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Leaf Pruning Increased Seed Yield and Leaf Production of Cowpea (*Vigna unguiculata* L. Walp)

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Abstract

The leaves and pods of cowpea (*Vigna unguiculata* L. Walp) have potential uses as vegetables. This research aimed to assess the impact on cowpea growth and seed yield through different pruning times, methods, intensities, and their interactions. Conducted at the Cikabayan Experimental Field, IPB University, between April and August 2022, the study employed a randomized complete block design with three factors and three replications. The first factor, pruning time (5 and 7 weeks after planting, WAP), represented vegetative and generative phases. The second factor involved pruning methods (leaf and shoot), while the third focused on pruning intensity (0, 10, 30, and 50% of leaf numbers). This resulted in 16 treatment combinations, replicated three times, yielding 48 experimental plots. Measured variables included pruned leaf count, pruned leaf weight, total leaf count, plant fresh and dry weights, cowpea plant C/N ratio analysis, pod wet and dry weights, pod count, pod length, seeds per pod count, 100-seed weight, dry seed weight per plant, dry seed weight per plot, and cowpea seed productivity. Results highlighted significant effects of pruning time, method, and intensity on leaf count, shoot fresh and dry weights, and C/N ratio of cowpea plants after two weeks of pruning. However, the treatments did not significantly influence cowpea seed yield. Pruning cowpea leaves led to an average pruned leaf weight of 30 g per plant, offering a nutritious vegetable source without compromising cowpea seed yield. These leaves commanded a market price of approximately Rp. 6000 per kg, transforming them into a valuable economic asset when utilized as vegetables, thus contributing to the sale of nutritious food.

Keywords: pruning time, pruning method, pruning intensity, C/N ratio

Introduction

Cowpea (*Vigna unguiculata* L. Walp) is a leguminous species sp native to Africa and well-suited to tropical regions (Kebede and Bekeko, 2020). Its potential as a nutritious ingredient, alongside other foods like soybean, is remarkable. With notable nutritional value, cowpea boasts approximately 22-30% protein, 33-59% carbohydrates, 3.60-4.21% ash content, and 2.10-2.98% crude fiber (Carvalho, 2012; Animasaun et al., 2015). The versatility of cowpea extends to its processing options, including the creation of tempeh, tofu, tauco, soy sauce, and even flour for baking purposes (Prihapsari and Setyaningsih, 2021). Cowpea's resilience to drought and hot weather make it well-adapted to challenging climatic conditions. This adaptability renders it a promising choice for cultivation and as a potential forage crop in tropical lowland areas (Alemu et al., 2016).

Cowpeas offer a dual harvest of both seeds and leaves. These leaves and pods hold utility as valuable vegetables. Particularly in Africa, the tender leaves of cowpea play a pivotal role in local diets, serving as a crucial vegetable source. Young pods and seeds also find their place on the culinary table, either through boiling or as canned products, adding to their versatility (Singh et al., 2017). Within the Indonesian context, cowpea leaves, referred to as "lembayung" in the local language, hold significance. Lembayung leaves are not only easily accessible and cost-effective but also find use as a means to enhance breast milk production. Especially within rural communities, these leaves are commonly employed as galactagogues or breast milk boosters (Murtiana, 2011). The presence of saponins and polyphenols in Lembayung leaves contributes to the elevation of prolactin levels, a pivotal hormone governing breast milk synthesis. Beyond this lactogenic effect, the nutritional composition of Lembayung leaves bestows benefits extending to anemia prevention and

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improved blood circulation. Furthermore, the practice of pruning cowpea leaves, or Lembayung leaves in this context, carries economic promise and nutritional significance. This process not only holds potential economic value but also bolsters the availability of a nutritious food source.

In Indonesia, cowpea production has reached a significant level, with yields ranging between 1.5 to 2 tons of dry seeds ha^{-1}. This output is influenced by a combination of factors including the variety of cowpea, geographical location, growing season, and cultivation techniques (Sayekti et al., 2012). However, despite these achievements, cowpea production and its overall productivity still face challenges, mainly attributed to a lack of access to modern agricultural technologies. Notably, the absence of high-yielding varieties and effective plant and pest management practices hampers the full potential of cowpea cultivation (Kebede and Bekeko, 2020). Furthermore, the exploration of cowpea as source of protein remains relatively limited in Indonesia. Efforts to harness its nutritional benefits have yet to realize their full scope.

