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RESEARCH ARTICLE

Pruning effects on growth dynamics and seed productivity of Jatropha

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Abstract

Jatropha curcas L. is widely recognized as a promising bioenergy crop for semi-arid regions due to its drought tolerance and ability to produce oil-rich seeds under low-input conditions. However, its productivity remains inconsistent, largely due to environmental stress and suboptimal agronomic practices. Among these, pruning is commonly recommended to improve plant architecture and enhance yield, yet its effectiveness under semi-arid conditions remains unclear. This study evaluated the short-term effects of pruning on vegetative growth and seed production of Jatropha using 19 and 28 accessions in two field trials conducted under semi-arid conditions in Mali. A pruning treatment was applied at 50 cm height and compared with non-pruned controls. Vegetative traits and reproductive parameters were monitored over two growing seasons and analyzed using mixed linear models. Results revealed that pruning significantly reduced plant height (15–25%) and branching intensity, while root collar diameter remained unaffected. More importantly, seed yield in pruned trees decreased by approximately 57% compared to non-pruned plants. Monthly analysis showed consistently significant reductions in seed production, with peak yield occurring in August. Correlation analysis indicated that fruit biomass was strongly associated with seed yield, whereas vegetative traits exhibited only moderate relationships with productivity. We observed that severe pruning at early growth stages is not suitable for Jatropha under semi-arid conditions. Maintaining canopy integrity is essential for sustaining productivity, and alternative pruning strategies should be explored. This study provides important insights for optimizing agronomic practices and improving the sustainability of Jatropha-based bioenergy systems in marginal environments.

Keywords: Jatropha, oil, semi-arid, drought, yield, correlatation

Jatropha curcas L., a perennial shrub belonging to the Euphorbiaceae family, has gained global attention as a promising biofuel crop due to its ability to produce oil-rich seeds suitable for biodiesel production (Biofuel production). The species is native to tropical America but has been widely introduced across Africa, Asia, and other tropical regions because of its adaptability to marginal lands, drought tolerance, and low nutrient requirements (Openshaw, 2000; Achten *et al.*, 2008). These characteristics make *Jatropha curcas* particularly attractive for semi-arid regions where conventional crops often fail, offering opportunities for sustainable energy production and rural development. Despite its potential, the productivity of *Jatropha curcas* remains highly variable and often below expectations under field conditions. Yield instability is primarily attributed to environmental constraints such as irregular rainfall, poor soil fertility, and high temperature stress, as well as inadequate agronomic management practices (Divakara *et al.*, 2010; Carels, 2009; Eruotor, *et al.*, 2024). In semi-arid regions like Mali, these limitations are further exacerbated by water scarcity and degraded soils, which significantly influence plant growth, flowering, and seed development. Recent studies have also emphasized that Jatropha performance is highly sensitive to environmental stress, particularly water deficit, which can restrict physiological processes and reduce biomass accumulation (Irshad *et al.*, 2021). Among agronomic practices, pruning is widely used in perennial crops to regulate plant architecture, improve light interception, and stimulate lateral branching by reducing apical dominance. Theoretically, pruning can enhance canopy structure and increase the number of productive sites, thereby improving yield potential (Gour, 2006; Behera *et al.*, 2010). However, the response of *Jatropha curcas* to pruning is complex and not yet fully understood. While some studies report that moderate pruning can promote vegetative growth and branching, others indicate that excessive or poorly timed pruning may negatively affect plant performance by reducing leaf area and photosynthetic capacity (Abdelgadir *et al.*, 2009; Ghosh *et al.*, 2011). The inconsistency in reported results suggests that the effectiveness of pruning depends on multiple interacting factors, including pruning intensity, timing, environmental conditions, and genetic variability among accessions. For instance, under water-limited environments, the removal of canopy biomass may delay plant recovery and reduce assimilate availability for reproductive development. Recent research further indicates that reproductive processes such as flowering and seed set in *Jatropha curcas* are highly influenced by environmental conditions and physiological status, including pollen viability and stress responses (Kasthurirengan *et al.*, 2025). This highlights the importance of understanding how management practices like pruning interact with environmental stress to influence both vegetative and reproductive performance. In Mali, *Jatropha curcas* is commonly cultivated as hedgerows or live fences, providing multiple ecosystem services such as soil conservation, protection of crops, and energy supply for rural households (Henning, 1996; Henning, 2004). However, productivity under local conditions remains relatively low, and there is a lack of scientifically validated management practices to optimize yield. Most existing studies on Jatropha agronomy have been conducted in other regions, particularly in Asia and Latin America, with limited applicability to Sahelian environments characterized by harsher climatic conditions. Given these gaps, there is a critical need for location-specific research to evaluate the effects of agronomic practices such as pruning under semi-arid conditions semi-arid conditions.

