

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 5, May 2019

Impact of Pruning over Physical growth of the Plant in Physic Nut

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ABSTRACT: In order to cope with the world energy crisis a large scale research work is going on and liquid bio-fuels for transportation receive growing attention globally which can be produced from various sources among all *Jatropha curcas* L. (further called *Jatropha*) attracted the researchers. Considering the lack of scientific knowledge and the practical difficulties in cultivation of *Jatropha* as a biofuel alternative, a field work has been conducted for a period of three years to contribute to the knowledge on the potential sustainability of *Jatropha* at Krishna district of Andhra Pradesh, selecting various block and boundary plantations of 1 to 1½ years old, to evaluate the assumed sustainability of *Jatropha* cultivation under varied environmental conditions.

Different conditions were maintained in all these plantations to study the impact of various parameters over the physical growth and also the dry seed output. Various observations were made from different trials, such as pruning and cropping system (monoculture, intercropping and living fence), plant spacing, mode of watering and fertilizer application and here the details of the impact of pruning were mentioned. Pruning was done to strengthen the main stem and also to increase the number of branches per plant. Different field stations were pruned at different times. All the stations were pruned once except the control site which was pruned twice. Plant height from the ground surface in feet and number of branches per plant were measured before and after pruning to compare the growth. Results revealed that higher productivity and profitability could be achieved by pruning the main stem. Full details of the investigation were discussed in this article.

KEYWORDS: *Bio-fuel, Energy crops, Jatropha, Pruning.*

I. INTRODUCTION

Jatropha curcas is grown for the biofuel production and also used to reclaim wastelands and a large scale research work is going on across the world to find out the sustainability of *Jatropha* as a renewable energy alternative. Many plantations were undertaken in India by the state governments to reclaim waste lands, where *Subabul*, *Eucalyptus*, *Pongamia* etc. were grown previously to reclaim such soils. Cultivators started growing *Jatropha* on large scale due to its various benefits such as the drought resistance, non-palatability, easy propagation, suitability to various climatic and soil conditions, faster rate of growth and perennial nature. But the seed output could not reach the expected level though the physical growth of the plant was good under different climatic conditions. With this some of the cultivators uprooted their plantations in the later period due to one or the other reason like inconsistency in the seed

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Vol. 8, Issue 5, May 2019

output, less output than the expected average, economic losses etc. Such situations were observed even in some states of India like Tamilnadu, Gujarat and Andhra Pradesh where large scale plantations were existing.

In this regard, it is the objective of the present work to provide necessary and complementary information for an improved understanding of *Jatropha* cultivation on large scale on profitable basis.

II. REVIEW OF LITERATURE

Jatropha is still a wild plant, comprehensive research and experimentation is also needed to optimize input/output balances of plantations and to assure long-term productivity in different climate conditions. The yield depends on site characteristics (rainfall, soil type and soil fertility) (Francis et al., 2005), genetics (Ginwal et al., 2004), plant age (Heller, 1996) and management (propagation method, spacing, pruning, fertilizing, irrigation, etc. (Gour, 2006).

Proper pruning (2/3 of the branch in the dormancy phase, when leaves are shed) seems to be an efficient technique to induce further branching. To give a bushy shape, the plant should be trimmed during spring (Feb-Mar) upto 5 years including one pruning when the plants attain 1.5 m height. Thereafter the plant should be pruned back above ground level once in 10 years at 45 cm above the ground.

The main objectives of pruning the physic nut trees are to 1) control plant height and to give a bushy shape 2) get rid of the apical dominance and stimulate the side shooting, and 3) help the plants keep moisture content during the dry season. Some studies by Euler and Gorriz (2004) and Tigere et al (2006) revealed that pruning has influencing the growth of the plant by increasing the number of branches. Kaushik and Kumar (2006) have reported that at the age of six months it is useful to pinch off the terminal shoots in order to induce lateral branching. It is recommended to prune the secondary or tertiary branches to induce more shoots branches. Once in 10 years the entire plant should be cut to the ground level leaving a stump of 45cm.