Leaf pruning holds the potential to significantly influence cowpea seed yield due to its intricate connection with the distribution of photosynthate across various plant parts during both vegetative and reproductive growth stages. The role of leaves as the primary source of photosynthate and the pods/seeds as the principal photosynthetic sink organ is pivotal in this context. The efficiency and activity of these photosynthetic sources, coupled with the dynamic competition among different sink organs, play a crucial role in shaping overall crop yields (Purnamawati et al., 2010). The strategic act of pruning leaves serves a dual purpose. Firstly, it addresses the internal competition for assimilates within the plant, thus optimizing assimilation processes which in turn, boosts the translocation of these assimilates toward the seeds, which are vital for the reproductive output (Destifa, 2016). Secondly, pruning shoots contributes to creating an improved growth environment for the plant by mitigating issues arising from excessive plant density and inadequate sunlight exposure. By engaging in shoot pruning, the distribution of photosynthates within the plant can be more effectively managed, particularly considering their typical concentration in plant shoots under normal conditions (Hadirochmat, 2008; Wibowo et al., 2015). In essence, the strategic practice of leaf and shoot pruning plays a dynamic role in optimizing the allocation of resources and energy within the plant, ultimately influencing its reproductive success and overall yield potential.

The findings of Sarijan's research (2020) indicate that various components of crop yields, such as total pod count, number of damaged or fallen pods, harvested pod count, pod length, and seeds per pod, displayed comparable results between pruned and unpruned plants. Notably, the highest production recorded from pruned jack bean plants, yielding 3.4 t.ha^{-1}, aligns closely with the yield of unpruned plants at 3.2 t.ha^{-1}. These results highlight the equivalence in yield outcomes regardless of pruning in jack bean cultivation. Similarly, the research conducted by Prayudi et al. (2019) offers insights into the impact of shoot pruning timing on *Abelmoschus esculentus*, commonly referred to as "okra." Pruning the shoots 15 days after planting (DAP) led to increased branch count, productive branches, fruit weight per plant, and fruits per plant. Additionally, shoot pruning at the 30 DAP enhanced stem diameter and altered flowering time.

Determining the appropriate interval and height for pruning holds significant importance due to its direct influence on various aspects of plant physiology, production, and regrowth capabilities. The research conducted by Ibrahim et al. (2010) offers valuable insights in this regard. Their study explored the effects of pruning cowpea at three distinct growth stages (vegetative, flowering, and pod) and across four pruning intensities (ranging from 0, 25, 50 and 100%). The results of their research underscore the nuanced impacts of cowpea leaf pruning. Particularly, when conducted at the pod stage and at intensities below the 50% threshold, significant effects were observed on multiple aspects of vegetative plant characteristics, overall development, as well as key parameters influencing cowpea yield. This study serves as a reminder of the intricate relationship between pruning practices and their repercussions on plant growth and production. It emphasizes that both the timing of pruning and the extent to which it is carried out play a pivotal role in shaping the final outcomes of cowpea cultivation.

Materials and Methods

The research was conducted from April to August 2022 at the Cikabayan Experimental Field, IPB University, Bogor Regency, West Java. Soil and plant analysis was conducted at the Testing Laboratory of the Agronomy and Horticulture Department, Faculty of Agriculture, IPB University. The research area is located at an altitude of about 250 m above sea level.

The material used in this research were cowpea with the variety name "Albina IPB," cow's manures 2 t.ha^{-1} and dolomite 2 t.ha^{-1}, 249 kg Urea ha^{-1}, 249 kg SP-

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36 ha^{-1}, 176 kg KCl ha^{-1}, furan, herbicide with the active ingredient *Isopropilamina Glifosat*, fungicide Dithane M-45 with the active ingredient *Mancozeb*, and insecticide Decis 25EC with the active ingredient *Deltamethrin.* The size of the experimental plots was 2 m x 3 m (6 m^2), and the distance between plots was 50 cm using a spacing of 50 cm x 20 cm.

The experiment used a randomized complete block design with three factors. The first factor is the pruning time (5 and 7 weeks after planting (WAP), representing vegetative and generative phases, respectively). The second factor is the pruning method (leaf and shoot pruning), and the third is the pruning intensity (0, 10, 30, and 50% of the leaf numbers). The pruned cowpea leaves are located at the top of the plant, and the number of pruned leaves is in accordance with the predetermined pruning intensity. Meanwhile, the shoots of cowpea were pruned at the shoot stalks, and the leaves were adjusted according to the number of leaves at the specified pruning intensity. The treatments were arranged into 16 combinations and repeated three times into 48 experimental plots.