Understanding the relationship between vegetative growth traits and reproductive output is also essential for improving selection strategies and management recommendations. Moreover, recent global assessments highlight that improving yield stability remains one of the key challenges limiting the large-scale adoption of Jatropha as a bioenergy crop (Birhanu *et al.,* 2026. Therefore, the present study aims to (i) evaluate the short-term effects of pruning on vegetative growth and seed production of diverse Jatropha curcas accessions under semi-arid conditions in Mali, (ii) assess the relationships between growth traits and yield components, and (iii) identify potential indicators for improving productivity through management or selection. The findings are expected to contribute to the development of evidence-based agronomic practices and enhance the sustainability of Jatropha production systems in semi-arid regions.

Materials and methods

A diverse collection of Jatropha curcas accessions originating from different geographical regions was used to assess the response to pruning under semi-arid conditions. The plant material included both local and introduced genotypes to capture a wide range of genetic variability, which is essential for evaluating adaptation and productivity potential. Two independent field trials were established, each comprising a distinct set of accessions.

Field trial I

Field Trial I consisted of 19 accessions collected from Africa, Asia, and Latin America, representing diverse agro-ecological origins. The inclusion of both local Malian accessions and exotic genotypes allowed comparison of adaptation and performance under uniform environmental conditions. The accessions from Mali (e.g., Bougouni, Falou, Sotuba) represent locally adapted genotypes commonly cultivated under semi-arid conditions. Accessions from India (e.g., BAAS and SNES series) are known for their genetic diversity and have been widely used in breeding programmes.

Table 1: Accessions used in field trial I

S. No.	Accession name	Country of origin	S. No.	Accession name	Country of origin
1	BAAS38	India	11	OUELESSEBOUGOU	Mali
2	BAAS22	India	12	SBAN 24	India
3	BOUGOUNI	Mali	13	SNES29	India
4	DIALAKOROBA	Mali	14	SNES 30	India
5	FALOU	Mali	15	SNES 39	India
6	GUINEA BISSAU	Guinea Bissau	16	SNES 44	India
7	LASPILLAS	Mexico	17	SNES 45	India
8	MALI	Mali	18	SOTUBA	Mali
9	MEXICO	Mexico	19	TANZANIE	Tanzania
10	OTAGONE	Mexico			

Mexican accessions represent the center of origin of Jatropha, providing valuable genetic traits related to yield and oil content. The inclusion of accessions from Guinea Bissau and Tanzania further broadens the genetic base. Hence, the material used in the present research work indicates that, based on their diverse geographical origin, the accessions possess a wide range of genetic variability. Such diverse germplasm resources are highly valuable for identifying superior genotypes and for developing improved cultivars with enhanced adaptability, productivity, and oil quality traits through future breeding programmes

Field trial II

Field Trial II included 28 accessions, comprising both previously tested and additional genotypes, with a stronger representation of local Malian accessions and improved lines.

