International Journal of Agronomy and Agricultural Research
ISSN: 2223-7054 (Print); 2225-3610 (Online) | IJAAR |
Website: https://www.innspub.net
Email: info@innspub.net

RESEARCH PAPER
Vol. 29, Issue: 1, 2026
OPEN ACCESS

Effect of different cutting ages of Jali (*Coix lacryma-jobi* L.) on dry matter production, neutral detergent fiber, acid detergent fiber, and lignin contents

Oktavia Desi Nirga, Markus Miten Kleden*, Tara Tiba Nikolaus

Department of Animal Science, Faculty of Animal Husbandry, Marine and Fisheries, Nusa Cendana University, Kupang, Indonesia

DOI: https://dx.doi.org/10.12692/ijaar/29.1.21-28

ARTICLE INFORMATION

RESEARCH PAPER

Vol. 29, Issue: 1, p. 21-28, 2026
Int. J. Agron. Agri. Res.

Nirga *et al.*

ACCEPTED: 15 July, **2026**
PUBLISHED: 25 July, **2026**

Corresponding author:
Markus Miten Kleden
Email: mkleden21@gmail.com

ABSTRACT

Optimizing the harvest age of forage crops is essential to achieve a balance between biomass production and nutritional quality for sustainable ruminant feeding. *Coix lacryma-jobi* L. (Jali) has considerable potential as an alternative forage crop in tropical regions; however, information on the effects of cutting age on its dry matter production and fiber characteristics remains limited. This study evaluated the effects of different cutting ages on dry matter production, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), and lignin contents of Jali forage. A Completely Randomized Design consisting of four cutting-age treatments, namely 6, 8, 10, and 12 weeks after planting (CA6, CA8, CA10, and CA12), with five replications was employed. Data were analyzed using analysis of variance (ANOVA), followed by the Least Significant Difference (LSD) test to compare treatment means. Cutting age had a highly significant effect ($p < 0.01$) on dry matter production, NDF, and ADF contents but had no significant effect ($p = 0.05$) on lignin content. Dry matter production increased from 0.80 t ha^{-1} at CA6 to 8.27 t ha^{-1} at CA12. Similarly, NDF increased from 54.18% to 62.70%, while ADF increased from 30.71% to 36.12% as cutting age advanced. Lignin content ranged from 3.00% to 5.06% and did not differ significantly among treatments. In conclusion, delaying harvest increased dry matter production and structural fiber fractions of Jali forage, whereas lignin content remained relatively stable. These findings indicate that cutting age is an important management factor influencing forage yield and fiber composition and should be considered when determining the appropriate harvest stage according to the intended feeding objective.

Key words: *Coix lacryma-jobi*, Cutting age, Dry matter production, Neutral detergent fiber, Forage quality

INTRODUCTION

Forage is the principal feed resource for ruminant livestock and provides the structural carbohydrates required to maintain normal rumen function and digestive health. The nutritive value of forage is determined not only by biomass yield but also by its cell wall composition, particularly Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), and lignin. These fiber fractions directly influence voluntary feed intake, digestibility, and nutrient utilization in ruminants. Neutral Detergent Fiber represents the total cell wall constituents, including hemicellulose, cellulose, and lignin, and is closely associated with feed intake, whereas Acid Detergent Fiber, composed primarily of cellulose and lignin, is commonly used as an indicator of forage digestibility. Lignin is an indigestible phenolic polymer that limits the degradation of structural carbohydrates by rumen microorganisms and therefore reduces forage utilization as its concentration increases (Van Soest, 1994; Jung *et al.*, 1997; Mertens, 2002).

Plant maturity is one of the major factors affecting forage quantity and quality. As forage crops develop, biomass production generally increases because of continued vegetative growth and the accumulation of structural tissues. However, plant maturation is also accompanied by progressive thickening of the cell wall and changes in fiber composition, resulting in increased concentrations of NDF and ADF and, in many species, greater lignification. Consequently, harvesting at different growth stages may substantially influence the balance between forage yield and nutritional quality (Van Soest, 1994; Van Soest *et al.*, 1991).

