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Coppicing as a tool for improved growth and yield of shrub and tree crops

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Abstract

Aged shrubs and trees usually have poor branching structure, a decline in yield and possess weak health status to the extent that they need replacement after some time. Starting afresh with seedlings creates a void in the farmer's cultivation process, a significant decline in crop yield and a drop in income because it takes a long time for seedlings to establish, develop and become mature enough to yield the desired product(s). Some plants have a great ability to regrow after severe cutting. Coppicing makes such plants to renew their juvenile state; this extends the life of the plants by many years. Coppicing has been used in some plants to mitigate these types of aging problems. The objective of this paper is to identify the possibilities of shortening the time gap in reviving low yielding good old shrubs and trees as well as enhancing their performance through coppicing. Coppicing of the very tall trees will result in new plants that will be short and may even be harvested without the aid of a harvesting stick in the first few years. Seeing trees in appropriate locations, bearing plenty of fruits with exceptionally good qualities for eating and processing dying gradually because of old age is a loss; coppicing can bring such plants back to youthful vigor and apt productivity. Because the coppiced tree has an established root system, the new growth is particularly vigorous. Coppicing should be part of the useful tools in the management of plantation trees and shrubs for enhanced output.

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Introduction

The word 'coppice' is from the French word 'couper' which implies 'to cut.' It is trimming shrubs or trees in a way that encourages them to sprout back shoots from the stumps, roots, or suckers.

The shoots are left to grow for a certain number of years and then are cut, starting the entire cycle again (Spengler, 2018). Coppicing is built on the capacity of deciduous hardwood trees to produce fresh growth year after year from the old stump (Tonge, 1983). When a tree is cut down to its stump, a few years later it would grow several meters high once again. Some plants have a great ability to regrow after severe cutting (Roberts, 2017). The pruning method where trees and shrubs are cut to a ground-level resulting in the growth of new shoots is known as coppicing (Woodie, 2012).

Current practices of coppicing in the management of trees

Coppicing is regularly carried out to generate renewable wood harvests. The tree is cut and shoots grow. The shoots are left to grow for a certain number of years and then are cut, starting the entire cycle again (Spengler, 2018). Archaeologists have discovered that coppicing has been in practice since the Neolithic times. Coppicing pruning was especially important before man had machinery for cutting large trees and transporting them. Coppicing trees made available an endless supply of logs of suitable size that could be handled easily.

Essentially, coppicing is a way of providing a sustainable harvest of tree shoots (Spengler, 2018). First, a tree is felled. The stool is formed when sprouts grow from dormant buds. The sprouts that arise are allowed to grow until they are of the correct size, and then are harvested and the stools allowed growing again.

Coppicing a tree results in multiple stems growing out of the main trunk-suitable for fencing, firewood, tool handles, and many additional woodland crafts (Briana, 2012).

Hazelwood dries well without splitting and burns nicely.

It is a quick-growing species that coppices readily and will provide a good crop of round logs and kindling if cut regularly at twelve to more than twenty years interval (Michael, 2010). For the sake of efficiency, the right types of species are to be planted. It dries well both split and un-split. It burns a bit rapidly.

Because the coppiced tree has an established root system, the new growth is particularly vigorous. Coppice production is up to ten times more efficient than starting afresh with seedlings after each harvest (Tonge, 1983).

Benefits of coppicing

Maintains trees at a juvenile stage

A regularly coppiced tree will never die of old age **(**Wikipedia**,** 2019). Avocado (Persea americana Mill) that has been very old and in front of a residential building, already a threat to the building because of the widespread branches and the fact that the tree was so tall that if any strong wind should blow it down both the house and the occupants of the house may be endangered. The plant was then very useful. Hassan *et al.* (2016) revealed that avocado consumption has benefits for heart health, weight management, and it has a potential role in lowering cholesterol. I had mooted the idea of cutting down the frightful tree but one of my neigh boughs who had been enjoying the tasty fruits of the avocado pear does not want to think of killing the tree. Coppicing such a tree could serve the dual purpose of doing away with the fearsome size that was a treat to lives and properties within the vicinity of the house as well as rejuvenating the old pear tree.

