>
<td>NS</td>
<td>NS</td>
<td>&lt;0.05</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Defoliation frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months interval</td>
<td>13.75</td>
<td>130.6</td>
<td>2.33</td>
<td>6.39</td>
</tr>
<tr>
<td>6 months interval</td>
<td>14.86</td>
<td>145.3</td>
<td>1.19</td>
<td>3.86</td>
</tr>
<tr>
<td>SEM</td>
<td>0.86</td>
<td>3.70</td>
<td>0.22</td>
<td>0.43</td>
</tr>
<tr>
<td>F-Probability</td>
<td>NS</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

The interaction effects of the season and defoliation frequency on the annual fodder yield has been presented in Table 2. The number of branch was not affected (p>0.05) by the season and the defoliation interval, whereas the difference among the branch height was significant (p<0.01). The plants defoliated in six months interval had resulted taller branch height in both dry and wet seasons. Higher (p<0.001) leaf: stem ratio was obtained from the plants defoliated in wet season with three months interval. It was followed for the treatment of dry season defoliation with three months interval. Highest fodder dry matter yield (7.62 t ha\(^{-1}\)) was obtained from the plants defoliated in three months interval at wet season (p<0.001), and was followed by the treatment of three months defoliation interval in dry season (5.15 t ha\(^{-1}\)). The plants defoliated in the dry season and six months interval had shown lowest fodder yield.

Table 2: Interaction effects on season and defoliation interval on the fodder yield and yield attributing characters

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of branch (plant(^{-1}))</th>
<th>Branch height (cm)</th>
<th>Leaf:stem ratio</th>
<th>Fodder yield (DM, t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry season × 3 months interval</td>
<td>12.62</td>
<td>126.0</td>
<td>2.06</td>
<td>5.15</td>
</tr>
<tr>
<td>Dry season × 6 months interval</td>
<td>14.86</td>
<td>142.6</td>
<td>1.16</td>
<td>3.47</td>
</tr>
<tr>
<td>Wet season × 3 months interval</td>
<td>14.87</td>
<td>135.2</td>
<td>2.95</td>
<td>7.62</td>
</tr>
<tr>
<td>Wet season × 6 months interval</td>
<td>14.86</td>
<td>148.1</td>
<td>1.23</td>
<td>4.24</td>
</tr>
<tr>
<td>SEM</td>
<td>1.22</td>
<td>5.23</td>
<td>0.38</td>
<td>0.60</td>
</tr>
<tr>
<td>F-probability</td>
<td>NS</td>
<td>&lt;0.01</td>
<td>&lt;0.001</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>

b) Nutrient composition

Nutrient compositions of the fodders for different treatments are presented in Table 3. The dry matter content and acid detergent lignin (ADL) content of the fodder were higher in the dry season than in the wet season. But, CP content and calcium (Ca) content were higher in the fodders harvested in the wet season in comparison to the fodders for dry season. Similarly, the effects of defoliation interval was significant (p<0.05) in the nutrient composition. The dry matter content was higher for the fodder defoliated in six months interval than in the three months. Likewise, the detergent fractions (NDF, ADF and Lignin) and Ca content were also higher (p<0.05) in the fodder defoliated in the six months than in the fodder defoliated in three months interval. But, the CP content was better (p<0.05) for the fodder defoliated in three months than in the fodder defoliated in the six months interval. Likewise, P content was also higher (P<0.001) in the fodder harvested in three months interval than six months interval.
Table 3: Nutrient composition of the fodders defoliated in different seasons and intervals, %

