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Effects of Pruning Levels and Fertilizer Rates on Yield of Physic Nut (*Jatropha curcas* L.)

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Abstract: Appropriate canopy management and proper application of fertilizer under different growing conditions and agronomic practices can obtain reliable yield of physic nut (*Jatropha curcas* L.). The objective of this study was to determine the effects of pruning level in first year and fertilizer rate of combined NPK in the first and second years on growth and yield of three-year old physic. A split plot design with four replications was used. Three pruning levels of 50, 75 and 90 cm from the ground were assigned in main plots and combinations of NPK fertilizers at the rates of 0, 312.5 and 625 kg ha^{-1} were arranged randomly in subplots. All pruning levels from the ground did not have significant effects on branch number and branch length (cm), whereas application of fertilizer did increase branch number and branch length especially at the rate of 312.5 kg ha^{-1}. Harvest in the second year gave higher yield (1,559 kg ha^{-1}) than did in the first year (1,180 kg ha^{-1}) for all treatments, suggesting that it is not necessary to prune physic nut every year in commercial plantations. It is recommended to prune the three-year old physic nut at 70 cm from the ground. Pruning at 90 cm from the ground is possible but not at 50 cm. it is also recommended to apply fertilizer to the three-year old physic nut under rainfed conditions at the rate not exceeding 312.5 kg ha^{-1} and this should be based on soil analysis. Application of higher rates depressed yield.

Key words: *Physic nut* (*Jatropha curcas* L.), fertilizer application, fruit yield, seed yield, pruning

INTRODUCTION

Physic nut (*Jatropha curcas* L.) is an under-utilized small tree native to the Central and South America. The plant has been distributed to other parts of the world including Southeast Asia, India and Africa (Schmook and Serralta-Peraza, 1997; Tan *et al*., 2002). The crop flowers only once a year during the rainy season (Raju and Ezradanam, 2002). However, it can flower all year round under irrigated conditions and its yield is much higher (Heller, 1996). Physic nut is a promising crop for biofuel production (Sujatha *et al*., 2008). It is well adapted to semi-arid conditions although, it yields better under more humid conditions (Achten *et al*., 2008). It can be grown in the average temperatures between 20 and 28°C, a range of rainfall between 250 and 3,000 mm and in a wide range of soils although well-drained and aerated soil is most favorable (Heller, 1996; Foidl *et al*., 1996).

Physic nut is well adapted to marginal soils with low nutrient content (Heller, 1996) and annual seed yield of 2-3 t ha^{-1} has been reported in semi-arid areas (Kumar and Sharma, 2008). However, the crop still requires high demand for N and P fertilization for high biomass production and high yield (Foidl *et al*., 1996) and its annual seed yield of 5 t ha^{-1} has been reported under good management and favorable environments (Foidl *et al*., 1996; Kumar and Sharma, 2008). As an under-utilized crop with high potential for biodiesel production, yield of physic nut is still low compared to other crops such as sugarcane (Saccharum officinarum), cassava (Manihot esculenta) and oil palm (*Elaeis guineensis*). Drought, low soil fertility and lack of external sources of nutrients are major constraints. Production of physic nut is also constrained by non availability of quality planting material and agro-techniques.

Systematic nutrient studies are scarce for physic nut and few studies are available in the literature. Yin *et al*. (2010) observed that different levels of nitrogen fertilizer significantly affected growth, development, kernel set and yield of physic nut. Novoa and Loomis (1981) also found that application of nitrogen fertilizer significantly increased leaf area index, leaf area duration, crop photosynthetic rate and radiation interception and radiation use efficiency. Further investigations are still required to establish fertilizer recommendations for physic nut of different ages and in different growing conditions.

Physic nut grown under commercial plantations needs to be pruned to control plant size and to provide acceptable yield. Pruning is believed to assist the

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production of more branches and to stimulate abundant and healthy inflorescences, thus finally enhancing good fruit setting and seed yield (Gour, 2006). Achten *et al.* (2008) suggested that pruning should be done in dormant period. The ten-year old tree should be cut back to a stump of 45 cm and the tree will begin yielding again within 1 year. They also suggested annual pruning of the plantations by cutting 2/3 of terminal branches. Little information on the effects pruning methods and fertilizer rates on yield of physic nut of different ages under rainfed conditions in the tropics and further investigations are required to optimize pruning methods and rates of applied fertilizer. The objective of this study was to determine the effects of pruning level in the first year and fertilizer rate of combined with NPK in the first and second years on growth and yield of three-year old physic nut.

