

Pruning in apple trees – Important considerations

Pruning is an important operation employed to improve both crop load and the appearance of a tree, but this practice is frequently neglected and misunderstood by the apple growers. Most of the time, apple growers want to do pruning correctly and they have right intentions, but they make a plenty of mistakes in this process. Improper pruning can not only negate the benefits of all other orchard operations but sometimes can cause damage that lasts throughout the productive age of the apple trees. Therefore, proper pruning is crucial to harvest the production potential of apple varieties. Here in this article we are highlighting the basics, types and techniques of pruning in apple trees. This will help in improving the basic understanding of apple growers about appropriate pruning, so they can prune their trees more effectively to obtain maximum returns.

APPLE trees can produce fruits regardless of human intervention but, it is important to manage apple trees for profitable production. Pruning is one of the most powerful horticultural techniques available to apple growers. Pruning is a multi-year process and employed to build a strong framework of a tree to support heavy crop load, to improve light penetration inside the canopy which is required for flower bud development, fruit set, fruit growth, and colour development. Pruning also helps to improve airflow which reduces humidity inside canopy and allows a tree to dry faster after a rain, consequently reduces the incidence of certain diseases, such as apple scab, bitter rot, and sooty blotch fungus. Further pruning operation regulate growth and flowering, to keep fruit picking manageable, to create new fruiting area and maintaining the existing fruiting area. Pruning can also be used to remove dead, damaged, diseased, insect-infested shoots or branches, which will reduce disease inoculum and pest populations in the subsequent years. A good understanding of the bearing habit of different cultivars and the general response of different types of pruning cuts is important while pruning apple trees to achieve the above purpose and to avoid excessive vegetative growth.

Types of pruning

Pruning which is done to build a strong framework and to obtain the specific form of the tree, and done during the first 3 or 4 years can be categorized in formative pruning. Whereas in a mature tree based on the objective we can categorize pruning into two types *i.e.* basic pruning which is applicable in all trees and specific pruning which varies according to the bearing habit of cultivars.

Formative pruning

The objective of formative pruning is to obtain a specific shape of the trees. The step under formative pruning depends on the orchard planting system adopted *i.e.* central leader system, modified central leader system, delayed open central leader system *etc.* However, there is some basic step or general rules which must be kept in mind while giving shape to young trees.

General rules for formative pruning

- Prune young trees very lightly, follow rules of minimal pruning for the first four years to induce precocity.
- Follow the 3: 1 pruning rule - the leader should be 3 times the diameter of any of the lateral branch in the upper part of the tree. Limbs that are larger than the 3: 1 rule should be removed early to preserve a hierarchy of branch and leader diameter.
- Remove low branches (below knee height or 70 cm) to ensure proper movement of machinery to work or to facilitate intercultural operation under the trees.
- Ensure proper vertical and radial spacing of primary scaffold (Fig. 1) branches on the trunk. Proper radial spacing prevents one primary scaffold branch from overshadowing another consequently, reduces competition for light and nutrients. Vertical spacing between two primary scaffolds depends primarily on the orchard planting system adopted.
- Retain more branches in spur-type cultivars than in a tree of standard growth habit. The orientation of a limb along with the central leader has a major influence on growth by its effects on apical dominance (Fig. 2). For the greatest strength and optimum growth, the primary branches must have a wide-angle of attachment to the trunk. The ideal branch angle

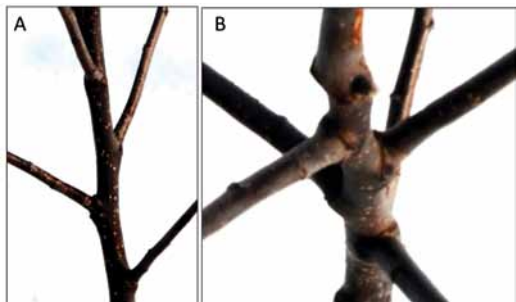


Fig. 1. Maintain proper vertical (A) and radial spacing (B) between primary scaffolds

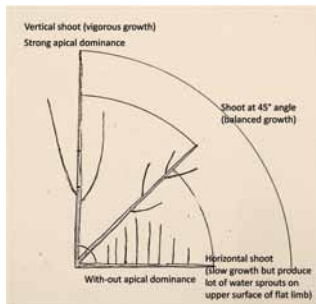


Fig. 2. Limb orientation affects vegetative growth

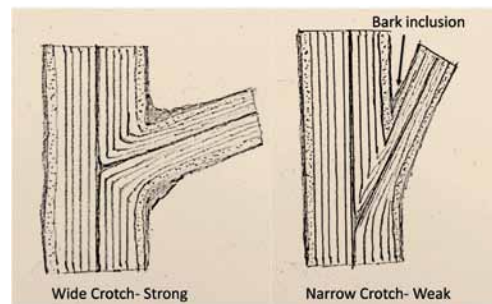


Fig. 3. Branches with wide crotches are stronger than narrow crotches

for most of the traditional orchard planting systems is about 45 to 60 degrees from the vertical (Fig. 3). Narrow crotch angles lead to weak attachment due to the inclusion of bark. The tissues in narrow crotches are slower to mature in the fall and are susceptible to low temperatures injury. Narrow crotches are usually further weakened by water, ice, rotting organisms, and cankers. While the tree is young, spread branches that make very narrow angles with the main trunk. Limb positioning can be done by tying young branches or by using spreaders.