<table>
<thead>
<tr>
<th>Treatments</th>
<th>DM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
<th>Lignin</th>
<th>Ca</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Season</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>30.89</td>
<td>16.60</td>
<td>56.46</td>
<td>45.37</td>
<td>32.31</td>
<td>1.38</td>
<td>0.27</td>
</tr>
<tr>
<td>Wet</td>
<td>28.61</td>
<td>17.75</td>
<td>54.49</td>
<td>46.75</td>
<td>30.14</td>
<td>1.16</td>
<td>0.28</td>
</tr>
<tr>
<td>SEM</td>
<td>0.33</td>
<td>0.21</td>
<td>0.85</td>
<td>0.86</td>
<td>0.65</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>F-Probability</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>NS</td>
<td>NS</td>
<td>&lt;0.05</td>
<td>&lt;0.001</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Defoliation frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months interval</td>
<td>27.37</td>
<td>17.43</td>
<td>54.01</td>
<td>43.91</td>
<td>30.05</td>
<td>1.14</td>
<td>0.29</td>
</tr>
<tr>
<td>6 months interval</td>
<td>32.13</td>
<td>16.91</td>
<td>56.94</td>
<td>48.20</td>
<td>32.41</td>
<td>1.39</td>
<td>0.25</td>
</tr>
<tr>
<td>SEM</td>
<td>0.33</td>
<td>0.21</td>
<td>0.85</td>
<td>0.86</td>
<td>0.65</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>F-Probability</td>
<td>&lt;0.001</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.001</td>
<td>&lt;0.05</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

The interaction effects of the season and defoliation frequency on the nutrient content of the fodders are presented in Table 4. Dry matter content was similar (p>0.05) for all the treatments. Similarly, the detergent fractions, viz. NDF, ADF and Lignin were not also influenced by the treatments (p>0.05). The P content were also similar for different treatments (p>0.05). But, CP content and Ca content were influenced. The treatments of wet season harvests with three months defoliation interval, the dry season harvests with three months defoliation interval and wet season harvests with three months defoliation interval had yielded higher (p<0.01) proportion of CP than the treatment of dry season harvest with six months defoliation interval. Similarly, the fodder having the treatment of dry season harvest with six months defoliation interval had the higher content of Ca (p<0.05).

Table 4: Interaction effect of the season and defoliation frequency on the major nutrient composition of the fodders, %

<table>
<thead>
<tr>
<th>Treatments</th>
<th>DM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
<th>Lignin</th>
<th>Ca</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry season × 3 months interval</td>
<td>28.68</td>
<td>17.59</td>
<td>55.28</td>
<td>43.29</td>
<td>30.77</td>
<td>1.19</td>
<td>0.29</td>
</tr>
<tr>
<td>Dry season × 6 months interval</td>
<td>33.10</td>
<td>15.92</td>
<td>57.65</td>
<td>47.45</td>
<td>33.86</td>
<td>1.57</td>
<td>0.25</td>
</tr>
<tr>
<td>Wet season × 3 months interval</td>
<td>26.06</td>
<td>17.90</td>
<td>52.75</td>
<td>44.54</td>
<td>29.33</td>
<td>1.09</td>
<td>0.30</td>
</tr>
<tr>
<td>Wet season × 6 months interval</td>
<td>31.17</td>
<td>17.27</td>
<td>56.23</td>
<td>46.96</td>
<td>30.96</td>
<td>1.22</td>
<td>0.25</td>
</tr>
<tr>
<td>SEM</td>
<td>0.46</td>
<td>0.29</td>
<td>1.20</td>
<td>1.22</td>
<td>0.92</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>F-Probability</td>
<td>NS</td>
<td>&lt;0.01</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>&lt;0.05</td>
<td>NS</td>
</tr>
</tbody>
</table>

IV. Discussion

The number of branch was neither affected by the seasons nor by the defoliation frequency in the mature stands of F. macrophylla (Table 1). Branch height was not affected by the season, but influenced by the defoliation frequency. The plants with longer growing period of six months defoliation interval had attained the taller height of the branches. With the similar number of branches and branch heights, the leaf and stem ratio was higher (p<0.05) in the wet season. The similar results were obtained for the dried fodder yield. The fodder yield of F. macrophylla was significantly higher (p<0.01) in the wet season in comparison to dry season. Comparing the higher biomass yield in wet seasons with climate pattern (Figure 1), higher rainfall and higher temperature could have accelerated the foliage growth rate. These significant influences of the seasons caused the seasonal variations in the yield of F. macrophylla like in other leguminous fodder trees which was also reported by Ivory (1989). The results of this study was in the agreement with the results of another experiment that the monsoon harvest of F. macrophylla was higher than the winter harvest in the similar climatic condition of Nepal (Kayastha, 2004). The winter foliage production of F. macrophylla could be slow due to low temperature and due to decrease in the activity of root nodules bacteria in legumes (Barnes, 1998).