MATERIALS AND METHODS

The experiment was conducted at the Khon Kaen University's Agronomy farm, in Khon Kaen, Thailand (16°28'N and 102°48'E, 200 m.a.s.l.) for two years in 2009 and 2010. The soil type is Yasothorn soil series with sandy loam (Paleustults) texture. The soil particles averaged from soil surface to 105 cm consisted of 92% sand, 4% silt and 4% clay with lower silt and clay in upper soils. The soil pH varied from 4.7 to 6.3 with lower values in lower soils. The organic matter was in a range of 0.10-0.33% with lower values in lower soils and total nitrogen was in a range of 0.005-0.02% with lower values in lower soils (Table 1). Annual rainfall was about 900 mm for both years, the minimum daily air temperature was 22.0°C in 2009 and 23.8°C in 2010, while the maximum daily air temperature was 32.1°C in 2009 and 34.1°C in 2010 (Fig. 1). Solar radiations were 17.1 MJ/m^2/day in 2009 and 17.0 MJ/m^2/day in 2010. The plantation was established in 2006 and the plants were about 5-7 m tall. The experiment was initiated in 2009 when the plants were about three years old to evaluate the effects of pruning methods and rates of fertilizer application on growth and yield of physic nut. The experiment was set up in a split plot design with four replications. The main plots consisted of three pruning levels of 50, 75 and 90 cm from the ground and sub-plots comprised three rates (0, 312.5 and 625 kg ha^{-1}) of fertilizer application which were randomly arranged in the main plots. The fertilizer used was the formula 15-15-15 of N-P_2O_5-K_2O. Each plot had three rows with 3 m long and spacing of 2.5 m between rows and 1 m between plants within a row and could accommodate nine plants. Pruning was carried out in March 2009 and fertilizer was applied as a single dose to the crop soon after pruning. The crop was allowed to grow until harvest under rainfed conditions. Weeding was done as needed. Conventional tillage was also practiced between the rows of plants. The crop was allowed to grow in 2010 without pruning, but fertilizer at the same rates and formula was applied to the crop in April. Other management practices were similar to those in 2009.

Data collection: Soil samples were taken at four different spots in the field in the 2009 at depths of 0-15, 15-30, 30-45, 45-60, 60-75, 75-90 and 90-105 cm and the soil samples at the same depths were mixed thoroughly. They were then analyzed for physical properties including soil texture, bulk density and soil moisture. The soil chemical properties including pH, organic matter, exchangeable K, exchangeable P, NO_3^- concentration and NH_4^+ concentration were also determined. The weather data (daily maximum and minimum air temperatures, solar radiation and rainfall) in 2009 and 2010 were obtained from the weather station just 200 meters away from the

Table 1: Physical and chemical properties of the soil in the experimental field in the Khon Kaen in Thailand in 2009 evaluated at different soil depths

	0-15	15-30	30-45	45-60	60-75	75-90	90-105
Properties	(cm)						
Physical							
Bulk density	1.75	1.97	1.81	1.65	1.72	1.69	1.66
Sand (%)	95.80	95.50	91.80	91.80	90.80	90.30	89.30
Silt (%)	3.30	3.50	4.30	4.30	4.50	4.50	4.80
Clay (%)	1.00	1.00	4.00	4.00	4.80	5.30	6.00
Water content (%)	3.70	10.80	9.20	10.60	10.40	12.40	10.50
Chemical							
pH (H_2O)	6.30	6.40	5.90	5.10	4.80	4.70	4.80
Organic matter (%)	0.33	0.38	0.25	0.21	0.16	0.12	0.10
N-total (%)	0.02	0.02	0.01	0.01	0.01	0.01	0.01
NH_4 (ppm)	3.00	5.50	4.80	5.60	6.10	5.80	6.20
NO_3^-(ppm)	7.00	5.80	5.00	5.40	4.30	3.20	2.90
Available P (ppm)	45.00	41.20	15.50	3.80	1.10	0.50	0.20
Exchangeable K (ppm)	28.30	24.80	23.20	10.40	10.40	9.50	9.60
Exchangeable Ca (ppm)	163.60	206.40	248.00	193.40	160.40	147.50	143.10
CEC (meq/100 g soil)	2.84	3.72	4.06	3.02	3.68	3.89	2.94

