Growth and Yield of *Cajanus Cajan* Forage at Different Cutting Interval of Regrowth Defoliation

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**Abstract.** *Cajanus cajan* (L.) Millsp is Fabaceae family (alt. Leguminosae). It has a different common name the most common is congo pea, pigeon pea or yellow dahl. The morphological of the plant is an annual or short-lived perennial shrub or small tree with leaves trifoliate, alternate, set in a spiral around the stem, flowers usually yellow and a flat pods (5–9 cm long, 12–13 mm wide, containing 2–9 oval to round seeds varying in color from light beige to dark brown) that can grow up to one to four meters and usually with an erect woody at the base. *Cajanus cajan* primarily grown as a grain crop for seed for human consumption with over 4 million hectares cultivated worldwide. The foliage may be cut and fed to livestock fresh or conserved. This study was conducted to evaluate the growth and yield of *Cajanus cajan* forage at different cutting intervals of regrowth defoliation. The seeds were collected from South Sulawesi, Indonesia. The research was conducted in Field 15 UPM, Serdang, Selangor, Malaysia. The regrowth was harvested after 3 months plot establishment period. The regrowth of *Cajanus cajan* forages at 4-weeks, 8-weeks and 12-weeks old were harvested to determine the quantity and quality. The results indicate that the different cutting intervals had significant effect (P<0.05) on plant height (68, 111, and 137 cm), fresh weight (38, 142, and 192 g), dry matter (14, 52.5, and 71.2 g), leaf to stem ratio (3.0, 1.3, and 1.8 g) and yield of *Cajanus cajan* forage (1.5, 5.5, and 7.5 ton/ha/cutting). The older cutting age had increased the yield. However, the best cutting interval of *Cajanus cajan* as ruminant feed for optimal production was 8 weeks (33 ton/ha/year).

1. Introduction

*Cajanus cajan* (L.) Millsp is Fabaceae family (alt. Leguminosae). It has a different common name the most common is congo pea, pigeon pea or yellow dahl. The morphological of the plant is an annual or short-lived perennial shrub or small tree with leaves trifoliate, alternate, set in a spiral around the stem, flowers usually yellow and a flat pods (5–9 cm long, 12–13 mm wide, containing 2–9 oval to round seeds varying in color from light beige to dark brown) that can grow up to one to four meters and usually with an erect woody at the base [1]. *Cajanus cajan* primarily grown as a grain crop for seed for human consumption with over 4 million hectares cultivated worldwide [2]. The foliage may be cut and fed to livestock as fresh or conserved [3]. Pigeonpea cultivars developed have been tested for grain and forage production [4]. The defoliation time of forage legume is an important aspect that influences quantity and quality [5]. It's associated with the plant age which affects the
accumulation of dry matter (DM) and leaf to stem ratio [6]. The objectives of this study were conducted to evaluate the growth and yield of Cajanus cajan forage at different cutting intervals of regrowth defoliation.

2. Materials and methods

2.1. Experimental site and design

This study was conducted at field 15, UPM. The experimental forages plot is located in a tropical humid zone, 3\(^\circ\)00'24.3 North latitude, and 101\(^\circ\)42.'10.3 East longitude, with an average rainfall of 2507 mm per annum. The average relative humidity was 74%. The soil texture of the experimental area is clay as classified by soil Taxonomy classification (USDA) and determined by the Texture Autolookup. The details of the soil are clay (45.13%), silt (42.14%) and sand (30.53%). The experimental design was completely-randomized design with three different cutting intervals (4-weeks, 8-weeks, and 12-weeks) and five replicates. The land was prepared by using plowing and disc harrowing. The seeds were collected from South Sulawesi, Indonesia. The Cajanus cajan seed was sowed with three seeds each hole, spacing each plant 40 cm x 50 cm. The Cajanus cajan were trimmed after 3-months of establishment period. The herbicide was sprayed to reduce weeds a month after trimming. The regrowth of Cajanus cajan forages was harvested at 4-weeks, 8-weeks, and 12-weeks old to determine the quantity and quality.

2.2. Plant height, DM yield, and leaf to stem ratio

The Cajanus cajan forage was randomly selected using quadrate (1 m\(\times\)1 m), the measurement of the plant height was recorded and cut approximately 30 cm from the ground level. The Cajanus cajan fresh samples obtained were divided into three fractions; stem, leaf, and whole plant and put in a forced-air oven at 60\(^\circ\)C until a constant weight achieved. The fresh, DM yield per hectare (ha) and leaf to stem ratio were calculated. Differences among cutting intervals were analyzed using analysis of variance. Means were separated using Duncan’s Multiple Range Test at 5% level of significance using SAS 9.2 [7].