Defoliation frequency did not affect the number of branches, whereas branch height was taller (p<0.001) for the plants defoliated in six months interval. The plants defoliated in three months interval had yielded higher (p<0.01) proportion of CP than the treatment of dry season harvest with six months defoliation interval. Similarly, the fodder having the treatment of dry season harvest with six months defoliation interval had the higher content of Ca (p<0.05).
plants defoliated on wet season with six months interval and the plants defoliated on dry season with six months interval, the leaf and stem ratio and fodder dry matter yield were better for the plants defoliated on wet season with three months defoliation interval and the plants defoliated on dry season with three months defoliation interval. The results of this study agree with the findings of Asare (1985) that the defoliation interval depends upon the climatic conditions. In the experiment also, F. macrophylla responded better during wet than cool and dry season. The results from another study on Gliricidia and Leucaena had revealed that the foliage growth and retention appeared lower during the dry season, demonstrating the seasonal influence under frequent defoliation (Smith, 1992). The results of this study also support the findings in the case of F. macrophylla.

a) **Nutrient composition**

The fodder of F. macrophylla harvested in dry season had higher (p<0.001) DM and Ca content than in the fodders harvested in wet season, whereas crude protein content was better in wet season (Table 3). The detergent fractions, except lignin, were not affected by the season. The result was in agreement with Smith (1992) that the season of defoliation affects the nutrient composition of the tree and shrub fodders (Smith, 1992). The higher concentration of CP and mineral content is a main feature of the legume browse plants and the concentration of CP in those fodder trees and shrubs is obtained higher even in the dry season when it tends to decrease (Dicko and Sikena, 1992). The fodder of F. macrophylla could be considered a good quality fodder while it content higher CP and mineral even in dry season (16.60% CP, 1.38% Ca and 0.27% P).

Delayed maturity alters certain nutrients composition in the fodder (Kamalak et al., 2005). The dry matter and detergent fractions were increased and CP and P concentration were decreased with the longer defoliation interval (six months). Similar results were obtained in another study on Pueraariaphaseoloides that increased detergent fractions and decreased CP due to increased cutting interval (Nguyen Van Hiep et al., 2008). Similarly, increasing the defoliation interval had decreased CP content of the fodder of Leucaenaleucocephala, Gliricidiaspium and Trichanthera gigantean in another experiment (Edwards et al., 2012). Calcium content was also increased in delayed harvests (Table 3). Significant increment of detergent fraction in the fodder defoliated in six months interval, especially lignin content is the indicator of reduced digestibility of the fodders to the animals. The fodder harvested in three months interval was considered better quality due to the significantly higher (p<0.05) content of CP and P and lower content of lignin.

V. **Conclusion**

The perennial leguminous fodder F. macrophylla had shown greater response of seasons and defoliation frequency on the fodder yield and quality. Yield was higher in the wet season and in the shorter defoliation interval of three months. The nutrient compositions were also obtained better for wet season and three months defoliation interval. It is clear that better fodder yield could be obtained in wet season from F. macrophylla three months defoliation interval, although, this perennial legume had shown considerable fodder yield in dry season as well. This fodder species could contribute substantially if used in the year round fodder management packages.

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To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT’S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5. STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also. Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

**Papers:** These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a) Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, “Abstract” (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper’s subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unreferred;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.
The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

**Format**

*Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.*

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

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Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:
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Acknowledgements: Please make these as concise as possible.

References

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- Significant conclusions or questions that track from the research(es)

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- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
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Approach

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- Put figures and tables, appropriately numbered, in order at the end of the report.
- If you desire, you may place your figures and tables properly within the text of your results part.

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- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts.
- In spite of position, each figure must be numbered one after the other and complete with subtitle.
- In spite of position, each table must be titled, numbered one after the other and complete with heading.
- All figure and table must be adequately complete that it could situate on its own, divide from text.

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information.
- Submit to work done by specific persons (including you) in past tense.
  - Submit to generally acknowledged facts and main beliefs in present tense.
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