Research implementation includes soil analysis, land preparation, planting, fertilizing, maintenance, and harvesting. Pruning is done by cutting the leaf and shoot using scissors. Pruning was carried out at pruning times 5 and 7 WAP with a pruning intensity of 0% (without pruning), 10% (2 and 4 leaves), 30% (5 and 11 leaves), 50% (12 and 19 leaves). The brackets indicate the number of leaves pruned at 5 and 7 WAP for each pruning intensity.

Plant growth measurement included the number of pruned leaves and pruned leaf weight. Plant harvest was carried out two weeks after treatment; the number of leaves, plant dry weight, and C/N ratio were measured. Carbon content was measured with a spectrophotometer at a wavelength of 561 nm and organic nitrogen is oxidized in a concentrated sulfuric acid environment with a selen mixture catalyst to

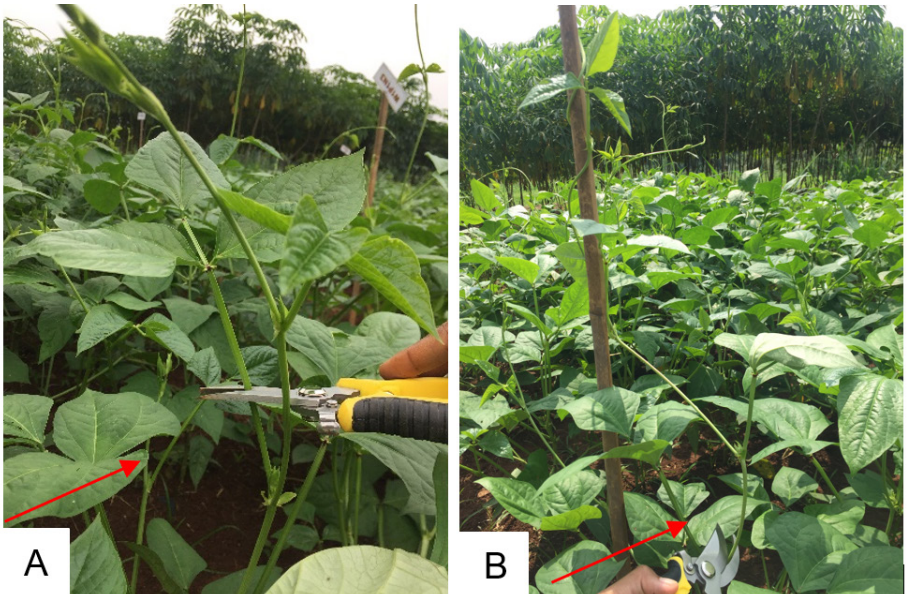

Figure 1. Cowpea leaf pruning (A) and shoot pruning (B).

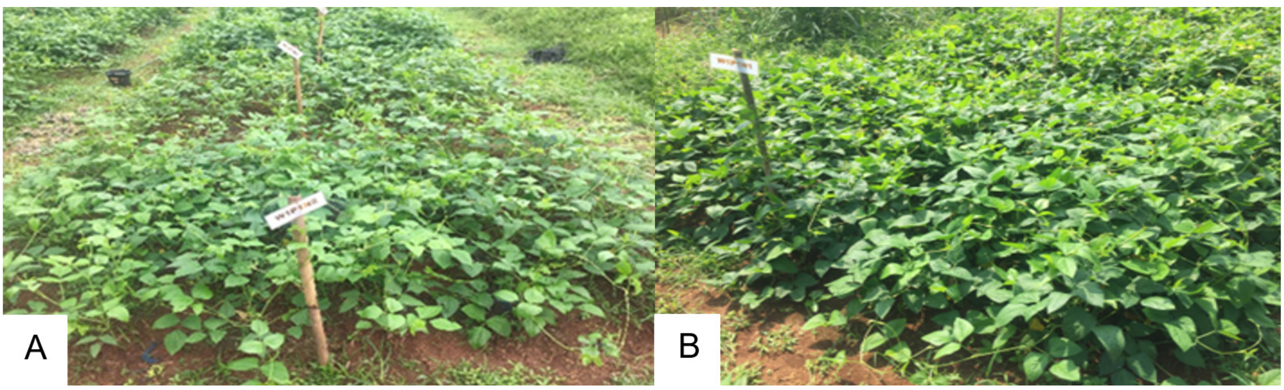

Figure 2. Cowpeas after 10% leaf pruning treatment (A) and two weeks after pruning (B).