- Remove unwanted shoots (water sprouts) in summer when they are small or before the base of the shoot has lignified.

Basic or fundamental pruning

Objectives of fundamental pruning are to increase light interception and distribution (increases quality of produce and bud formation), increase air circulation (reduce humidity and disease load), to maintain the shape and size of trees and to maintain an optimum balance between vegetative and reproductive parts *i.e.* to remove unwanted growth.

Steps for basic or fundamental pruning

- **Remove sucker growth** - Soft and green vigorous uprightly growing shoots originating from adventitious buds below the soil surface are called root suckers. Apple is known for having suckering shoots. Suckers are of no significance to the tree as these suck sap and energy from the tree. Therefore it is important to remove suckers from grafted plants. If suckers from the rootstock are allowed to grow, they will interfere with the desired effect of the scion. Therefore suckers should be removed from the base during winter pruning. However, it is ideal to remove root suckers at the time of sprouting in summer.
- **Remove water sprouts** - Vigorous shoots oriented from the upper surface of limbs at 90° angle are called water sprouts. They develop from dormant buds within the bark and grow very fast. Water sprouts are not very fruitful and are just generally a nutrient sink. During winter pruning, cut water sprouts from the wrinkle bubble area using a clean cut. However, summer is the best time to remove water sprouts from trees easily. Hand pull the water sprouts in May-June when they are 2-5 cm long and flexible, this makes

them less likely to regrow (Water sprouts pruned in winter may sprout back in spring, likewise in summer cutting after wood hardens leaving the basal buds, the water sprouts will like to start re-growth).

- Remove or cut dead, diseased, damaged shoots or branches. Pruning should be done in such a way that some healthy portion is also removed, to eliminate the reason for drying (2-3 buds below the dead portion).
- Remove downward growing or hanging branches to ensure proper movement of machinery to work or facilitate intercultural operation under the trees canopy smoothly.
- Remove the weakest of parallel growing branches/shoots to prevent shading.
- Remove branches growing back towards the centre or trunk because the objective of pruning is to promote outward lateral growth with a higher light interception in the interior of trees whereas, inward growing branches shade centre of the tree.
- **Remove the weakest of crisscrossing or would be crossing shoots/branches** - When these branches grow and get wider, will limit airflow and cause damage to the bark (due to rubbing with each other) and that can open up the interior of the tree exposing the cambium layer where the all cell divide and can allow pathogen like fungi and bacteria into the tree.
- **Remove broom head:** Multiple limbs from the same origin (we need only one limb).
- Prune shaded interior branches as they produce poor-quality fruits.
- Do not allow the upper branches to grow longer than the lower. Additionally, remove some outside branches to allow sunlight to penetrate inside canopy of the tree. This includes thinning out the clusters of branches on the perimeter of the tree.
- Remove one or two limbs at the top of an excessive tall tree to reduce height.
- Thin out more shoots toward the end of a well-pruned branch, this will improve apple fruit size and colour on remaining shoots.
- Prune slow-growing tree more heavily to promote new growth.
- Prune the top portion of the shoot more heavily to improve light penetration.

Specific pruning - Before specific pruning, it is essential to have knowledge about bearing habit of apple varieties. Objectives are to maintain the existing fruiting area and to create a new fruiting area.



Fig. 4. Vegetative bud (left) and fruit bud (right)