Management of height of old fruit trees

To control diseases and insects pests in large trees will be difficult until they have been lowered through coppicing (Crassweller *et al.*, 2018)**.** It will be a herculean task to treat the very tall old pawpaw tree in Fig. 1 of any foliar pest in the crown. A sprayer that can effectively spay pesticides to a pawpaw crown at

that height is likely to be out of reach of the average farmer because of cost. Coppicing can be practiced on an old tall pawpaw (*Carica papaya* L.) tree characterized by difficulty in harvesting the fruits. Some pawpaw trees might have become too tall that the sticks for harvesting would have become too long that harvesting becomes dangerous, tiresome, tough, slow and uncomfortable to execute. Harvesting turns out to be particularly dangerous in the sense that the harvesting stick might be too short for the harvester to stay at a safe distance from the falling fruits, this practice minimizes the chances of the falling pawpaw from heating the person plucking the pawpaw with a stick. The taller the pawpaw tree is the closer the harvester will get to the pawpaw stand for a higher reach; this will increase the chances of being hit by the plucked pawpaw fruit. Coppicing of the very tall pawpaw tree will result in a new pawpaw tree that will be short and may even be harvested without the aid of a harvesting stick in the first few years. Fig. 2a shows a coppiced pawpaw tree, while Fig. 2b shows a coppiced pawpaw tree that already has some sprouts that would eventually form the branches of the newly coppiced pawpaw tree. When the plant starts bearing fruits, even a small child can pluck fruits from it without the aid of any stick.

Fig. 1. A very tall old pawpaw tree with the crown possibly blown off by wind storm which could be regenerated through coppicing.

In the process of coppicing the pawpaw plant, the stand must be cut at a height above some of the nodes from where several sprouts will shoot out. The young sprouts must be allowed to develop to an extent when it becomes easy to differentiate the healthy and vigorous ones from the weak and poorly developed ones. Another alternative may be to allow only the number of sprouts expected to be developed into new shoots to grow while the rest are pruned out. The pawpaw plant in Fig. 2b is a result of a pruned plant where all the buds below the sprouted shoots have been rubbed off, allowing only buds in four different directions with equal distance; the fourth sprout was injured, which is the reason why it is less developed compared with the other three sprouts.

Things to consider before proceeding on pruning an old tree are: if the tree is in an appropriate place, has

the tree been bearing plenty fruits that are exceptionally good for eating in the fresh state, or are the fruits suitable for processing. Crassweller *et al.* (2018) indicated some reasons why it may not be necessary to prune an old tree if there are indications of the poor structural state where it could easily break when heavily laden or when it shades the garden or hinders lawn mowing and if the big old tree is full of disease-causing organisms and pests.

Fig. 2. Freshly coppiced old pawpaw tree (a) and coppiced pawpaw tree with three prominent sprouts with one minor sprout after the less vigorous and the unwanted ones had been rubbed off.

Briana (2012) noted that hardly do diseases take hold of the young growth and when the trees have been pruned they become short and are not affected by weather elements since they are of short stature so they live much longer than their un-pruned counterparts.

In an attempt to decrease tree height, branches growing more horizontal to the ground are left (Crassweller *et al.*, 2018). By implication, the ones that are more or less growing vertically up are selectively cut. More of the fruiting branches are therefore closer to the ground thereby making the harvesting of fruits to be easier. To give fruit tree a good shape after trimming the tree to a favorable height and spread, there is a need to examine the major branches to determine which ones are to be cut with the mind of reducing overlapping and shading of the branches.

Regeneration of old trees

In an event of a transfer or an outright purchase of a new landed property, there may exist in that environment some big trees that may be a treat to the building(s) or causing the shade to cherished plants such as flowers or other trees. Crassweller *et al.*, (2018) noted that older fruit trees in your home landscape can be renovated by thoughtful pruning; the old trees can be put in a more adaptable state. Figure 2 shows an old pawpaw tree that has become very old to the extent that the crown has even become so weak that the wind has broken off the crown.

Regeneration of forests

Coppice forestry is a major sustainable procedure of woodland management that allows forests to naturally recover (Roberts, 2017).

After several years, the stock becomes exhausted and then comes the need to replace them with new ones.

Swift firewood production

Coppicing is an art that could greatly encourage firewood production. Gmelina in Fig. 3a which was coppiced to provide materials for staking tomato could be a suitable source of plenty of firewood materials. An acquaintance of Tonge (1983) practiced the art of coppicing by cutting down a vigorously growing tree because it shaded several nearby

blueberry bushes from the sun. Two years later the single tree originally cut down has produced five stems of up to $1^1/_2$ inches (3.8 cm) in diameter each. Subsequent cutting of the tree continuously increased the eventual number of stems produced. Crank (2019) noted that what makes the most appropriate firewood species depends on the climatic characteristics of a specific location. In some regions, an abundant supply of what's called hardwood may be available. Wood that has not been sufficiently seasoned is often difficult to light and may keep going out and will burn poorly, smolder and will not generate much heat.