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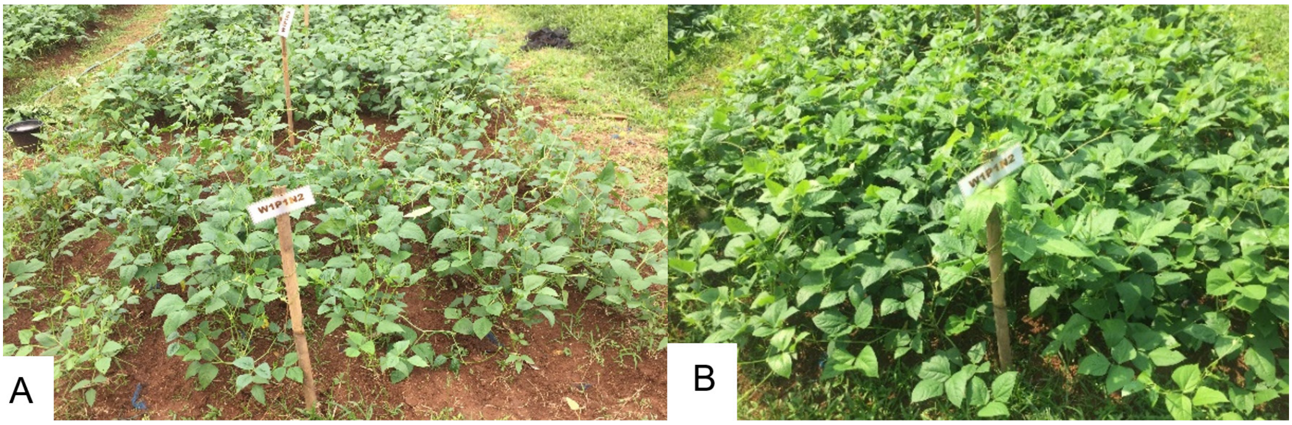

Figure 3. Cowpeas after 30% leaf pruning treatment (A) and two weeks after pruning (B)

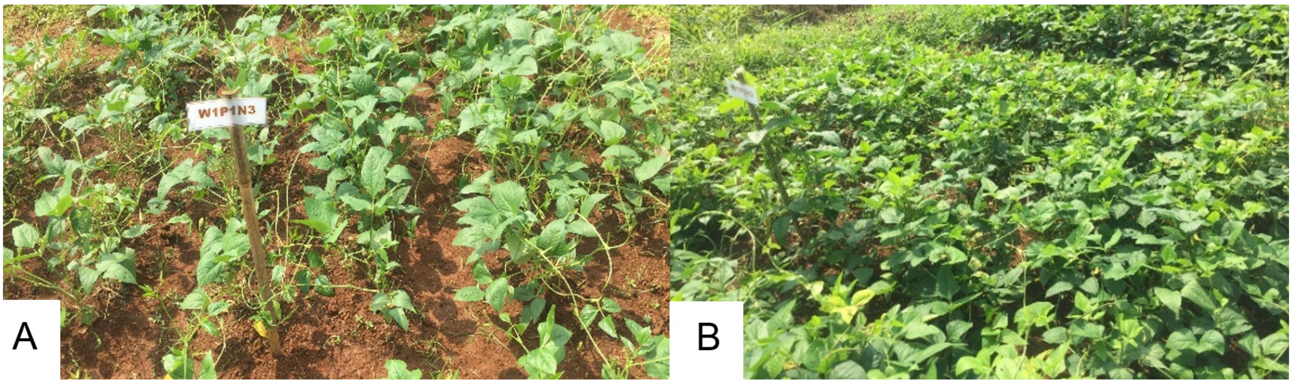

Figure 4. Cowpeas after 50% leaf pruning treatment (A) and two weeks after pruning (B).

form $(NH_4)_2SO_4$ by distillation or spectrophotometry. The yield components measured were harvesting age, pod weight per plant, total pod weight, 100-seed weight, dry seed weight per plant, and productivity of cowpea seeds. Data were analyzed using ANOVA using SAS 9.4. If the analysis results are significant, a further test is carried out with DMRT with level of significant, α = 5%.