Depending on the growth rate, pruning the main branch at 30-45 cm height is appropriate (Gour, 2006). The secondary and tertiary branches should be pruned at the end of the first year to provoke more branches. Each side branch should be pruned up to two-thirds of the top portion at the second year (Kaushik, 2006).

Ouwens et al (2007) have reported that canopy size determines the maximum number of flowering branches. Large trees on a low planting density or smaller (dwarfed) plants on high densities (up to 10000/ha) can results in sufficient flowering branches.

The studies on pruning effect by Xeenavong, 2005 proved in his study on pruning effect that pruning could stimulate the Physics plant to produce the highest seed yield 6 months after pruning while Brittain and Litaladio (2010) have reported that pruning during the dry season when the plant is dormant helped to increase the branching there by resulting in the increase of the number of inflorescences on the branch tips.

III. METHODOLOGY

The present study has been carried out establishing 7 field stations at 5 mandals in Krishna district of Andhra Pradesh for a duration of three years. Krishna district is located between 16° 10 N and 81° 08 E and the total area was 8,727 Km². The average temperature of the region was 45°C in summer and 21° C in winter.

Six natural plantations of *Jatropha* were selected from 4 mandals of Krishna district viz., Mylavaram, Agiripalli, G.Konduru and Nandigama. In addition, one control site was also maintained at Chandarlapadu mandal to compare the growth. The details of the study stations were mentioned below:

- Stations of Mylavaram Mandal : Morusumilli and Pulluru
- Stations of G. KonduruMandal : Kuntamukkala
- Stations of AgiripalliMandal: Rajavaram and Nekkalam
- Stations of Nandigama Mandal: Nandigama
- Chandarlapadu Mandal: Control site (Chandarlapadu)

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Vol. 8, Issue 5, May 2019

Different conditions were maintained in terms of spacing, nutrients, mode of watering etc. in all the field stations. Out of the seven selected field stations three were having *Jatropha* as Block plantation (mono crop) viz, Rajavaram, Nandigama and Chandarlapadu and in the remaining four stations viz, Kuntamukkala, Morusumilli, Pulluru and Nekkalam it was grown as a boundary crop (fence).

IV. RESULTS AND DISCUSSION

Impact of Pruning: Pruning was done to strengthen the main stem and also to increase the number of branches per plant. Different field stations were pruned at different times during the three years study period. All the stations were pruned once except the Field station-7 and it was pruned twice. Various parameters were studied. The collected data was presented as mean values for all the study aspects. A comparison was made among all the study sites for each parameter which were mentioned hereunder.

Effect of pruning over the growth of *Jatropha*:

Plant height from the ground surface in feet and number of branches per plant were measured before and after pruning to compare the growth in different block (Rajavaram, Nandigama and Chandarlapadu) and boundary plantations (Kuntamukkala, Morusumilli, Pulluru and Nekkalam). Pruning improved the growth in *Jatropha*. The height and number of branches were increased after pruning. (Table-1)

Table-1: Pruning of *Jatropha* at different field stations

S. No	Field Station	Time of pruning during the study period	Height of the plant before pruning (ft)	Height of the plant after pruning (ft)
1	Kuntamukkala	July (2 nd year)	8.8	5.5
2	Morusumilli	Feb (2 nd year)	6.4	4.7
3	Pulluru	Feb (2 nd year)	6.6	4.5
4	Rjavaram	Nov (1 st year)	6.4	4.2
5	Nekkalam	Nov (1 st year)	6.3	4.5
6	Nandigama	Oct (1 st year)	5.6	3.3
7	Chandarlapadu	Oct (1 st year) Nov(2 nd year)	6.0 8.6	3.5 7.8

(i). Effect of pruning in Block plantations of *Jatropha* on plant height and in the mean number of branches:

Initially the average height of the plant at Rajavaram was 3.8ft. It has grown up to 6.4ft before pruning (I year). Then it was pruned to 4.2ft in the second year of study and it has shown further growth of 3.6ft (4.2-7.8ft) in one year. By the end of this study it has grown up to 9.5ft.