CEC: Cation exchange capacity

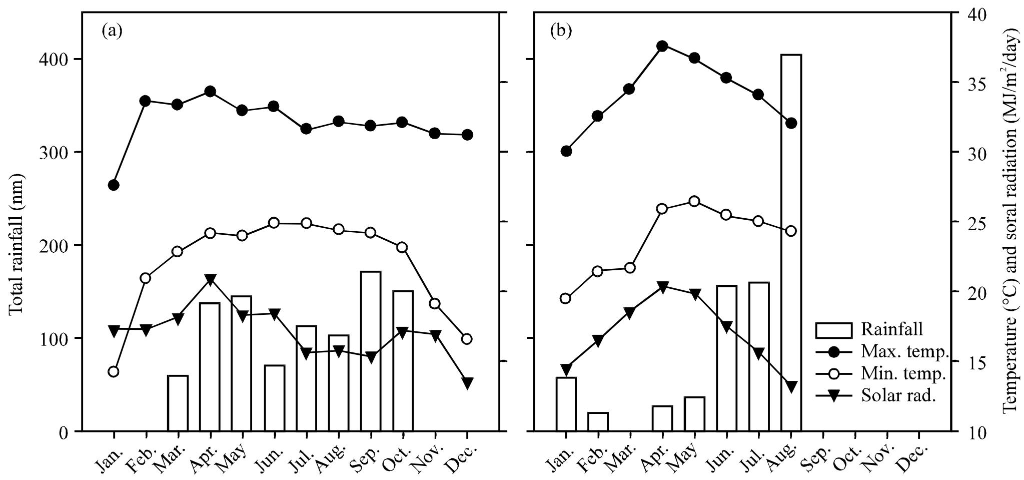

Fig. 1: Total rainfall, average maximum and minimum temperature and average solar radiation at Khon Kaen province, Thailand between (a) 2009 and (b) 2010

experimental field. Number of branches per plant was recorded from the five plants in each plot at 14 and 28 days after pruning in 2009 only. Branch length (cm) was recorded from ten branches of five randomly chosen plants in each plot at 14, 28, 42, 56 and 70 days after pruning in 2009 only.

For each year, fruit yield (kg ha^{-1}) and seed yield of physic nut (kg ha^{-1}) was recorded from nine plants with harvest area of 21.75 m^2 in each plot by manually collecting the mature fruits that showed yellow-brown color. Number of fruits per branch was also recorded for both years. The harvest period was from early June to late August in 2009 and 2010. The fruits were oven-dried at 80°C until constant weight, shelled manually and weighted to determine fruit yield and seed yield. The yields were later converted to per hectare.

Statistical analysis: All obtained data were subjected to analysis of variance according to a split plot design (Gomez and Gomez, 1984). Individual analysis of variance was performed for branch number and branch length that were recorded in 2009 only. Combined analysis of variance was performed for fruit yield (kg ha^{-1}), seed yield (kg ha^{-1}) and number of fruits per plant which were recorded for two years in order to estimate main effects of pruning level and fertilizer rate and their interaction effects and the differences between treatments were separated by Least Significant Difference (LSD).

RESULTS

Number and length of branches: Numbers of branches evaluated at 14 and 28 Days after Pruning (DAP) were not statistically different among pruning methods (Table 2). However, it seemed likely that taller pruning gave more branches than shorter pruning. The numbers of branches at the last count (28 DAP) were 19, 24 and 28 for 50, 75 and 90 cm pruning, respectively. Application of fertilizer at the rate of 312.5 kg ha^{-1} resulted in the highest numbers of branches at both 14 and 28 DAP. The numbers of braches of the plants receiving 312.5 kg ha^{-1} of fertilizer were significantly higher than those of the plants receiving 0 kg ha^{-1} of fertilizer but they were not significantly higher than those of the plants receiving 625 kg ha^{-1}. The numbers of branches at the last count (28 DAP) were 21, 27 and 23 for fertilizer application at the rates of 0, 312.5 and 625 kg ha^{-1}, respectively. The branches increased slightly from 14 DAP to 28 DAP for both pruning method and fertilizer rate. Lengths of branches evaluated at 14, 28, 42, 56 and 70 DAP were not

Table 2: Means number branches per plant of physic nut at three pruning levels (50, 75 and 90 cm above ground) and three fertilizer rates in 2009