Results and Discussion

Based on BMKG data from the Bogor climatology station, the average temperature from April to August 2022 ranges from 25.20–26.50^{o}C. The highest rainfall from June to August ranges from 358.40–463.70 mm per month occurring in the middle of planting to harvest. The average humidity ranges from 80.25–85.76%, which indicates normal humidity in a tropical climate environment and is suitable for the growth of cowpea plants. The average temperature of the study was optimal for cowpea plants, but the rainfall was in the high category level, exceeding the optimal conditions for plant growth. The length of sunlight exposure affects the growth and development of cowpea plants. Cowpea is less tolerant of flooding. Meanwhile, it is very tolerant of drought and can well produce in areas with low rainfall intensity, such as the Middle East and Africa, which are dry climates (Ngalamu et al., 2014).

The purpose of pruning is to regulate the balance of *source* and *sink* to modify plant growth, hence increased growth and yield. The pruned cowpea leaves can be used as vegetables and as additional production. Cowpea dry seeds can be used as a raw material in the manufacture of tempeh, tofu, and flour. According to a study by Ibrahim et al., (2010) that cowpea defoliation with the intensity of <50% at the pod growth stage increased plant vegetative growth, development, and yields.

The results were subjected to analysis of variance using DMRT with a significance level of α = 5%, aiming to assess the individual impact of each treatment on the observed variables. The measured variables include the composition of young and mature leaves, the count of pruned leaves, and the weight of the pruned leaves. The study involved plant evaluation through destructive measurements at the two-weeks following pruning, pruning method, and pruning intensity at 7 and 9 weeks after planting (WAP). This evaluation entailed the assessment of variables such as leaf count, shoot fresh and dry

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weight, root fresh and dry weight, and the C/N ratio. Yield components of the cowpea including like pod count, pod length, seeds per pod count, 100-seed weight, seed dry weight per individual plant, seed dry weight per experimental plot, and the overall dry seed productivity, were determined. Analysis of variance coupled with DMRT at a 5% significance level were conducted to evaluate the impacts of the diverse treatments on the aforementioned variables across different stages of plant growth and development.
Top of Form

The pruning time of two weeks after 5 WAP of the vegetative phase significantly affected the number of leaves, crown wet weight, and shoot dry weight, whereas the pruning time of two weeks after the 7 WAP generative phase significantly affected the C/N ratio (Table 2). Shoot pruning affected the pod dry weight of the second harvest at 10 WAP and the total dry weight of the pods of the first and second harvests (Tabel 3). A pruning intensity of 10% significantly affected shoot dry weight, while a pruning intensity of 50% significantly affected the number of pods per plant. The interaction between pruning time, pruning method, and pruning intensity significantly affected the number of pruned leaves per plant, pruned leaf weight per plant, second harvest pod dry weight, pod length, and number of pods per plot.

The results showed that the interaction between pruning time and pruning intensity of 30% to 50% significantly affected the number of pruned leaves and the weight of pruned leaves per plant during the generative phase (Table 1). If pruning is done later

Table 1. Interaction between pruning times, pruning methods, and pruning intensities on the number of leaves and harvested leaf weight

Variable	Pruning time (WAP)	Pruning method	Pruning intensity		
			10%	30%	50%
Number of leaf	5	Leaf	2.00 h	5.66 f	11.33 c
		Shoot	2.00 h	7.00 e	9.66 d
	7	Leaf	3.66 g	11.00 c	18.00 a
		Shoot	4.66 fg	10.33 cd	16.33 b
Harvested leaf weight (g)	5	Leaf	8.60 e	21.46 c	32.06 b
		Shoot	6.33 e	11.20 de	16.00 cd
	7	Leaf	12.93 de	28.33 b	46.13 a
		Shoot	7.80 e	19.93 c	20.80 c

Note: values followed by the same letters within one variable are not significantly different according to DMRT α = 5%.

Table 2. Number of leaf, shoot and root fresh weight and dry weight, and C/N ratio of two-week-old cowpea at different pruning times, pruning methods, and pruning intensities.

Treatment	Number of leaf	Shoot wet weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	C/N ratio
Pruning times (W)						
5 WAP	50 a	156.70 a	5.55	28.64 a	1.46	12.79 b
7 WAP	39 b	106.93 b	5.71	23.79 b	1.62	16.61 a
Pruning methods (P)						
Leaf	45	142.76	5.97	27.27	1.62	14.53
Shoot	44	120.86	5.29	25.17	1.42	14.86
Pruning intensities (%) (N)						
0	50 a	120.74	5.00	23.57 b	1.43	14.69
10	46 ab	142.97	6.37	30.86 a	1.75	14.61
30	43 bc	142.89	5.94	26.71 ab	1.63	15.41
50	39 c	120.64	5.21	23.72 b	1.37	14.07
W x P x N	ns	ns	ns	ns	ns	ns

Note: values followed by the same letters within one variable are not significantly different according to DMRT α = 5%. ** significant α = 1%. * significant α = 5%. ns: not significant.