Coix lacryma-jobi L. (Job's tears or Jali) is a cereal species belonging to the family Poaceae that has traditionally been cultivated as a food crop in many Asian countries. Besides its grains, the vegetative parts of the plant have considerable potential as an alternative forage resource because of their ability to produce substantial biomass under tropical conditions. The species is well adapted to marginal environments, exhibits good tolerance to drought, and can be cultivated under a wide range of environmental conditions, making it a promising forage crop in regions where conventional forage availability is limited (Sugiura *et al.*, 2012). In addition, its multipurpose nature provides opportunities for integrating food and livestock production systems, thereby contributing to more efficient utilization of agricultural resources (Anwar *et al.*, 2022; Sari *et al.*, 2020; Rachman *et al.*, 2021).

Despite the increasing interest in Jali as an alternative forage crop, available studies have primarily focused on its grain characteristics, nutritional composition, and potential as a functional food (Anwar *et al.*, 2022; Juhaeti, 2015). Comparatively little information is available regarding changes in forage quality during plant development, particularly with respect to dry matter production and the structural fiber fractions that determine feeding value. Information on the responses of NDF, ADF, and lignin contents to different cutting ages remains limited, making it difficult to identify an appropriate harvest stage that balances forage yield and fiber characteristics.

Therefore, evaluating the effect of cutting age on biomass production and fiber composition is essential for optimizing the utilization of Jali as a forage crop. Such information can support the development of appropriate harvesting strategies and improve the use of this species as an alternative feed resource for ruminant production systems.

Accordingly, this study aimed to evaluate the effects of different cutting ages on dry matter production, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), and lignin contents of *Coix lacryma-jobi* L. forage. The findings are expected to provide scientific information for determining an appropriate harvesting age that balances forage production with desirable fiber characteristics.

MATERIALS AND METHODS

Study site

The experiment was conducted at the Dryland Archipelago Laboratory, Faculty of Animal Science, Marine and Fisheries, Universitas Nusa Cendana, Kupang, Indonesia. Laboratory analyses of forage quality were performed at the Feed Chemistry Laboratory of the same faculty.

Plant materials and experimental management

The experimental material consisted of Job's tears (*Coix lacryma-jobi* L.) forage cultivated under field conditions. Seeds were planted at a spacing of 50 × 50 cm. Compound NPK fertilizer (16:16:16) was applied at four weeks after planting at a rate of 300 kg ha^{-1} to support vegetative growth.

The experimental field measured 10 × 8 m and was divided into plots according to the assigned cutting-age treatments. Standard agronomic practices, including weed control and routine crop maintenance, were applied uniformly throughout the experiment.

Experimental design

The study employed a Completely Randomized Design (CRD) consisting of four cutting-age treatments with five replications. The treatments were:
CA6: forage cutting at 6 weeks after planting (WAP)
CA8: forage cutting at 8 WAP
CA10: forage cutting at 10 WAP
CA12: forage cutting at 12 WAP

Cutting ages were selected to represent successive stages of vegetative development in order to evaluate changes in biomass production and structural fiber composition.

Sample collection and dry matter determination

At each cutting age, representative forage samples were collected randomly from each experimental unit. Fresh forage was weighed immediately after cutting to determine fresh biomass. Samples were then oven-dried at 60°C until constant weight to determine dry matter production. The dried samples were ground using a laboratory mill and stored in airtight containers prior to chemical analyses.

Fiber analysis

Neutral detergent fiber (NDF), acid detergent fiber (ADF), and lignin contents were determined according to the detergent fiber procedures developed by Van Soest (Van Soest, 1967; Goering and Van Soest, 1970; Van Soest *et al.*, 1991).

Neutral detergent fiber (NDF)

Neutral detergent fiber was determined by refluxing approximately 1 g of ground sample in neutral detergent solution for 60 min. The residue was filtered through a pre-weighed glass crucible, washed thoroughly with hot distilled water followed by acetone, dried at 105°C to constant weight, cooled in a desiccator, and weighed. NDF was expressed as a percentage of dry matter.