Table 2: Accessions used in field trial II

S. No.	Accession name	Country of origin	S. No.	Accession name	Country of origin
1	Sotuba	Mali	15	SNES 29	India
2	Inconnu	Unknown	16	Falou Sadore	Mali
3	Otagone	Mexico	17	BAAS22	India
4	Tanzanie	Tanzania	18	LAS PILLAS	Mexico
5	Kati-Farada	Mali	19	Koutiala	Mali
6	Ouelessebougou	Mali	20	SNES 30	India
7	Dialakoroba	Mali	21	BAAS38	India
8	Kokofata Kita	Mali	22	Mexico	Mexico
9	GERA	—	23	SNES 45	India
10	SNES 39	India	24	ISC14	India
11	SNES 44	India	25	SBAN24	India
12	Mali Sadore	Mali	26	SNES28	India
13	Guinea Bissau	Guinea Bissau	27	Falou Samanko	Mali
14	SNES 19	India	28	Bougouni	Mali

Field trial II expanded the genetic diversity by including additional accessions and replicating several genotypes from Field Trial I. A strong representation of Malian accessions (e.g., Kati-Farada, Koutiala, Falou Samanko) ensured relevance to local agro-ecological conditions. Indian accessions (SNES, BAAS, ISC series) contributed improved genetic lines, while Mexican accessions provided reference material from the species' center of origin. Study area, design for field trial I and II

The study was conducted at the research station of the International Crops Research Institute for the Semi-Arid Tropics located in Samanko, جنوب of Bamako, Mali (12°32′ N, 8°04′ W; altitude 330 m). The climate is semi-arid with a unimodal rainfall pattern ranging from 800 to 1200 mm annually. The rainy season extends from June to October, followed by a prolonged dry season from November to May. Soils in the experimental site are predominantly sandy loam with moderate fertility, typical of Sudano-Sahelian agro-ecological zones.

The first field trial consisted of 19 Jatropha accessions originating from Africa, Asia, and the Americas (Table 1). The trial was established in August 2008 using one-year-old seedlings planted at a spacing of 3 m × 3 m. The experimental design followed an incomplete block structure, with each accessions represented by eight tree per block. The second filed trial 28 accessions (Table 2) and was established in July 2009 using the same planting density. Each accession was arranged in rows without replication, and each row was divided into two plots assigned randomly to pruning and non-pruning treatments. Pruning was performed in March 2012 during the dormant period. Trees assigned to the pruning treatment were cut at 50 cm above ground level, while control trees were left unpruned. Data were collected to evaluate the effects of pruning on vegetative growth and reproductive performance following standardized methodologies for *Jatropha curcas* (Behera *et al.*, 2010; Ghosh *et al.*, 2011; Tripathi *et al.*, 2013).

Vegetative growth parameters reproductive traits studied

Plant height (cm): Measured from the soil surface to the apical tip using a measuring tape (±1 cm accuracy). Measurements were taken before pruning (March 2012) and monthly for six months after pruning.

Root collar diameter (mm): Measured at 5 cm above ground level using a digital caliper (±0.1 mm). This parameter was used as an indicator of plant vigor and structural development (Abdelgadir *et al.*, 2009; Everson *et al.*, 2013).

Number of branches: Branching intensity was assessed using a categorical scale (0–6) adapted from Behera et al. (2010): 0 = no branches; 1 = 1–10; 2 = 11–20; 3 = 21–50; 4 = 51–100; 5 = 101–150; 6 = >150 branches. Observations were recorded before pruning and monthly thereafter to assess regrowth patterns.

Fruit number per tree: All mature fruits were counted manually during each harvest. Observations were conducted monthly from July 2012 to February 2013.

Fruit fresh and dry weight (g): Fresh weight was measured immediately after harvest using a digital balance (±0.1 g). Dry weight was determined after oven-drying at 70°C until constant weight (~48 h) (Foidl *et al.*, 1996; Francis *et al.*, 2005).

Seed fresh and dry weight (g): Seeds were manually extracted from fruits. Fresh and dry weights were measured following the same procedure, and moisture content was recorded.

Seed yield per tree (g): Total seed yield was calculated as the cumulative dry weight per tree across all harvest months. accuracy, measurements were independently verified by two observers. All instruments, including calipers and balances, were calibrated weekly. Plant samples were stored in labeled, ventilated containers prior to weighing to prevent moisture variation. Data were analyzed using mixed linear models in SAS software (SAS Institute, 2009). Pruning treatment and accession were considered fixed effects, while block and interactions were treated as random effects. Monthly observations were analyzed as repeated measures. Data transformations (logarithmic and square root) were applied where necessary to meet assumptions of normality and homogeneity of variance. Pearson's correlation coefficients were computed to assess relationships between vegetative traits and yield components.