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(7 WAP) it will increase the number of leaves, and the weight of pruned leaves per cowpea plant is higher. This is because plants that have entered the generative phase, i.e. at week 7, had more leaves, so the pruned cowpea leaves can be consumed as vegetables or animal feed. Cowpea leaves that are pruned for consumption are young leaves that have opened before, so they are soft and less fibrous (Saidi et al. 2010). Cowpea leaves consumed for vegetables are young leaves with shiny leaves, which grew profusely after pruning. Cowpea leaves, or lavender leaves, have a market price of around IDR 6,000 per kg. The population in the study was 60 per experimental plot and produced about 30 g of pruned leaves per plant that worth Rp. 54,000. Therefore, these pruned young leaves have good economic values, as well as a source of nutritious food.

Plant at Two Weeks After Pruning

Pruning time significantly increased the number of cowpea leaves at 5 WAP after two weeks of pruning; the number of leaves at the vegetative phase were significantly greater than pruning at 7 WAP (Table 2). This is presumably because pruning was conducted during the reproductive phase so that the plant uses more energy to produce the formation of flowers and pods. Cowpeas start the reproductive phase at 33-51 DAP, flowering, and ripening pods at 53-67 DAP (Trustinah et al., 2017).

Plants can maintain the turgidity of plant cells during the vegetative phase, which allows plants to carry out cell division in leaves. However, at flowering and pod filling phases, the assimilates are diverted for the development of the generative organs, and decreased leaf production and hence, leaf area. Plants pruned earlier will heal more quickly from pruning wounds, allowing plants to grow better and produce more inflorescences and new shoots (Sarijan, 2020). The results of research by Usman et al., (2013) showed that differences in pruning time, namely during the vegetative and generative stage, can lead to the growth of larger lateral shoots followed by the release of flower stalks on the jack bean branches.

Pruning at a 10% intensity significantly increased the dry weight of cowpea shoots (Table 2). This boost in dry weight can be attributed to sustained vegetative growth post-flowering and pod formation. According to Purnamawati et al. (2010), yields are influenced by the capacity and activity of photosynthetic sources and competition among sinks (nutrient-consuming parts of the plant). At two weeks after pruning, cowpeas pruned at 7 weeks after planting (WAP) exhibited a higher C/N ratio compared to those pruned at 5 WAP (Table 2). This change likely results from increased leaf formation, subsequently boosting shoot dry weight. The translocation of assimilates from source (usually leaves) to sink (nutrient-consuming structures like pods) primarily involves carbon and nitrogen (Atkins and Smith, 2007). Research by Gardner et al. (1991) indicates that photosynthetic products are distributed to different plant organs, including generative and vegetative structures, thereby affecting dry matter accumulation. Moreover, Shiraiwa et al. (2004) reported that the initial phase of dry matter accumulation during the seed-filling period is important in determining yield disparities among soybean genotypes.

Cowpea Yield Components

Table 3 demonstrates that cowpea shoot pruning, with a pruning intensity of 30%, had a significant impact on the total dry weight of cowpea pods per plot. This effect is likely attributed to the practice of pruning the upper parts of cowpea plants, encouraging the development of multiple branches or stem nodes and thereby increasing the formation of flower clusters that eventually lead to pod production.

Research conducted by Rochayat et al. in 2017 supports this notion, as it indicates that pruning contributes to the increased number of branches, longer branch lengths, a greater number of leaves, and expanded leaf area in Japanese frangipani plants. These findings align with the observations of Nadira et al. (2009), who emphasized that efforts to boost crop production through pruning result in the enhanced growth of productive branches, ultimately leading to greater fruit production. This increase in productive branches can be attributed to heightened growth hormone activity in the pruned areas of the plant. The data underscores the positive impact of pruning intensity, particularly at 30%, on cowpea pod yield by stimulating branch and flower development, thereby increasing the potential for pod formation and ultimately enhancing crop productivity.