Acid detergent fiber (ADF)

Acid detergent fiber was determined using the acid detergent method. Approximately 1 g of sample was extracted in acid detergent solution for 60 min, filtered through a pre-weighed glass crucible, washed with hot distilled water and acetone, dried at 105°C until constant weight, cooled in a desiccator, and weighed. ADF content was expressed as a percentage of dry matter.

Lignin determination

Lignin content was determined from the ADF residue following standard detergent fiber procedures. The residue remaining after ADF determination was combusted in a muffle furnace at approximately 550–600°C until complete ashing. Lignin concentration was calculated from the difference between the oven-dried residue and ash weight and expressed as a percentage of dry matter (AOAC, 1998; Van Soest *et al.*, 1991).

Variables measured

The variables evaluated were:

1. Dry matter production (t ha^{-1});
2. Neutral detergent fiber (NDF, %);
3. Acid detergent fiber (ADF, %); and
4. Lignin content (%).

Statistical analysis

Data were subjected to analysis of variance (ANOVA) appropriate for a Completely Randomized Design to determine the effect of cutting age on all measured variables. When treatment effects were significant ($P < 0.05$), mean separation was performed using the Least Significant Difference (LSD) test. Statistical analyses were conducted using IBM SPSS Statistics version 24 (Steel and Torrie, 1991).

RESULTS

Soil chemical and physical properties

The chemical and physical characteristics of the experimental soil are presented in Table 1. The soil contained 1.30% organic carbon and 0.14% total nitrogen. Available phosphorus and exchangeable potassium were 65.81 ppm and 0.90 me/100 g soil, respectively, while the cation exchange capacity was 35.33 me/100 g. The soil pH was 6.95.

Regarding the physical properties, the soil consisted of 72.02% sand, 17.02% clay, and 10.91% silt, resulting in a sandy loam texture with a granular structure (Table 1).

Climatic conditions during the study

The climatic conditions recorded during the study period are presented in Table 2. Monthly air temperature ranged from 26.7°C in July to 29.8°C in November. Relative humidity varied between 70.0% and 88.0%, with the highest value recorded in March and the lowest in August.

Rainfall showed considerable monthly variation. The highest rainfall was recorded in March (380.7 mm), followed by December (297.6 mm), February (215.8 mm), and November (177.3 mm). No rainfall was recorded during June, July, and August, whereas relatively low rainfall occurred in May (1.3 mm) and October (3.0 mm) (Table 2).

Table 1. Results of soil chemical and physical properties analysis

Soil chemical						Soil physics				
C-organic	N	P	K	CEC	pH	Textur			Texture class	Structure
..... %		Ppm	(me/100g			Sand	Clay	Dust		
1.3	0.14	65.81	0.90	35.33	6.95	72.02	17.02	10.91	Sandy loam	Granular

Note: soil laboratory analysis result, faculty of Agriculture Nusa Cendana University

Table 2. Climate conditions

Month	Temperature (°C)	Air humidity (%)	Raifall (mm)
January	29.1	84.3	161.0
February	28.4	86.0	215.8
March	28.3	88.0	380.7
April	28.6	81.0	35.4
May	28.7	76.0	1.3
June	27.1	77.0	0
July	26.7	71.0	0
August	26.9	70.0	0
September	28.0	73.0	46.8
October	29.4	72.0	3.0
November	29.8	75.0	177.3
December	29.3	86.0	297.6

Source: central bureau of statistic of Kupang city 2025

Table 3. Dry matter production, NDF, ADF, and lignin contents of Jali

Parameter	Treatment				*p*-value
	CA_6	CA_8	CA_{10}	CA_{12}	
DM Prod. (ton/ha)	$0.80±0.12^a$	$1.30±0.23^a$	$6,29±1.84^b$	$8.27±2.42^b$	<0.001
NDF (%)	$54.176±1.777^a$	$56.180±1.493^b$	$60.290±1.084^c$	$62.696±1.492^d$	<0.001
ADF (%)	$30.714±886^a$	$30.383±1.513^a$	$36.117±1.005^b$	$36.124±2.691^b$	<0.001
Lignin (%)	4.242±3.029	2.9998±0.458	5.060±1.261	4.614±0.546	0.292

Remarks: Values bearing different letter in the same row differ significantly at p<0.05.