Results and discussion

Effect of pruning and accession on vegetative growth The results of the statistical analyses for vegetative growth traits in both field trials are presented in table 3 and 4.

In Field Trial I (Table 3), accession effects were generally non-significant for plant height and number of branches in 2013 ($P > 0.05$), indicating limited genetic variability for these traits after pruning. However, accession had a significant effect on root collar diameter ($F = 2.46$, $P = 0.0372$), suggesting that radial growth may be more genetically controlled than other vegetative traits. Pruning had a highly significant effect on plant height ($F = 108.44$, $P < 0.0001$) and number of branches ($F = 2187.95$, $P < 0.0001$), demonstrating a strong suppression of vertical growth and branching. In contrast, pruning did not significantly affect root collar diameter ($F = 0.23$, $P = 0.6409$), indicating that radial growth was less ensetive to canopy removal sensitive to canopy removal. Similarly, in Field Trial II (Table 4), pruning showed no significant effect on diameter ($F = 0$, $P = 0.9473$), but had a highly significant effect on plant height ($F = 28.99$, $P < 0.0001$) and number of branches ($F = 480.91$, $P < 0.0001$). Accession effects were significant for all traits in 2012 ($P < 0.05$), reflecting genetic variability before treatment application, but became non-significant in 2013, suggesting that pruning effects dominated over genetic differences. These results clearly indicate that pruning at 50 cm height significantly reduces vegetative growth, particularly plant height and branching. This finding contrasts with the theoretical expectation that pruning stimulates lateral branching through the reduction of apical dominance. Instead, the observed suppression suggests that the intensity of pruning combined with semi-arid conditions limited the plant's capacity for regrowth. Similar findings have been reported by Abdelgadir *et al.,* (2009), who showed that excessive pruning can reduce shoot regeneration in Jatropha curcas. Likewise, Behera *et al.*, (2010) and Rajaona *et al.,* (2011) observed that pruning under resource-limited conditions can lead to reduced vegetative growth. Under semi-arid conditions, water stress further constrains recovery after biomass removal, as demonstrated by Irshad *et al.,* (2021), reported reduced growth rates under stress conditions.

Effect of pruning on seed production

The effect of pruning on seed production was highly significant across most observation periods in both trials (Tables 5 and 6). In Field Trial I (Table 5), pruning significantly reduced seed production in all months from July 2012 to February 2013. The strongest effects were observed in August ($F = 166.94$, $P < 0.0001$), September ($F = 57.26$, $P < 0.0001$), and November ($F = 63.31$, $P < 0.0001$), indicating that pruning consistently affected reproductive performance during peak production periods. Even during lower production months, such as December ($F = 10.22$, $P = 0.0053$) and January ($F = 15.15$, $P = 0.0012$), pruning effects remained significant. The cumulative seed production over the 2012–2013 period was also significantly reduced ($F = 36.38$, $P < 0.0001$), confirming a strong negative impact of pruning on overall productivity. In Field Trial II (Table 6), pruning effects were even more pronounced. Extremely high F-values were observed in August ($F = 383.82$, $P < 0.0001$) and July ($F = 210.89$, $P < 0.0001$), indicating a very strong influence of pruning on seed production. Significant effects were also observed in September, October, and November ($P < 0.0001$). However, pruning effects became non-significant for seed production in February 2013 and for fruit production in 2013, suggesting a gradual recovery of plants over time. Interestingly, accession effects were generally non-significant for seed production in both trials ($P > 0.05$), indicating that pruning had a stronger influence than genetic variability on yield under the studied conditions. The significant reduction in seed yield due to pruning can be attributed to several physiological factors.