Fig. 3. Gmelina stand after the plant has been coppiced to provide materials for staking vegetables (a) and Moringa plant with many sprouts after coppicing (b).

Before coal was economically significant in metal smelting, coppices provided wood for particularly charcoal and wood for numerous purposes.

Regeneration of soil fertility

Numerous farmers practice a rotational planting system based on coppice forestry in the Mayan areas of Guatemala. Quite a lot of widespread species of nitrogen-fixing trees that regrow when cut down to their stump are planted throughout the plantation of cardamom (*Elettaria cardamomum* L. Maton). Cardamom is the main cash crop meant for export. When cardamom has been grown for about ten years it is then removed.

The trees that grow rapidly are cut down, and annual crops of corn, beans, and yucca are planted for between two and three years. Once the shade trees have grown sufficiently high to make annual crops unfeasible, cardamom is once again planted to initiate the cycle (Roberts, 2017).

Such frequent growth means the soils can be easily depleted and so fertilizer application is often required. Out of the four sources of nitrogen fertilizer reported by Ogbonnaya and Kinako (1993), NO_3-N as potassium nitrate, NH_4-N as ammonium sulfate, NH_4NO_3-N as calcium ammonium nitrate, and urea-N as urea) on a latosolic soil, with a pH of 4.4, Gmelina (*Gmelina arhorea* Roxb.) seedlings fertilized with urea-N (urea) or NH_4NO_3-N (calcium ammonium nitrate) had greater relative growth rate, dry weight, height, collar diameter, net assimilation rate, than seedlings fertilized with NO_3-N (potassium nitrate) or NH_4-N (ammonium sulfate). This indicates that out of the four inorganic fertilizers, urea or calcium ammonium nitrate proved to be better than ammonium sulfate or potassium nitrate. Ogbonnaya and Kinako (1993) concluded that both urea-N and NH_4No_3-N are suitable sources of nitrogen for stimulating the growth of Gmelina seedlings in a forest nursery or for establishing field plantations on latosolic soil.

In effect, the first year's pruning means that the same amount of root system is supplying fewer growing points. The application of nitrogen fertilizer would encourage excessive vegetative growth that would further increase next year's pruning activity

(Crassweller *et al.*, 2018). It is to be noted that the tree that was cut down has a widespread root system that was supplying a big shoot system, now that the big shoot system has been replaced by just young and small sprout(s), application of nitrogen will result in an excessive availability of such nutrient that will engender unnecessary disproportionate vegetative growth, especially if it is a fruit-bearing tree; but in case it is for wood production such a vigorous growth may be needful.

The continuous stand of nitrogen-fixing coppice trees aids in the maintenance of the long term fertility of the lands (Roberts, 2017).

Creation of a multi-stemmed plant

Coppicing also creates a multi-stemmed plant instead of one with a single, large trunk. Fig. 3b shows a single strand of Moringa (*Moringa oleifera* Lam.) which has developed more than five sprouts from the various coppicing operations carried on the plant. Some plants naturally start branching after attaining a great height, most fruit trees with this growth pattern present the challenges of fruit harvesting which must be with sticks. Coppicing could make the single big trunk to result in a pre-determined number of stems.

A specific growth pattern can be made to exist by practicing coppicing, similar to the way cinnamon trees are grown for their bark. Woodie (2012) observed that coppicing was suitable for obtaining wiry stems useful for making baskets and for fencing. Tonge (1983) reported that coppicing possess an exceptional potentiality of high output from a very small area.

Coppicing can bring about biodiversity

Harvesting can be in cycles, in the rotation of two to ten years depending on the type of wood grown and the purpose for which the tree or shrub is established.

Typically, coppiced woodland is harvested in sections or *coups* on a rotation. This system made a crop obtainable at least in one portion each year in the woodland. Coppicing has the benefit of making available a rich variety of habitats, as there is always a range of a variety of coppice at different ages growing in the woodland every time, this is beneficial for biodiversity. On a three- or four-year cycle, whereas oak can be coppiced over a fifty-year cycle for poles or firewood. Some of the mature trees in the woodland are left uncut, to be grown into the timber. The woodland provides a range of larger timber for jobs like bridge repair, house building, cart-making as well as the small material from the coppice.