	Days after pruning	
Treatments	14	28
Pruning levels (P)		
50 cm	17	19
75 cm	20	24
90 cm	22	28
F-test	ns	ns
CV (%)	11.2	8.4
Fertilizer rate (F)		
0 kg ha^{-1}	18b	21b
312.5 kg ha^{-1}	22a	27a
625 kg ha^{-1}	19ab	23ab
F-test	**	**
P×F	ns	ns
CV (%)	12.7	9.2

ns: Not significant, **Significant at p<0.01

Table 3: Means for branch length (cm) of physic nut at three pruning levels (50, 75 and 90 cm above ground) and three fertilizer rates in 2009

	Days after pruning				
Treatments	14	28	42	56	70
Pruning levels (P)					
50 cm	5.3	37.1	66.3	81.7	83.9
75 cm	6.2	43.6	62.2	85.7	83.9
90 cm	7.4	40.5	60.5	74.1	76.6
F-test	ns	ns	ns	ns	ns
CV (%)	16.7	10.6	9.9	12.0	11.6
Fertilizer rates (F)					
0 kg ha^{-1}	5.2b	35.9c	57.6b	73.9b	74.9b
312.5 kg ha^{-1}	7.1a	45.1a	67.2a	85.9a	90.7a
625 kg ha^{-1}	6.1ab	40.2b	63.8a	81.7a	82.9b
F-test	**	**	**	**	**
P×F	ns	ns	ns	ns	ns
CV (%)	12.4	8.4	8.0	9.0	8.6

ns: Not significant, **Significant at p<0.01

statistically different among pruning methods (Table 3). The lengths of branches increases with time and at the last evaluation date (70 DAP), they were 83.9, 83.9 and 76.6 cm long for 50, 75 and 90 cm pruning, respectively.

The branches of the plants receiving fertilizer at the rate of 312.5 kg ha^{-1} were longest and significantly longer than those of non-fertilized plants at 14, 28, 42, 56 and 70 DAP. However, they were not statistically different from those of the plants receiving fertilizer at the rate of 625 kg ha^{-1} for some evaluation dates. The lengths of branches increases with time and at the last evaluation date (70 DAP), they were 74.9, 90.7 and 82.9 cm long for fertilizer application rates of 0, 312.5 and 625 kg ha^{-1}, respectively. In general, application of fertilizer gave longer branches than did no fertilizer application.

Fruit yield, seed yield and number of fruits per branch: Combined analysis of variance of two-year data showed significant differences between years, among pruning levels and among fertilizer rates for fruit yield, seed yield and number of fruits per branch (Table 4). The interaction effects between year and pruning level and between year and fertilizer rate were also significant for fruit yield and seed yield. However, the interaction effects, through significant, were much smaller than those of pruning level main effects and fertilizer rate main effects for all characters.

Fruit yields in 2010 were higher than those in 2009 for all fertilizer rates and pruning methods (Table 5). The interaction effects resulted from higher fruit yield in 2010 than fruit yield in 2009. The interaction effects was confound only between pruning levels at the 70 and 90 cm and fertilizer rates at the 312.5 and 625 kg ha^{-1}, whereas pruning level at the 50 cm and 0 fertilizer rate were consistently lower than others in both years. Similarly, Pruning at the 75 cm and application of fertilizer at the rate of the 312.5 kg ha^{-1} showed

Table 4: Combine analysis of variance for fruit yield and seed yield of physic nut subjected to three pruning levels (50, 75 and 90 cm above ground) and three fertilizer rates in 2009 and 2010

		Mean square	
Source of variance	df	Fruit yield (kg ha^{-1})	Seed yield (kg ha^{-1})
Years (Y)	1	1,725,921**	1,941,428**
Rep./Y	4	39,118	54,974
Pruning levels (P)	2	1,356,153**	1,240,141**
Fertilizer rates (F)	2	2,196,980**	1,332,100**
Y×P	2	206,998**	124,270*
Y×F	2	431,453**	282,512**
Pooled error	24	12,079	9,732

df.: Degree of freedom, * Significant at p<0.01, **Significant at p<0.05

Table 5: Means for fruit yield physic nut at three pruning levels (50, 75 and 90 cm above ground) and three fertilizer rates in 2009 and 2010