Pruning reduces leaf area, leading to decreased photosynthetic capacity and lower carbohydrate production. This, in turn, limits assimilate availability for reproductive development. Additionally, pruning disrupts source–sink relationships, reducing the allocation of resources to fruits and seeds. These findings are consistent with previous studies. Ghosh *et al.,* (2011) reported that heavy pruning significantly reduced yield in Jatropha due to loss of photosynthetic tissues. Similarly, Singh *et al.,* (2013) observed that pruning intensity negatively affects seed production, particularly under stress conditions. Foidl *et al.,* (1996) and Francis *et al.,* (2005) also emphasized the importance of maintaining canopy structure for optimal yield in Jatropha. Recent research further supports these findings. Kasthurirengan *et al.,* (2025) demonstrated that reproductive processes such as pollen viability are highly sensitive to environmental stress, which can be exacerbated by management practices like pruning. This suggests that pruning-induced stress may directly affect. The combined results from Tables 3–6 demonstrate that pruning has a strong and consistent negative impact on both vegetative growth and seed production of *Jatropha curcas* under semi-arid conditions. The significant reduction in plant height and branching indicates that pruning limited the plant's ability to regenerate canopy structure. This effect was consistent across both trials, suggesting that environmental constraints such as water availability played a key role in limiting recovery. The substantial reduction in seed production further confirms that pruning negatively affects reproductive performance. The consistency of these effects across months and trials highlights the robustness of the findings. Although some recovery was observed in later stages (2013), the initial reduction in yield suggests that short-term pruning is detrimental under the studied conditions. The lack of significant accession effects for most traits suggests that environmental and management factors play a more dominant role than genetic variability in determining plant performance under semi-arid conditions. This highlights the importance of optimizing agronomic practices to improve productivity. From an agronomic perspective, these results indicate that severe pruning at early growth stages should be avoided in semi-arid environments. Maintaining canopy structure is essential for sustaining photosynthesis and maximizing yield. Alternative pruning strategies, such as reduced intensity or delayed timing, should be explored to improve long-term productivity. Furthermore, recent global assessments (Birhanu *et al.,* 2026) emphasize that yield instability remains a major limitation for Jatropha adoption. The present study contributes to addressing this challenge by demonstrating the negative effects of inappropriate pruning practices. The combined results indicate that pruning at 50 cm negatively affects both vegetative growth and reproductive output. The reduction in height and branching is likely due to loss of photosynthetic tissues and delayed canopy recovery, as also observed by Everson *et al.,* (2013). The significant decline in seed yield is attributed to reduced photosynthetic capacity and altered source–sink relationships (Foidl *et al.,* 1996; Francis *et al.,* 2005). Under semi-arid conditions, these effects are exacerbated by water and nutrient limitations. The moderate correlations between vegetative traits and yield suggest that growth parameters alone are insufficient for predicting productivity, particularly under stress conditions. Instead, fruit biomass should be prioritized as a selection criterion. From a broader perspective, Jatropha continues to be recognized as a promising bioenergy crop under changing climatic conditions, with recent studies highlighting its potential expansion.

(Nexus, 2025). However, productivity constraints such as those observed in this study remain key limitations to its large-scale adoption. Furthermore, recent evaluations emphasize that inconsistent yield and environmental sensitivity remain major challenges for Jatropha production systems (Birhanu *et al.,* 2026), supporting the need for optimized management practices such as appropriate pruning strategies Additionally, emerging research has demonstrated the multifunctional potential of Jatropha, including pest control and bioactive applications (Valdez-Ramírez *et al.,* 2025), further highlighting its agricultural relevance beyond biofuel production.

Relationship between vegetative traits and yield

Correlation between growth traits and seed production

The correlation analysis presented in Table 7 shows the relationships between vegetative traits measured in March 2012 and total seed production during the 2012–2013 season in non-pruned trees of Field Trial I. Strong and highly significant positive correlations were observed among vegetative traits. Plant height was strongly correlated with root collar diameter ($r = 0.63$, $P < 0.0001$) and number of branches ($r = 0.60$, $P < 0.0001$), while diameter was also significantly correlated with number of branches ($r = 0.52$, $P < 0.0001$). These results indicate a strong internal association among growth parameters, suggesting that more vigorous plants tend to develop larger canopies and structural biomass. Total seed production showed moderate but highly significant correlations with all vegetative traits, including height ($r = 0.56$, $P < 0.0001$), number of branches ($r = 0.53$, $P < 0.0001$), and diameter ($r = 0.44$, $P < 0.0001$). Among these, plant height exhibited the strongest relationship with seed yield, indicating that taller plants with greater canopy development tend to produce higher yields. These findings suggest that vegetative vigor contributes positively to reproductive performance under non-pruned conditions. However, the moderate strength of these correlations indicates that vegetative traits alone are not sufficient predictors of yield, and other factors such as environmental conditions and reproductive efficiency also play important roles. Similar relationships between growth traits and yield have been reported in previous studies. Behera *et al.,* (2010) and Kaushik *et al.,* 2007) found that plant height and branching are positively associated with seed yield in Jatropha. Likewise, Tripathi *et al.,* (2013) reported moderate correlations between vegetative growth and productivity, emphasizing the importance of canopy development for biomass accumulation and reproductive output.