Steps of specific pruning

- **Identification of vegetative and flower bud** - While pruning apple trees it is important to know the difference between vegetative and flower buds. By proper identification, you can ensure that you have enough flower buds on trees for a good crop. The bud differentiation is easy as flower buds are plump and round with downy bud scales whereas vegetative buds are slender, pointed and smaller than flower buds (Fig. 4).
- **Pruning according to the type of group** - Apple trees bear fruits on lateral, non-vigorous wood that is at least two years old. Some apple varieties produce fruiting spur readily. There are several types of bearing habits in the apple but for the most part, they are covered by three types *i.e.* spur bearing, tip bearing and partial tip bearing. Based on bearing habit, the spur bearing varieties are broadly categorized into two groups. The first group (spur type) is mainly characterized by short shoots in the scaffold limbs. The trees tend to be upright with numerous spurs close to the trunk. Spur continues to be produced on older wood. Thus the fruits remain close to the branches or central leader. Whereas in the second group (standard type), main branches have strong wide angles and the central leader shows great dominance. The majority of spurs are located on branches that are two to four years old. As a result, the fruiting zone tends to move away from the trunk to the outer sides of the tree. Tip-bearing varieties produce flower buds on the tips of branches, instead of on fruiting spurs situated along the branch. Some tip-bearing apple varieties bear fruit entirely on the tips of the previous year's shoots, while others bear fruits on ends of the branch as well as on spurs which are known as partial tip bearer. Any form of pruning that includes heading back of shoot tips will reduce the yield of tip-bearing apple varieties, and to a lesser extent, partial tip-bearers. Therefore these forms are subjected to less rigorous pruning than spur-bearing cultivars. Generally, the

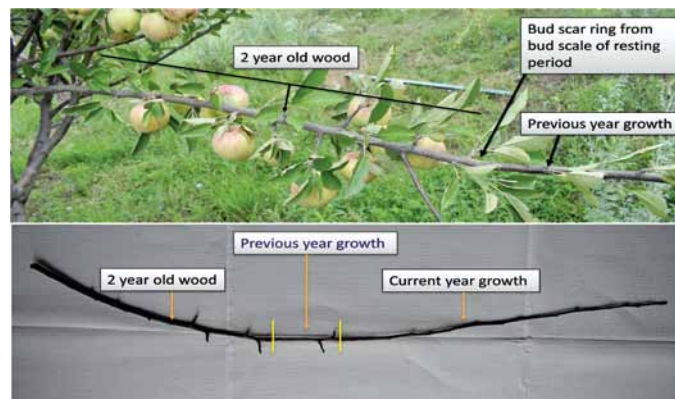


Fig. 5. Age of apple wood and fruiting

partial tip bearer varieties can be pruned the same way as normal apple varieties. But it is better to prune partial tip bearer employing pruning technique a combination of both spur and tip bearing varieties.

Pruning of spur bearing trees

While pruning the apple trees, it is important to know the age of wood *i.e.*, one-year-old (current year), two-year-old (previous year), three years old etc. Apple trees will produce fruits only on two or more than two-year-old wood. On a one-year-old shoot, the cells will differentiate in the 2nd year, developing small spurs that will eventually bear fruits in the coming year (Fig. 5). Good fruit-bearing will occur on 4-5 years old wood that is why we want to avoid pruning it on whole.

Spur pruning: Spur is a short, strong, stubby, compressed stem that may grow a quarter-inch (6 mm) each year. During pruning, it is important not to prune the spurs on apple trees, because that becomes fruit surface area. If we remove these spur, they will not grow again hence, it is very important to protect these spurs during the harvesting of the fruit. Sometimes when the tree is 25 or 30 years or even 40 years old, the spur may be several inches long and produce fruit every year. However,

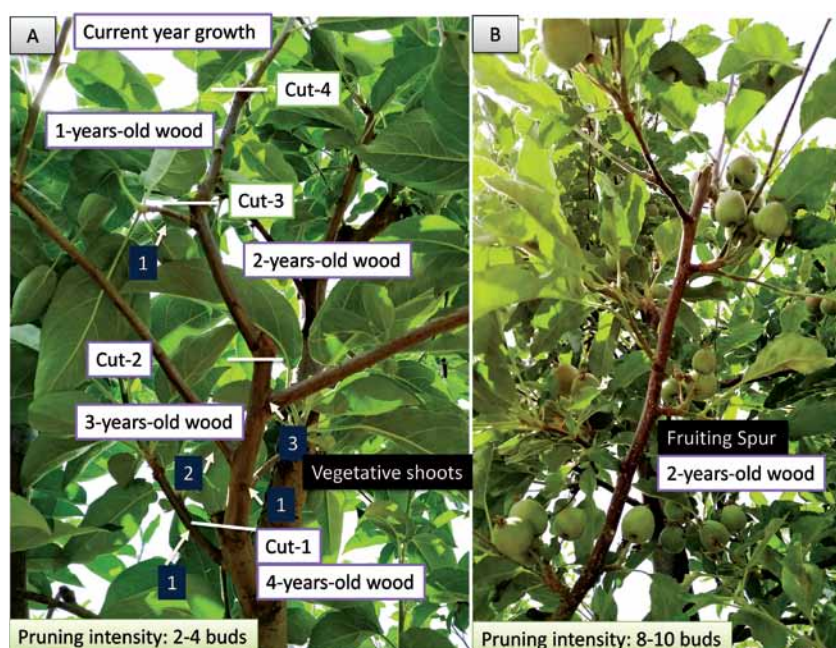


Fig. 6. Effect of pruning intensity on growth and fruiting behaviour

very old and weak spurs tend to produce inferior quality fruits of small size compared to new spurs. Therefore it is important to remove the older and weak spurs or part of the branched spurs to reduce fruiting area to improve fruit size and quality.