Potential source of bioenergy

The relevance of coppicing in ecosystem services and in recent years has been recognized by Šrámek *et al.* (2015). Globally, governments are endeavoring to lessen our dependency on fossil fuels by encouraging the use of renewable and sustainable energy sources (Vanbeveren and Ceulemans, (2019). It is mostly agreed that a mix of hydro, solar and wind energy are required, but energy from biomass should be added to the list (International Energy Agency, 2018). That energy, when required, can be kept and used is a major advantage of bioenergy. To meet the anticipated upsurge in biomass demand may not be met by forestry and (agricultural) waste streams – this creates an opening for biomass harvested from short-rotation coppice (Mantau *et al.* 2010 and Langeveld, *et al.,* 2012). In terms of biodiversity and management, the short-rotation coppice covers the middle ground between forestry and agriculture (Vanbeveren and Reinhart, 2019).

Making some plants to give a particular effect

Coppicing has been used not just to restrict the size of a potentially large shrub or tree, but as a way of making some plants to give a particular effect – a different kind of leaf perhaps or more brilliantly colored bark (Pavord, 2013).

Limitations of coppicing

One of the limitations of the coppicing technique is that certain plants that are very useful to humanity such oil palm (*Elaeis guineensis* Jacq.) cannot be rejuvenated by coppicing. Darby (2014) commented

that oil palm is evolving as the topmost efficient vegetable oilseed crop globally due to its high yield in oil; an oil palm plantation of one hectare can produce as much as ten times more oil compared to the other world-leading oilseed crops such as rapeseed, soybean and sunflower. Barcelos *et al.* (2015) later added that their average productive span-life is about 25 to 30 years, where each tree can bear 8 to 12 fruit bunches per year. Any attempt to coppice oil palm will end its life.

Suggested modifications of coppicing

A way out of one of the limitations discussed above is to establish seedlings amid the old plants at an earlier time before the old oil palm is exterminated; this will reduce the time lap between the cutting down of the old oil palm and when the newly established plant will come into bearing stage.

Henry VIII, the king of England in the mid-1500´s, issued an order that made it compulsory that woodsmen must fence in patches of woodland that the trees had recently been cut down. This fence would inhibit wild animals from feeding on the new shoots of the recently cut trees until they had sufficiently matured (Roberts, 2017). Wikipedia (2019) in corroborating this report noted that Henry VIII required woods to be enclosed after cutting to prevent browsing by animals.

There is a need to identify the type of wood that will meet the particular need of the grower. Crank (2019) noted that all woods are not created equally for any given task on the homestead. Seasoned wood burns better than greenwood. An integral part of the usefulness of wood depends on the suitability of the moisture content of the wood. (Tonge (1983) observed that the coppice is cut when the stems of the plants have attained the appropriate height and thickness required for producing the wood that results from coppicing exercise. It was added that some sprouts will shoot up from the old stump after the tree has been cut down. All the sprouts will be allowed to grow through summer, but are pruned to remain only the three most vigorous stems after leaf drop in the fall. The tree's vigor is then concentrated into the three most vigorous sprouts selected and growth will be rapid and fairly uniform.

Dry wood brings about a more efficient system than wet wood. Wet wood produces a hot fire (Crank, 2019). Coppicing can be practiced in such a way to allows growing firewood to just the appropriate size and then harvest it for firewood; there will be very little or no need for splitting the wood to smaller sizes since the wood will be allowed to grow to the desired size and harvested.

Improving the efficiency of coppice harvesting requires a good comprehension of contemporary operations, regardless of the level of technology. The survey by Spinelli *et al.* (2016) indicates that carrying out felling, processing, and harvesting in a mechanized pattern are viable choices for coppice stands. There is a prevalence of coppice forestry in France and Italy as indicated by a recent study.

Conclusion

Trees and shrubs respond in diverse ways to the height of cutting, frequency of cutting and soil fertility conditions, therefore research is required in these areas to optimize the output of coppiced plants. For a very useful old plant that cannot be coppiced like oil palm, seedlings of the plant should be established amid the old plants long before the old plant is exterminated; this will reduce the time lap between the cutting down of the old plant and the time when the newly established seedlings will come into bearing stage. Additionally, replanting can be executed in stages. Coppicing of the very tall trees will result in new plants that will be short and may even be harvested without the aid of a harvesting stick in the first few years. Watching a tree die yet it is in an appropriate location, bearing plenty of fruits with exceptionally good qualities for eating and processing because of old age is a loss; coppicing could be used to bring such plants back to productivity within a short period. Coppicing could be a useful tool in the management of plantation trees and shrubs for enhanced output.

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