The seed production yield depends on the number of pods produced and the ability to fill the seeds. Iska et al., (2018) stated that pod number and dry pod weight per plant correlated positively with dry seed yield, so that high dry seed yield was associated with the ability of plants to produce many pods in one plant. Seed filling is closely related to photosynthesis and plant nutrients, especially nitrogen Iska et al., (2018). The pod formation stage, nitrogen in the leaves moves towards the pods to support pod ripening and seed formation Iska et al., (2018)

Pruning method interacted with a pruning intensity of 30% increased the dry weight of cowpea pods per

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Table 3. Average dry weight of pods per plant and per plot of the first and second harvests and total dry weight of cowpea pods at different pruning times, pruning methods, and pruning intensities.

Treatment	Pod weight per plant (g)	Pod dry weight per plot of the first harvest (g)	Pod dry weight per plot of the second harvest (g)	Total pod dry weight of first and second harvest (g)
Pruning times (W)				
5 WAP	35.26	399.08	223.63	622.71
7 WAP	35.12	407.63	212.13	619.75
Pruning methods (P)				
Leaf	34.3	387.50	182.63 b	570.13 b
Shoot	36.0	419.21	253.13 a	672.33 a
Pruning intensities (%) (N)				
0	35.70	427.67	273.75 a	701.42 a
10	34.65	402.17	182.83 b	585.00 b
30	34.91	397.33	234.67 a	632.00 ab
50	35.50	386.25	180.25 b	566.50 b
W x P x N	ns	ns	*	ns

Note: values followed by the same letter in the same column are not significantly different according to DMRT; ** significant α = 1%. * significant α = 5%. ns: not significant.

Table 4. Effect of interactions between pruning times, pruning methods, and pruning intensities on dry weight of second harvest cowpea pods at 10 WAP and number of pods per plot

Variable	Pruning time	Pruning method	Pruning intensity			
			No pruning	10%	30%	50%
Pod dry weight per second harvest plot (g)	5 WAP	Leaf	209.00 cde	186.33 cde	154.00 de	207.00 cde
		Shoot	338.00 ab	224.33 cde	258.33 bcd	212.00 cde
	7 WAP	Leaf	265.33 bc	136.33 e	153.00 de	150.00 de
		Shoot	282.67 abc	184.33 cde	373.33 a	152.00 de
Number of pods per plot	5 WAP	Leaf	248 abc	229 bc	222 bc	210 bc
		Shoot	254 abc	281 ab	247 abc	210 bc
	7 WAP	Leaf	212 bc	202 c	200 c	219 bc
		Shoot	318 a	188 c	300 a	247 abc

Note: values followed by the same letter in the same column are not significantly different according to DMRT;** significant α = 1%. * significant α = 5%. ns: not significant.

second harvest plot by 373.33 g. In comparison, the effect of the interaction between pruning methods with a pruning intensity of 10% and 30% on the number of cowpea pods per plot, but the number of pods per plot showed no significant effect due to pruning because the yields of pruned and unpruned plants had values that were not significantly different (Table 4).

Pruning at an intensity of 10% increased cowpea pod length, whereas pruning at an intensity of 50% increased the number of cowpea pods per plant (Table 5). It is suspected that cowpea pod length is influenced by the plant's genetics. The act of pruning the plant has a direct impact on the yield of cowpea pods. This finding aligns with the results of Ibrahim et al. (2010), who reported that pruning conducted during the pod stage, especially when the pruning intensity was below 50%, had a significant effect on key cowpea yield parameters, including pod length and the number of pods. Similarly, Rahman et al. (2008) reported that the removal of cowpea leaves influenced yield and profitability. The effects were particularly significant when the pruning intensity reached 50% during the flowering stage. However, it's important to note that excessive pruning, at a 100% intensity during the vegetative stage, resulted in a decrease in cowpea growth.

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Table 5. Average pod length, number of pods per plant, and number of cowpea seeds per pod at different pruning times, pruning methods, and pruning intensities.

Treatment	Pod length (cm)	Number of pods per plant	Number of seeds per pod
Pruning times (W)			
5 WAP	17.0	19.3	14.0
7 WAP	17.2	17.4	13.9
Pruning methods (P)			
Leaf	17.0	18.7	13.9
Shoot	17.2	18.1	14.0
Pruning intensities (%) (N)			
0	16.9 b	16.9 b	13.9
10	17.5 a	17.6 b	14.2
30	16.9 b	17.2 b	13.8
50	17.0 b	21.7 a	13.9
W x P x N	ns	ns	ns

Note: values followed by the same letter in the same column are not significantly different according to DMRT; ** significant α = 1%. * significant α = 5%. ns: not significant.