Number of branches per plant was counted at these study stations. Number of branches was recorded as 4 initially at Rajavaram site. The number has been increased up to 14 before pruning. Pruning was done up to 5 branches.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 5, May 2019

In one year duration branches were increased by 10 (5-15) and noted as 15 in the beginning of third year. Finally, on average 20 branches were identified per plant by the end of the study.

Height of the plant at Nandigama was recorded as 4.2ft initially. It was pruned at a height of 5.6ft up to 3.3.ft at the end of the first year of study. After pruning the growth was good and it showed an increase of 5.5ft (3.3-8.8ft) in one year duration. Then in the next year it showed an increase of 6.2ft (8.8-15ft). Growth was more from Oct to April (3.6ft increase) when compared to April to Oct (2.6ft increase). (Table-2)

Initially there were 3 branches in at Nandigama field station. Before pruning the number was counted as 11 and was pruned to 7 branches. In one year duration it showed an increase of 11 branches (7-18). In the final year an increase of 12 branches was recorded (18-30).

Chandarlapadu plantation has undergone first pruning in Oct (I year) at a height of 6ft up to 4ft. After pruning, the number of branches was increased from 3 to 11 showing an increase of 8 branches in one year duration. Then, in the second year of study the plant growth was measured as 8.6ft height, and the plantation was again pruned in Nov at a height of 8.6ft to 7.8ft. After pruning growth was more positive and the height was increased to 14.5ft, and branches were increased to 30 per plant by the end of the study period. (Table-2)

Three branches were identified at Chandarlapadu plantation at the beginning and were increased to 9 before first pruning. After pruning, it has showed an increase of 11 branches in one year (7-18). Then it pruned for the second time from 18 branches to 15. At the end of the third year the branches were counted as 30. Thus, the number of branches was increased from 3 to 30 during the period after pruned twice.

Table-2: Mean height of the plant (ft) at various field stations:

Mean height of the plant (ft)												
	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
Rajavaram	3.8	4.9	5.5	6.4	*4.2	5.2	5.9	6.7	7.8	8.4	8.9	9.5
Nandigama	4.2	5.1	5.6	*3.3	5.8	6.7	7.5	8.8	11.2	12.4	13.5	15
Kuntamukkala	3.9	5.3	5.9	7.5	8.3	8.8	*5.5	6.7	8.4	9.1	9.9	11.1
Morusumilli	4	4.8	5.4	5.9	6.4	*4.9	6.3	7.7	9.1	10.7	11.4	12.5
Pulluru	4.1	4.8	5.5	6	6.6	*4.7	5.6	7	8.6	9.7	10.5	11.9
Nekkalam	3.7	4.7	5.4	6.3	*4.5	5.2	6	6.9	8.1	8.6	9.1	10
Chandarlapadu	4.3	5.3	6	*3.5	6	6.7	7.4	8.6	*10.8	11.9	13.2	14.5

*After pruning

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Vol. 8, Issue 5, May 2019

Table-3: Mean number of branches per plant at various field stations:

Mean number of branches per plant												
	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
Rajavaram	4	7	10	14	*5	7	9	12	15	17	18	20
Nandigama	3	6	9	*7	11	14	16	18	21	24	26	30
Kuntamukkala	4	5	7	9	12	14	*6	10	14	17	20	22
Morusumilli	5	7	8	11	14	*12	15	19	21	24	26	29
Pulluru	5	7	9	12	15	*11	14	17	19	21	23	25
Nekkalam	4	7	11	14	*7	9	10	13	16	18	21	23
Chandarlapadu	3	6	9	*7	11	14	16	18	*20	23	26	30

*After pruning

Before pruning, in one year the increase in height was recorded as 2.6ft at Rajavaram and after pruning it was recorded as 3.6ft (4.2-7.8ft). At Nandigama before pruning the increase in height was 1.4ft in one year and after pruning it has shown an increase of 3.4ft in 9 months (Oct to Apr). At Chandarlapadu the height was increased by 1.7ft in the initial 9 months (Jan-to Oct) before pruning and after pruning it was recorded an increase of 3.2ft during the second year of study (Oct to Apr). After second pruning it was shown an increase of 6.7 ft (7.8 to 14.5ft) in the third year of study. Thus, during the study period Rajavaram plantation has shown an overall increase of 5.7ft height, Nandigama site has shown 11.8ft increase after one pruning. The control site after pruning twice has shown an increase of 10.2 ft height.