Dry matter production

Dry matter production of *Coix lacryma-jobi* increased with increasing cutting age (Table 3). The lowest dry matter production was recorded in CA6 (0.80 ± 0.12 t ha^{-1}), followed by CA8 (1.30 ± 0.23 t ha^{-1}). Higher values were observed in CA10 (6.29 ± 1.84 t ha^{-1}) and CA12 (8.27 ± 2.42 t ha^{-1}). Analysis of variance indicated a highly significant effect of cutting age on dry matter production (P < 0.001). Mean separation showed that CA10 and CA12 produced significantly greater dry matter than CA6 and CA8.

Neutral detergent fiber (NDF)

Neutral detergent fiber (NDF) content increased progressively with increasing cutting age (Table 3). The

NDF content was 54.176 ± 1.777% in CA6, 56.180 ± 1.493% in CA8, 60.290 ± 1.084% in CA10, and 62.696 ± 1.492% in CA12. Statistical analysis showed that cutting age significantly affected NDF content ($P < 0.001$), with each treatment differing significantly from the others.

Acid detergent fiber (ADF)

The ADF content of *Coix lacryma-jobi* forage is presented in Table 3. The lowest ADF value was recorded in CA8 (30.383 ± 1.513%), followed by CA6 (30.714 ± 0.886%). The highest ADF values were obtained in CA10 (36.117 ± 1.005%) and CA12 (36.124 ± 2.691%). Analysis of variance revealed a highly significant effect of cutting age on ADF content ($P < 0.001$). According to the mean comparison, CA6 and CA8 did not differ significantly, whereas CA10 and CA12 formed a second group with significantly higher ADF values.

Lignin content

Lignin content varied among the cutting-age treatments (Table 3). The recorded values were 4.242 ± 3.029% for CA6, 2.999 ± 0.458% for CA8, 5.060 ± 1.261% for CA10, and 4.614 ± 0.546% for CA12. Statistical analysis showed that cutting age did not significantly affect lignin content ($P = 0.292$), and no significant differences were detected among treatments.

DISCUSSION

Cultivation aspects

The soil chemical and physical properties indicated that the experimental site provided favorable conditions for the growth of Jali. The soil contained adequate levels of organic carbon, nitrogen, phosphorus, and potassium, with a relatively high cation exchange capacity and a near-neutral pH. These characteristics enhance nutrient availability and uptake, thereby supporting vegetative growth and biomass production. In addition, the sandy loam texture and granular soil structure promote good drainage, aeration, and root penetration, which are essential for healthy crop establishment (Slamet Hardjowigeno, 2015; Brady and Weil, 2016).

The climatic conditions also varied throughout the growing period, particularly in rainfall. Rainfall was abundant during the early months of the year but declined markedly from June to August. Such seasonal variation may influence plant growth and forage production because water availability directly affects photosynthesis, biomass accumulation, and plant development. Under adequate moisture conditions, plants generally maintain active vegetative growth, whereas prolonged dry periods may alter the accumulation of structural carbohydrates within plant tissues.

Effect of treatments on dry matter production

Dry matter production increased significantly with increasing cutting age. Plants harvested at 10 and 12 weeks after planting produced considerably greater dry matter than those harvested at 6 and 8 weeks, indicating continuous biomass accumulation as the plants matured. The increase in dry matter production is associated with prolonged vegetative growth, during which photosynthetic products continue to accumulate in leaves, stems, and other structural tissues. As plant age advances, both plant height and stem development increase, resulting in greater total biomass. Consequently, older plants generally produce higher dry matter yields than younger plants.

These findings are consistent with Tillman *et al.* (1998), who reported that dry matter production increases with plant age because a longer growth period allows greater accumulation of photosynthates. Likewise, Van Soest (1994) explained that advancing maturity promotes the development of structural tissues, thereby increasing plant dry weight and forage yield.