	2009			2010		
Fertilizer rates	50	70	90	50	70	90
(F)	(cm)			(cm)		
0 kg ha^{-1}	1,156c	1,729b	1,355c	1,804b	2,171c	1,983b
312.5 kg ha^{-1}	1,940a	2,887a	2,363a	2,277a	2,612a	2,308a
625 kg ha^{-1}	1,354b	2108b	1,877b	2,142a	2,450b	2,239a
Mean	1,483	2,241	1,865	2,074	2,411	2,177

Means in the same column with the same letter are not statistically different at 0.01 probability level by LSD

consistently high fruit yield in both years. Figure 2a and b showed seed yield patterns of three-year old physic nut subjected to three pruning methods and thee levels of fertilizer application and harvested for two years in 2009 and 2010. The patterns of seed yield were similar for both years except for higher yield in 2010. It is clear that the consistently lowest yielding treatments were pruning level at the 50 cm and 0 kg ha^{-1} fertilizer application rate and the consistently highest seed yields were obtained from the application of fertilizer at the rate of 312.5 kg ha^{-1} and pruning at the 75 cm.

The combined analysis showed that fruit yield in 2010 was 2,221 kg ha^{-1} and significantly higher than the 1,863 kg ha^{-1} in 2009 (Table 6). Seed yield of 1,559 kg ha^{-1} in 2010 was also significantly higher than the 1,180 kg ha^{-1} in 2009. Number of 26 fruits per branch in 2010 was significantly higher than the 19 fruits per branch in 2009. For pruning method, all treatments were significantly different. Pruning at the 75 cm was the best treatment for fruit yield (2,327 kg ha^{-1}), seed yield (1,617 kg ha^{-1}) and number of fruits per branch (31 fruits). Pruning at the 90 cm was significantly better than pruning at the 50 cm for fruit yield (2021 kg ha^{-1}), seed yield (1,396 kg ha^{-1}) and number of fruits per branch (27 fruits), whereas pruning at the 50 cm was the poorest for fruit yield (1779 kg ha^{-1}), seed yield (1094 kg ha^{-1}) and number of fruits per branch (19 fruits). Yields of physic nut receiving different fertilizer rates followed the similar patterns of those of physic nut subjected to different pruning methods. The highest fruit yield (2,398 kg ha^{-1}),

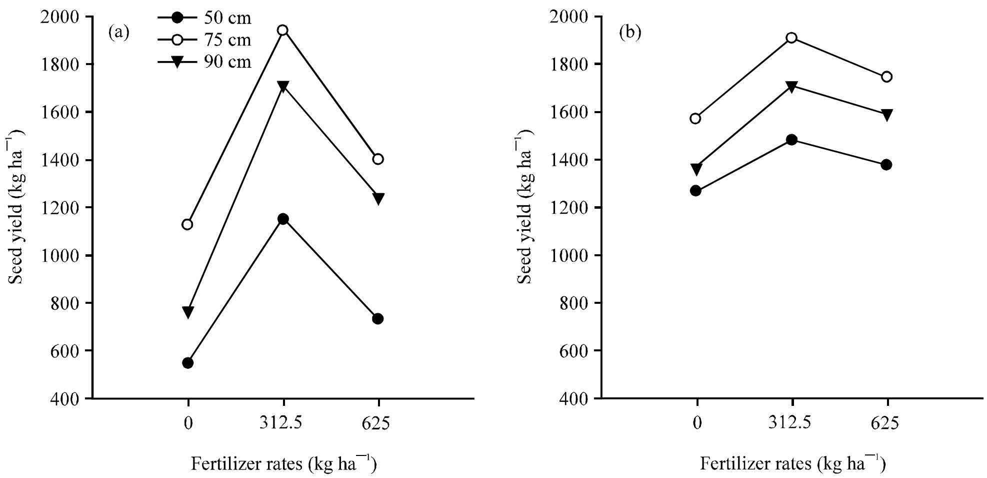

Fig. 2: Yielding patterns of three-year old physic nut subjected to three levels of pruning and three levels of fertilizer application and harvested for two years in (a) 2009 and (b) 2010

Table 6: Means for fruit yield seed yield and number of fruit per branch of physic nut at three pruning levels (50, 75 and 90 cm above ground) and three fertilizer rates in 2009 and 2010