Correlation between vegetative traits and fruit production under pruning

The correlation analysis in Table 8 provides insights into the relationships between vegetative traits and fruit production (total fruit dry weight, TFDW) under both pruned and non-pruned conditions in

Field Trial I

Pruned and non-pruned trees

In pruned trees, moderate and highly significant correlations were observed between vegetative traits and fruit production. Plant height showed the strongest correlation with fruit production in both July ($r = 0.51$, $P < 0.0001$) and August ($r = 0.57$, $P < 0.0001$), indicating that taller plants retained a relatively higher capacity for reproductive output even after pruning.

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Table 3: Effect of the accession and the effect of pruning on growth of Jatropha in field trial I

Trait	Effects	Number	Den	F-value	P > F
Diam 2012	Accession	18	26,4	1,92	0,0615
	Block	3	25,6	0,72	0,5472
Height 2012	Accession	18	24,9	1,59	0,1412
	Block	3	24,2	3,11	0,0452
Number of branches 2012	Accession	18	25,2	1,74	0,0987
	Block	3	24,6	1,73	0,1863
Diameter 2013	Block	3	24,6	2,17	0,1172
	Accession	18	16,2	2,46	0,0372
	Pruning	1	16	0,23	0,6409
Height 2013	Block	3	24	2,3	0,1032
	Accession	18	17,3	1,03	0,4739
	Pruning	1	19,9	108,44	<.0001
NBR 2013	Block	3	25	3,61	0,027

Table 4: Effect of the accession and the effect of pruning on growth of Jatropha in field trial II

Trait	Effects	DF Number	DF Den	F-value	P > F
Diameter 2012	Accessions	27	322	1,67	0,0217
Height 2012	Accessions	27	322	2,43	0,0001
Number of branches 2012	Accessions	27	322	4,42	<.0001
Diameter 2013	Accession	27	24,6	1,31	0,2532
	Pruning	1	25	0	0,9473
Height 2013	Accession	27	25,3	1,29	0,2645
	Pruning	1	25,5	28,99	<.0001
Number of branches 2013	Accession	27	25,8	0,66	0,8582
	Pruning	1	26	480,91	<.0001