Effect of different cutting age treatment on NDF content

Neutral Detergent Fiber (NDF) content increased progressively with increasing cutting age. The lowest NDF concentration was observed in forage harvested at 6 weeks after planting, whereas the highest value was recorded at 12 weeks. This trend indicates a continuous increase in structural cell wall components as the plants matured.

As forage plants develop, the proportion of stem tissue generally increases relative to leaves. Stem tissues contain higher concentrations of cellulose, hemicellulose, and lignin than leaf tissues, resulting in a gradual increase in total cell wall constituents. Consequently, the structural fiber fraction becomes more dominant as plant maturity advances.

The present findings agree with Van Soest *et al.* (1991), who reported that increasing plant maturity is accompanied by greater accumulation of cell wall components, leading to higher NDF values. Similarly, Buxton and Redfearn (1997) stated that cell wall thickening and progressive lignification during plant development contribute to increased structural fiber content. Although higher NDF is generally associated with greater forage yield, it also reflects increased structural material within the plant.

The significant differences among cutting ages indicate that plant maturity strongly influences NDF accumulation in Jali. Therefore, harvesting at different growth stages can substantially affect the fiber composition of the forage.

Effect of different cutting age treatment on ADF content

Acid Detergent Fiber (ADF) content also increased significantly with increasing cutting age. Forage harvested at 10 and 12 weeks contained higher ADF concentrations than forage harvested at 6 and 8 weeks, indicating greater accumulation of cellulose and lignin within the cell wall.

The increase in ADF is a normal consequence of plant maturation. During early vegetative growth, plants allocate a larger proportion of assimilates to the production of metabolically active tissues. As growth progresses, carbon allocation shifts toward the formation of secondary cell walls, resulting in increased cellulose deposition and strengthening of supporting tissues.

These results are consistent with Van Soest *et al.* (1991), who identified ADF as an important indicator of the less digestible portion of plant cell walls. Similarly, Tillman *et al.* (1998) reported that forage quality generally changes with increasing maturity because structural tissues continue to develop. Buxton and Redfearn (1997) further explained that secondary cell wall formation contributes directly to higher ADF concentrations, while Jung and Allen (1995) reported that increasing stem development during plant maturation is accompanied by greater structural carbohydrate accumulation.

The significant increase in ADF observed in this study demonstrates that cutting age substantially influences the structural composition of Jali forage and should therefore be considered when determining the appropriate harvest stage.

Effect of different cutting age treatment on lignin content

Unlike NDF and ADF, lignin content was not significantly affected by cutting age, although numerical differences were observed among treatments. This finding suggests that lignin accumulation remained relatively stable during the harvest period evaluated in the present study. Lignin deposition is influenced not only by plant age but also by tissue differentiation and developmental stage. During plant growth, lignification occurs primarily in supporting and vascular tissues to strengthen the cell wall. However, the rate of lignin accumulation does not necessarily increase uniformly throughout plant development, particularly over relatively short harvest intervals.

The present results are consistent with Jung and Allen (1995), who reported that lignin concentration depends on tissue type and developmental stage rather than chronological age alone. Likewise, Buxton and Redfearn (1997) emphasized that both genetic characteristics and environmental conditions contribute to variation in lignin accumulation among forage plants.

The absence of significant differences in lignin content indicates that the increases observed in NDF and ADF were mainly associated with greater accumulation of structural carbohydrates rather than marked changes in lignin concentration. Within the cutting-age range evaluated, Jali forage appeared to undergo progressive structural development without substantial changes in lignification.

CONCLUSION

Cutting age significantly influenced the dry matter production and fiber composition of *Coix lacryma-jobi* forage. Dry matter production increased progressively with increasing cutting age, with the highest yield obtained at 12 weeks after planting. Likewise, Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) contents increased significantly as plant maturity advanced, indicating greater accumulation of structural fiber in older plants. In contrast, lignin content was not significantly affected by cutting age within the harvesting period evaluated.

These findings demonstrate that delaying harvest increases forage biomass but is accompanied by higher structural fiber concentrations. Therefore, selecting an appropriate cutting age is important to balance forage yield and fiber characteristics according to the intended feeding objective.