During the study period block plantations viz., Rajavaram site has shown an increase of 16 branches (4-20), Nandigama site has shown an increase of 27 branches (3-30) after undergoing pruning once whereas Chandarlapadu site has shown an increase of 27 branches (3-30) after undergoing pruning twice.

(ii) Effect of pruning in Boundary plantations of *Jatropha* on Height and in the mean number of branches:

Height of the plant at Kuntamukkala was measured initially as 3.9ft. It has shown an increase of 4.4ft (i.e., up to 8.3ft) in one year. Before pruning in second year, it has reached a height of 8.8ft. Then it was pruned from 8.8ft up to 5.5ft. Further it has grown up to 11.1ft by the end of third year. The average growth was less reported due to the rocky surface and the absence of direct sunlight in some part of the plantation. Number of branches was initially counted as 4 and increased to 9 by in the first year. Then it was pruned to 6. Again by the end of the second year it was raised to 10 after 6 months of pruning. Finally an increase of 12 branches (10-22) was recorded by the end of the study.

Morusumilli and Pulluru stations recorded an initial height of 4 ft and 4.1ft and in one year showed an increase of 2.4 ft and 2.5ft respectively. They were pruned at a height of 6.4 ft and 6.6ft in in the second month of second year of study, up to 4.7ft and 4.5ft and later recorded an increased upto 7.7ft and 7ft respectively within 8 months. Finally they have reached to a height of 12.5ft and 11.9ft in the third year.(Table-3).

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 8, Issue 5, May 2019

Number of branches was recorded as 5 at the beginning of the study. The number has been increased up to 14 within one year. Then it was pruned up to 10 branches. Finally, 29 branches were identified per plant by the end of the third year.

Initially there were 5 branches at Pulluru plantation. Before pruning the number was counted as 15 and was pruned to 9 branches. Finally, 25 branches were identified per plant by the end. At Kuntamukkala site has shown an increase of 18 branches (4-22), Morusumilli site has shown an increase of 24 branches (5-29) and Pulluru site has shown an increase of 20 branches (5-25) in the study period of three years after undergoing pruning once. Nekkalam has shown the number of branches was increased from 4 to 29, after undergoing pruning once.

It was observed that after pruning number of branches was increased and flowering also induced. Results revealed that higher productivity and profitability could be achieved by pruning main stem for profuse branching and higher yield. Due to the increase in number of branches percentage of flowering, fruiting and seed output were also increased.

Behera et al, 2009 reported that pruning helps in maximizing the number of lateral branches and the optimal height of the plant for better biomass as 30-45 cm.

Present results were in conformity with the earlier works by Gour (2006), Peer (2010) and others. Pruning in the dry or winter period after the trees have shed their leaves will result in a lower and wider tree shape, stimulate earlier seed yield and facilitate manual harvesting. The entire plant has to be cut low once every 10 years by leaving a stump of 45 cm to induce new growth and stabilize the yield. The re-growth will be quick and the trees start give yield again within about 1 year (Gour, 2006). Peer (2010) reported that pruning should be a continuous process to select the right branches and to allow the sunlight by thinning. With too many branches sunlight will not be received properly and flowering may be reduced. Sunlight is also important along with water and nutrients for flowering.

V. CONCLUSION

In addition to the regular supplementation of water and nutrients, regular pruning also enhances the physical growth of the plant and contributes for the better seed output in Physic nut cultivation. It helps in profuse branching and higher yield since pruning favoured the number of branches and thus, flowering. Due to the increase in number of branches percentage of flowering, fruiting and seed output were also increased.

Acknowledgements:

Our sincere thanks to Co-ordinator and the Faculty members of the Dept. of Environmental Sciences, Acharya Nagarjuna University for their immense cooperation through out the work. We specially thank the management of Sri Vasavi Engineering College for the unstinted support and encouragement at all levels of this publication work.

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Vol. 8, Issue 5, May 2019

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