Table 5: Effect of pruning on seed production of Jatropha in field trial I

Trait	Effects	Number	Den	F-value	P > F
Seed production July 2012	Block	3	71	3,56	0,0183
	Accession	18	71	0,58	0,9
	Pruning	1	71	27,87	<.0001
Seed production Aug 2012	Block	3	25	0,47	0,7086
	Accession	18	25	0,79	0,6982
	Pruning	1	46	166,94	<.0001
Seed production Sep 2012	Block	3	53,8	1,01	0,3938
	Accession	18	16,6	1,04	0,4708
	Pruning	1	15,3	57,26	<.0001
Seed production Oct 2012	Block	3	25	0,86	0,4756
	Accession	18	25	0,65	0,8261
	Pruning	1	46	50,51	<.0001
Seed production Nov 2012	Block	3	54,7	2,2	0,0979
	Accession	18	16,9	1,02	0,4871
	Pruning	1	15,1	63,31	<.0001
Seed production Dec 2012	Block	3	25	0,86	0,4745
	Accession	18	12,9	1,09	0,4495
	Pruning	1	17,1	10,22	0,0053
Individual seed weight 2012	Block	3	24,9	0,08	0,9705
	Accession	18	7,82	1,18	0,4295
	Pruning	1	10,2	25,79	0,0004
	Pruning	1	17,1	10,22	0,0053
Seed production Jan 2013	Block	3	55,5	3,23	0,029
	Accession	18	18,1	1,09	0,4244
	Pruning	1	16,5	15,15	0,0012
Seed production Feb 2013	Block	3	56,1	1,93	0,1345
	Accession	18	17,6	2,06	0,0694
	Pruning	1	15,3	26,23	0,0001
Fruit production July 2013	Block	3	55,3	3,56	0,0198
	Accession	18	18,2	0,96	0,5355
	Pruning	1	16,6	11,89	0,0032
Fruit production Aug 2013	Block	3	25	2,06	0,1316
	Accession	18	10,4	1,86	0,1532
	Pruning	1	16,2	20,76	0,0003
Seed production 2012_2013	Block	3	56,6	1,86	0,1466
	Accession	18	18,5	1,04	0,4629
	Pruning	1	16,2	36,38	<.0001
Individual seed weight 2012	Block	3	24,9	0,08	0,9705
	Accession	18	7,82	1,18	0,4295
	Pruning	1	10,2	25,79	0,0004
Ratio between seed weight	Block	3	21,9	12,86	<.0001
and fruit weight	Accession	18	25	0,81	0,6754
	Pruning	1	169	15,04	0,0002
Ratio between seed weight	Block	3	14,2	2,42	0,1085
and fruit weight tree level	Accession	18	17,7	0,78	0,7020
	Pruning	1	3,98	6,24	0,0672

Table 6. Effect of pruning on seed production of Jatropha in field trial II

Trait	Effects	Number	Den	F-value	P > F
Seed production July 2012	Accessions	27	25,5	0,97	0,5305
	Pruning	1	25,7	210,89	<.0001
Seed production Aug 2012	Accessions	27	27	1	0,5016
	Pruning	1	27,2	383,82	<.0001
Seed production Sep 2012	Accessions	27	26	0,85	0,6668
	Pruning	1	26,3	45,76	<.0001
Seed production Oct 2012	Accessions	27	24,7	0,84	0,6672
	Pruning	1	24,8	123,32	<.0001
Seed production Nov 2012	Accessions	27	25,8	1,16	0,3538
	Pruning	1	25,9	99,89	<.0001
Seed production Dec 2012	Accessions	27	23,9	1,1	0,4069
	Pruning	1	24,2	14,24	0,0009
Total Seed production 2012	Accession	27	25,6	0,86	0,6558
	Pruning	1	25,7	28,29	<.0001
Seed production Jan 2013	Accessions	27	22	1,39	0,2177
	Pruning	1	27,4	22,42	<.0001
Seed production Feb 2013	Accessions	27	14,5	0,69	0,8054
	Pruning	1	16,6	0,47	0,5014
Fruit production July 2013	Accessions	27	25,5	1,47	0,1653
	Pruning	1	25,7	0,56	0,4616
Fruit production Aug 2013	Accessions	27	25,5	2,68	0,0073
	Pruning	1	25,9	1,72	0,201
Total Fruit production 2013	Accessions	27	25,5	1,56	0,1327
	Pruning	1	25,7	0,98	0,3302
Ratio between seed weight	Accessions	27	24,6	1,31	0,2532
and fruit weight tree level	Pruning	1	25	0	0,9473

Table 7: Correlation of seed production July-February 2012/2013 with root collar diameter, height and number of branches in March 2012 among the non-pruned trees in field trial I

Pruned trees (February 2012)	**Seed prod**	**Diameter**	**Height**
Diameter 20212	0.40		
	<.0001		
Height 2012	0.49	0.49	
	<.0001	<.0001	
Number of branches 2012	0.67	0.55	0.49
	<.0001	<.0001	<.0001
Non pruned trees (March 2012	**Diameter**	**Height**	**N branches**
Height 2012	0.63		
	<.0001		
Number of branches 2012	0.52	0.60	
	<.0001	<.0001	
Total seed production 2012	0.44	0.56	0.53
	<.0001	<.0001	<.0001