RECOMMENDATION(S)

Based on the findings of this study, harvesting *Coix lacryma-jobi* at an appropriate cutting age should be considered to achieve a balance between forage biomass production and fiber characteristics. Further studies are recommended to evaluate the effects of different cutting ages on crude protein content, in vitro digestibility, and animal performance in order to determine the optimum harvest stage for practical feeding applications.

REFERENCES

Anwar A, Sulaeman A, Desnawati. 2022. Karakterisasi tepung jali (*Coix lacryma-jobi* L.) untuk pengembangan pangan fungsional. Jurnal Pangan **31(2)**, 145–152.

AOAC International. 1998. Official Methods of Analysis of AOAC International. 16th ed., 4th revision. AOAC International, Gaithersburg, Maryland, USA.

Brady NC, Weil RR. 2016. The Nature and Properties of Soils. 15th ed. Pearson Education, Harlow, UK.

Buxton DR, Redfearn DD. 1997. Plant limitations to fiber digestion and utilization. The Journal of Nutrition **127**(5 Suppl.), 814S–818S.
DOI: 10.1093/jn/127.5.814S

Goering HK, Van Soest PJ. 1970. Forage Fiber Analyses (Apparatus, Reagents, Procedures, and Some Applications). Agriculture Handbook No. 379. Washington, DC: United States Department of Agriculture.

Juhaeti T. 2015. Jali (*Coix lacryma-jobi* L.; Poaceae) untuk diversifikasi pangan: Produktivitas pada berbagai taraf pemupukan. Berita Biologi **14(2)**, 171–177.

Jung HG, Allen MS. 1995. Characteristics of plant cell walls affecting intake and digestibility of forages by ruminants. Journal of Animal Science **73(9)**, 2774–2790.
DOI: 10.2527/1995.7392774x

Jung HG, Mertens DR, Payne AJ. 1997. Correlations of lignin content with forage digestibility. Journal of Animal Science **75**, 226–234.
DOI: 10.3168/jds.S0022-0302(97)76093-4

Mertens DR. 2002. Gravimetric determination of amylase-treated neutral detergent fiber in feeds with refluxing in beakers or crucibles: Collaborative study. Journal of AOAC International **85(6)**, 1217–1240.
DOI: 10.1093/jaoac/85.6.1217

Rachman MA, Widodo W, Prasetyo D. 2021. Potensi tanaman pakan alternatif untuk mendukung ketahanan pangan ternak di Indonesia. Jurnal Ilmu Ternak dan Veteriner **26(1)**, 45–52.

Sari DK, Handayani T, Nugroho A. 2020. Studi pertumbuhan dan hasil biomassa tanaman jali (*Coix lacryma-jobi* L.) sebagai pakan alternatif. Jurnal Agronomi Indonesia **48(2)**, 101–108.

Slamet Hardjowigeno. 2015. Ilmu Tanah. Jakarta: Akademika Pressindo.

Steel RGD, Torrie JH. 1991. Principles and Procedures of Statistics: A Biometrical Approach. 3rd ed. New York: McGraw-Hill.

Sugiura Y, Fukumoto Y, Tokuda S. 2012. *Coix lacryma-jobi* as a drought-resistant forage crop in Southeast Asia. Tropical Grasslands- Forrajes Tropicales **1(2)**, 123–130.

Tillman AD, Hartadi H, Reksohadiprodjo S, Prawirokusumo S, Lebdosoekojo S. 1998. Ilmu Makanan Ternak Dasar. 6th ed. Yogyakarta: Gadjah Mada University Press.

Van Soest PJ, Robertson JB, Lewis BA. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science **74(10)**, 3583–3597.
DOI: 10.3168/jds.S0022-0302(91)78551-2

Van Soest PJ. 1967. Development of a comprehensive system of feed analyses and its application to forages. Journal of Animal Science **26(1)**, 119–128.
DOI: 10.2527/jas1967.261119x

Van Soest PJ. 1994. Nutritional Ecology of the Ruminant. 2nd ed. Ithaca, NY: Cornell University Press.