3. Result and discussion

3.1. Plant Height

The height of the plants was significantly different between cutting intervals (P<0.05). The plant height increased with the increasing maturity of forage from 68 cm at 4-weeks to 137 cm at 12-weeks (Figure 1). This finding has a similar result with the study reported by Ansari and Mahmood [8], where the mature stage of Cajanus cajan fertilized with organic and bio-organic fertilizers was 118 to 188 cm. In contrast, this result was higher than the result reported by Gupta et al. [9] when they used chemical or bioinoculant fertilizer at 4-weeks to 12-weeks old (30 to 110 cm). The differences in plant height were probably caused by differences in environmental, soil fertility and the developmental stage of the plant [10].
Figure 1. The height of the Cajanus cajan plants at 4-, 8- and 12-weeks of cutting intervals (\textsuperscript{a,b,c} \textit{P}<0.05).

3.2. Fresh and DM yield
The fresh and DM yield per cut of Cajanus cajan increased with increasing interval between harvest (Table 1) with the highest values were at 12-weeks, followed 8-weeks and with the lowest at 4-weeks of cutting intervals (\textit{P}<0.05). However, the calculated annual production of Cajanus cajan at 8-weeks cutting intervals gives the highest DM value of forage (33 ton/ha/year DM). The fresh and DM yield per cut was significantly (\textit{P}<0.05) affected by different cutting intervals. These results were supported by FAO \cite{2} which reported that the DM yield Cajanus cajan forage ranges from 20 to 40 ton/ha/year when compared with other forages, for example, DM yield of Common Napier at harvesting age of 8-weeks (36 ton/ha/year) \cite{11}. Otherwise, the DM yield of Cajanus cajan is higher than Aeschynomene and Canavalia that produce less than 6 ton/ha/cut in the dry season \cite{12}.

Table 1: The fresh and DM yield of Cajanus cajan forage at 4-, 8- and 12-weeks cutting intervals of regrowth defoliation (mean±se).

| Parameters                  | Cutting intervals (week) |
|-----------------------------|--------------------------|
|                             | 4                        | 8                        | 12                        |
| Fresh weight (g)            | 38.0 ± 0.9\textsuperscript{c} | 142.0 ± 1.1\textsuperscript{b} | 193.0 ± 1.2\textsuperscript{a} |
| DM (g)                      | 14.0 ± 0.8\textsuperscript{c} | 52.5 ± 0.6\textsuperscript{b} | 71.2 ± 0.8\textsuperscript{a} |
| Production/ha/cut (ton DM)  | 1.5 ± 0.1\textsuperscript{c} | 5.5 ± 0.6\textsuperscript{b} | 7.5 ± 0.6\textsuperscript{a} |
| Production/ha/year (ton DM) | 18 ± 0.9\textsuperscript{c} | 33.0 ± 0.8\textsuperscript{a} | 30.0 ± 0.8\textsuperscript{b} |

\textsuperscript{a,b} Mean values with different superscript within the same rows are significantly different (\textit{P}<0.05).

3.3. Leaf to stem ratio
The leaf to stem ratio is variable with an increasing cutting interval (Figure 2). The ratio of leaf to stem of the Cajanus cajan forage was 3.0 at 4-weeks, then reduced to 1.3 at 8-weeks cutting interval and slightly increased to 1.8 at 12-week cutting interval (\textit{P}<0.05). The Cajanus cajan can grow with an increasing number of leaves at 4-weeks, subsequently enhance with their stem at 8-weeks, later at 12-weeks, the Cajanus cajan plant produces more leaves to prepare for the flowering stage. Overall, leaf to stem ratio decreases with longer cutting interval. This result had an agreement with Suksombat and Buakeeree \cite{13} who reported that the DM of the leaf to stem ratio decreased as the...
cutting interval increased. The reduction in the leaf to stem ratio indicates the reduction in quality in certain parts of the grass as it advanced in maturity [6].

Figure 2. The leaf to stem ratio of *Cajanus cajan* at 4-, 8- and 12-weeks of cutting intervals (a,b,c P<0.05).

4. Conclusion
As for ruminant feed, the *Cajanus cajan* produces forage at an optimal yield at 8 weeks cutting intervals (33 ton/ha/year).

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