Root collar diameter also showed moderate correlations with fruit production (r = 0.33–0.35, P < 0.0001), while number of branches exhibited weaker correlations (r = 0.29–0.31, P < 0.0001). These results suggest that pruning reduces the strength of the relationship between branching and yield, likely due to the disruption of canopy structure. Additionally, strong correlations were observed among vegetative traits themselves, indicating that structural growth relationships remain intact even after pruning. In non-pruned trees, correlations between vegetative traits and fruit production were generally weaker compared to pruned trees. Plant height maintained moderate correlations with fruit production (r = 0.42–0.51, P < 0.0001), while diameter showed moderate relationships (r = 0.32–0.43, P < 0.0001). However, the number of branches showed weak and sometimes non-significant correlations (r = 0.13–0.17), indicating that branching alone is not a reliable predictor of fruit production. The weaker correlations in non-pruned trees may reflect the influence of additional factors such as resource competition within a larger canopy, environmental variability, and reproductive constraints. The correlation analyses from provide important insights into the relationship between vegetative growth and reproductive performance in *Jatropha curcas*. Under non-pruned conditions, vegetative traits such as height, diameter, and branching showed moderate positive correlations with seed yield, indicating that plant vigor contributes to productivity. However, the moderate strength of these relationships suggests that yield is not solely determined by vegetative growth but also depends on reproductive efficiency and environmental conditions. Under pruning conditions, the relationships between vegetative traits and yield were altered. While plant height remained a relatively strong predictor of fruit production, the influence of branching was reduced. This indicates that pruning disrupts the natural relationship between canopy structure and reproductive output. These findings are consistent with previous studies. Rajaona *et al.,* (2011) reported that pruning alters biomass allocation patterns, reducing the contribution of vegetative traits to yield. Similarly, Ghosh *et al.,* (2011) found that pruning weakens the relationship between growth and productivity due to reduced assimilate availability. Recent research further supports these observations. Jonas *et al.,* (2020) demonstrated that seed yield in Jatropha is strongly influenced by physiological factors such as seed development and oil accumulation, rather than vegetative traits alone. Additionally, Kasthurirengan *et al.,* (2025) highlighted the importance of reproductive processes, including pollen viability, in determining yield under stress conditions. Overall, the results indicate that while vegetative growth contributes to yield under normal conditions, its predictive value decreases under management stress such as pruning. Therefore, selection and management strategies should prioritize reproductive traits, particularly fruit biomass, as more reliable indicators of productivity. Hence, in conclusion, this study demonstrates that pruning at 50 cm height has a strong negative impact on vegetative growth and seed production of Jatropha under semi-arid conditions. Pruning significantly reduced plant height and branching, limiting canopy regeneration, while root collar diameter remained unaffected. Seed yield declined markedly across all harvest periods, highlighting the importance of maintaining canopy structure for sustained photosynthesis and reproductive performance. Correlation analysis showed that vegetative traits moderately influence yield under non-pruned conditions, but these relationships weaken under pruning stress. The results indicate that environmental and management factors outweigh genetic variability in determining productivity. Severe pruning at early growth stages is therefore not recommended. Optimizing pruning strategies and improving agronomic practices are essential to enhance yield stability and support sustainable Jatropha production in marginal environments.

Table 8: Correlation of fruit production August and July 2013 with root collar diameter, number of branched and height March 2013 in Field trial I

Pruned trees	Total dry weight of fruits July 2013	Total dry weight of fruits August 2013	Number of branches 2013	Diameter 2013
TFDW Aug. 2013	0.48			
	<.0001			
Number of branches 2013	0.31	0.29		
	<.0001	0.0001		
		0		
Diameter 2013	0.33	0.35	0.34	
	<.0001	<.0001	<.0001	
		0		
Height 2013	0.51	0.57	0.49	0.51
	<.0001	<.0001	<.0001	<.0001
Non-pruned trees				
TFDW Aug. 2013	0.46			
	<.0001			
Number of branches 2013	0.13	0.17		
	0.0961	0.0241		
		0		
Diameter 2013	0.32	0.43	0.17	
	<.0001	<.0001	<.0001	
		0		
Height 2013	0.42	0.51	0.34	0.48
	<.0001	<.0001	<.0001	<.0001

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