Results	Fruit yield (kg ha^{-1})	Seed yield (kg ha^{-1})	No. of fruit per branch
Year			
2009	1,863b	1,180b	19b
2010	2,221a	1,559a	26a
F-test	**	**	**
Pruning levels (P)			
50 cm	1,779c	1,094c	19c
75 cm	2,327a	1,617a	31a
90 cm	2,021b	1,396b	27b
F-test	**	**	**
CV (%)	4.3	9.0	9.7
Fertilizer rates (F)			
0 kg ha^{-1}	1,700c	1,108c	19c
312.5 kg ha^{-1}	2,398a	1,651a	34a
625 kg ha^{-1}	2,029b	1,349b	24b
F-test	**	**	**
P×F	ns	ns	ns
CV (%)	4.2	5.0	9.6

ns: Not significant, **Significant at $p<0.01$

seed yield (1,651 kg ha^{-1}) and number of fruits per branch (34 fruits) were obtained from physic nut receiving fertilizer application at the rate of 312.5 kg ha^{-1}. Application of fertilizer at the rate of 625 kg ha^{-1} resulted in lower fruit yield (2,029 kg ha^{-1}), seed yield (1,349 kg ha^{-1}) and number of fruits per branch (24 fruits), whereas application of fertilizer at the rate of 0 kg ha^{-1} gave the poorest fruit yield (1,700 kg ha^{-1}), seed yield (1,108 kg ha^{-1}) and number of branch (19 fruits).

DISCUSSION

In this study, a promising provenance of physic nut was selected and the demonstration plantation was established at the Khon Kaen University's Agronomy farm in the 2006. At the first establishment, the plantation was established using the narrow spacing of 0.5×1.25 m and later they were thinned to obtain a spacing of 1×2.5 cm for final population density of 3,200 plants ha^{-1}. The crop had not been pruned before the experiment. The plantation was established in infertile sandy soil as indicated by very low nutrients and organic matter in soil analysis (Table 1). The soil is similar to most production areas of physic nut in the semi-arid tropics and will be a representative of most soils planted to physic nut in terms of low fertility and sandy texture.

Spacing for physics nut varies considerably. In South Indian conditions, 2×1.5 m spacing (3250 plants) is found to be ideal. The ideal spacing could be 2×2 m under rain-fed conditions and 2.5×2.5, 3×3 and 4×2 m for irrigated conditions (Singh *et al.*, 2006). Spacing in this study is in a range of those reported. There is no information on systematic pruning experiment of physic nut at different ages. The information available in the literature so far has been based on the experience of long period work with physic nut and the nutrient requirement should be dependent on different factors in the plantations including soil types, available soil nutrients, moisture, plant ages, pruning methods and weed control.

In this study, the cutting was carried out in March in 2009 and it would be too late for cutting operation and pruning was not practiced in 2010. It is recommended for physic nut that cutting should be carried out during the dry dormant season to increase branching and the number of tip-borne inflorescences, as well as to form a wide low-growing tree that is easier to harvest (Gour, 2006). The crop in 2010 had longer growing period than that in 2009 and it also gave higher yield.

This should be better explanation of the low seed yield in the first year. The difference in weather conditions between two years would not cause a large difference in yield because rainfall and rain distribution in 2009 was much better than 2010 (Fig. 1) but its yield was still lower. Climate does not appear to be an important factor, considering the fact that this plant can survive in a wide range of temperatures. However, warmer climates appear to result in better yields. Seed yields of 1,094 to 1,396 t ha^{-1} in this study were rather low compared to those in other reports. Seed production is reported to a range from about 2 t ha^{-1} to over 12.5 t ha^{-1} after five years of growth. Although not clearly specified, this range in production may be attributable to edaphic, climatic and nutritional factors in low and high rainfall areas (Kumar and Sharma, 2008).

Gour (2006) suggested cutting down the trees to 45 cm stumps after ten years to improve yield. Re-growth is rapid and the plants will start bearing fruits within a year. For newly-established plantation of physic nut, pruning the main branch (stem) at 30-45 cm is ideal for maximizing the growth rate and for optimizing the number of primary and secondary branches (Behera *et al*., 2010). In this study, the three-year old stumps of 50 cm were too short and caused lower fruit yield and seed yield than the stumps of 70 and 90 cm. The stumps of 70 cm were most productive. The contrasting results could be possibly due the difference in ages of the trees.