Table 6. Weight of 100-seeds, dry seed weight per plant, dry seed weight per plot, and dry seed productivity at different pruning time. pruning methods and pruning intensities

Treatment	100-seeds weight (g)	Seed dry weight per plant (g)	Seed dry weight per plot (g)	Dry seed productivity per plot (kg ha^{-1})
Pruning times (W)				
5 WAP	13.25	27.21	382.38	86.0
7 WAP	13.30	27.05	403.33	81.5
Pruning methods (P)				
Leaf	13.12	26.59	399.75	85.2
Shoot	13.43	27.67	385.96	82.3
Pruning intensities (%) (N)				
0	13.75	26.90	389.17	82.9
10	13.16	26.56	381.33	81.3
30	12.91	27.58	411.75	87.7
50	13.27	27.48	389.17	82.9
W x P x N	ns	ns	ns	ns

Note: ns = values within the same column were not significantly different according to the DMRT α = 5%.

The timing, method, and intensity of pruning did not have a significant impact on the weight of 100 seeds, the weight of dry seeds per plot, the weight of dry seeds per plant, or the overall productivity of dry cowpea seeds. There were no observed interactions between these treatments in affecting the weight of 100 seeds, the weight of dry seeds per plot, or the productivity of dry cowpea seeds (Table 6). The weight of 100 seeds ranged from 12.91 to 13.75 g, a range consistent with the findings of Wahyudi et al. (2022) in the Albina variety, which recorded a weight of 13.14 g. Furthermore, the dry seed weight of both pruned and unpruned plants was similar, indicating that pruning did not have a significant effect on this parameter. As suggested by Sarijan (2020), the removal of lateral branches through pruning results in a loss of photosynthetic capacity, rendering leaves ineffective as photosynthetic organs, which is crucial during seed filling due to the substantial photosynthate requirements.

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Pruning time, pruning method, and pruning intensity were found to have no significant effect on dry seed productivity, and there were no observed interactions between these treatments (Table 6). In this study, dry cowpea seed productivity was calculated based on a clean plot area of 3.75 m², derived from the larger plot area of 6 m². The productivity ranged from 81.3 to 87.7 kg.ha-1. Our study shows that pruning time in the vegetative phase affects cowpea production, likely because pruning reduced the number of leaves, the number of pods per plant, and the number of seeds per pod. According to Banks and Bernardi (1987), pruning can reduce photosynthesis and plant nitrogen intake, so soybean productivity decreases. In addition, Henreit et al., (1997) reported that pruning at the vegetative stage significantly reduced the number of grain production.

Sarijan (2020) reported that production of sword bean's branches and stems between pruned and unpruned plants were similar. The low yield is likely caused by the inability of plants to compensate for the loss of photosynthetic-producing organs. Pruning the jack bean, it is able to maintain flower buds and support the development of the pods due to limited photosynthesis. (Nazir, 2016), hence the yield of pruned and unpruned plants were similar.

The results of this study shed light on the relationship between pruning intensity, resource allocation (carbon and nitrogen), and plant growth, which, in turn, impact cowpea and soybean yields. These insights are valuable for optimizing crop management strategies to enhance yields.

Conclusion

Our study revealed the substantial impact of pruning time, pruning method, and pruning intensity on various aspects of cowpea plant growth. Specifically, these treatments exerted significant influence on parameters such as leaf count, shoot fresh weight, shoot dry weight, and the C/N ratio of the cowpea plants. However, despite these effects on plant growth, the pruning time, pruning method, and pruning intensity did not show a statistically significant impact on the ultimate yield of cowpea seeds. In the context of pruning cowpea leaves, the practice yielded pruned leaf weights ranging from 11.20 to 46.13 g. Importantly, these pruned leaves have the potential to be utilized as a vegetable, offering a nutritious food source. Remarkably, this utilization does not come at the cost of compromising the cowpea seed yield, highlighting the dual benefits of this approach. Interactions between the various treatments manifested across multiple parameters; notable interactions were observed concerning the number and weight of pruned leaves, as well as the dry weight of second harvest pods and the cumulative dry weight of first and second harvest pods. The interactions influenced pod length and the count of cowpea pods, underscoring the complexity of the relationships among the studied variables and treatments.

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