Gour (2006) also suggested cutting 2/3 of the terminal branches each successive year. In this study, the terminal branches were not cut in the second year, but fruit yield and seed yield were higher than those in the first year. Every year pruning seems to be not necessary for physic nut but the plants need to be cut back in the third year because they will be too tall and the branches will be too long that causes mutual shading and low yield. Moreover, harvest can be difficult.

Pruning is an agronomic practice to improve yield and product quality of horticultural crops. In physic nut, the objectives of pruning are to control plant size and plant architecture of bushy appearance with high number of branches and ultimately to increase seed yield. In tomato, pruning is used to increase weight marketable fruits and fruit yield (Muhammad and Singh, 2007a) and the optimum pruning levels would be two-stem and three-stem pruning levels compared to un-pruned plants (Muhammad and Singh, 2007a, b).

Optimal fertilization can increase the seed and oil yield, but high fertilization can induce high biomass but low seed production (Achten *et al*., 2008). High N nutrition improved the overall plant oil yield by increasing the total number of fruits/seeds produced per plant (Yong *et al*., 2010). The optimum levels of inorganic fertilizers have been seen to vary with the age of the tree (Patolia *et al*., 2007). In general, application of super phosphate @ 150 kg ha^{-1} and alternated with one dose of 40, 100 and 40 kg ha^{-1} NPK at 6 monthly intervals is reported to improve the yield (Singh *et al*., 2006).

Application of fertilizer as a single dose can cause high loss from leaching and spit fertilizer application may be more affective. Polthanee and Changdee (2008) found in kenaf that application of chemical fertilizer in split dosages at planting and 60 days after planting could increase fiber yield. In physic nut, seed yield was significantly influenced by nitrogen and phosphorus (Patolia *et al*., 2007) and the NPK in the ratio of 46:48:24 kg ha^{-1} is to be applied in split doses from second year onwards so as to obtain economic yields (Rao *et al*., 2008). Physic nut is often claimed as a hardy and low nutrient requirement crop and can grow in marginal land with low soil fertility (Heller, 1996; Jongschaap *et al*., 2007). However, it is rather conclusive from most studies that it responds well to fertilizer application. The claims might be too optimistic because without proper management and fertilizer application it will not be productive and profitable. In this study, the highest fruit yield and seed yield were obtained by application of fertilizer at the rate of 312.5 kg ha^{-1}. Application of fertilizer at the rate of 625 kg ha^{-1} depressed yield, whereas no application of fertilizer gave the lowest yield. The application of fertilizer at the rate of 312.5 kg ha^{-1} is considered to be optimum, but the application at the rate of 625 kg ha^{-1} was over-dosed. The results in this study supported previous findings and emphasized the importance of the application of fertilizer to increase yield in physic nut which seemed to be rather high input crop. However, site-specific fertilizer trials need to be established for the trees of different ages and over a number of seasons.

CONCLUSIONS

Hard pruning methods at 50, 75 and 90 cm from ground level did not showed significant differences in branch number and branch length. However, application of fertilizer at the rate of 312.5 kg ha^{-1} gave the highest number of branches (27 branches) followed by 625 kg ha^{-1} (23 branches) and 0 kg ha^{-1} (21 branches), respectively. Application of fertilizer at the rate of 312.5 kg ha^{-1} also gave the highest branch length (90.7 cm) followed by 625 kg ha^{-1} (82.9 cm) and 0 kg ha^{-1} (74.9 cm), respectively.

Cutting at 75 cm gave the highest fruit yield and seed yield due to higher number of fruits per branch. Cutting at 90 cm yielded lower than that of 75 cm but the yield was still higher than that of 50 cm. Application of fertilizer at the rate of 312.5 kg ha^{-1} resulted in the greatest fruit yield and seed yield of physic nut due also to higher number of fruits per branch. Application of fertilizer at the rate of 625 kg ha^{-1} yielded than that of 312.5 kg ha^{-1} but the yield was still higher than that of 0 kg ha^{-1}. Therefore, cutting at 75 cm above ground is recommended. On the other hand, cutting at 90 cm is optional, but cutting at 50 cm is not recommended because it caused the low yield. Application of fertilizer to tree-year old physic nut is also recommended but the application rate should not be higher than 312.5 kg ha^{-1} and the recommended rate should be dependent on soil analysis. Application of fertilizer at the rate higher than 312.5 kg ha^{-1} will not be profitable. Further investigations under different soils, plant ages and agronomic practices are still required.

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