Shoot pruning: It has been seen in many apple orchards that growers prune new growth leaving 4-6 inch stubs with 2-4 buds. These stubs in the next season produce leaf bud only (Fig. 6A). Lower and upper 4 to 6 buds of apple shoots generally produce leaf buds or otherwise remain quiet. The only middle portion of shoots usually produces flower buds and spurs. Therefore, while pruning new growth leave at least 10-12 buds (Fig. 6B) in the less vigorous or smaller shoots (generally $\frac{1}{2}$ portion of the shoot) or 12-14 buds on vigorously growing or strong shoots (generally $\frac{1}{3}$ portion of the shoot). On cultivars that exhibit strong alternate bearing habits, heavy pruning should be practiced just before the “on year” to regulate the alternate bearing habit.

Pruning of tip bearer trees

At the time of pruning, the lateral branches of tip bearing varieties will have side shoots (bourse shoot) produced during the growing season just completed (Fig. 7). If these side shoots are less than 20 cm long, then these can be left unpruned to produce flowers and fruit during the next season. A longer side shoots should be pruned back to 12-15 cm. This will encourage new side shoots in the following year, and these shoots will flower and fruit in coming year (So pruning cut in February 2020 will produce side shoot in summer 2020 and will then produce flower and fruit in the season 2021)

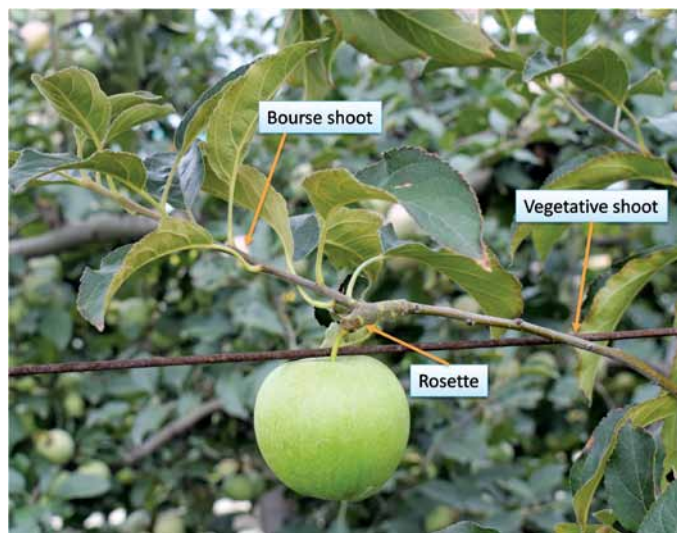


Fig. 7. Tip-bearing cultivar during growing season

Factors to consider during pruning

- **When to prune-** Apple trees rely heavily on stored food reserves from the previous year for bud burst and initial growth. With the onset of winter, the apple tree starts shedding leaves and the sap of apple branches starts to move towards the main trunk. With the onset of dormancy, the sap movement process is completed and the current year branch becomes hard or loses flexibility. If we cut branches before the

completion of sap movement, we lose reserve food material, therefore apple trees should not be pruned before the completion of sap movement. It is better to prune apple trees during late winter when trees are dormant or early spring before the sap starts moving in branches (just before bud swell). Winter pruning is invigorating, so if the tree is pruned too early in winter, such stimulation could cause the tissues to lose their hardiness and could result in freezing injury, poor flower bud survival, dieback of one-year-old shoots, and injury to bark on the trunk. On the other hand, late spring pruning *i.e.* just before bloom can make the flowering buds susceptible to frost.

- **Type of pruning cut**

Thinning cut - Removal of a shoot or branch from its point of origin (Fig. 12B). Thinning cuts are usually preferred for minimizing tree size and for removing excess shoots. Thinning cuts are less invigorating, increase light penetration inside the canopy, and can redirect the branch. Always start pruning with thinning cut *i.e.* remove suckers, water sprouts, dead, diseased, damaged, crossing, acute, downward growing, inward growing shoots or branches, *etc.*

1.1. Right thinning cut - Make thinning cuts smooth and close. If the cut is not in a right position, it can prevent the cut from sealing over. Use collar cut (Fig. 8B) for thinning instead of the stub cut (Fig. 8A) and flush cut (Fig. 8C). Collar cuts cure wounds quickly thus reducing external dieback and disease infestation. On the other hand, flush-cut delays the closure of the wound, since it damages the branch collar thus making it susceptible to disease infestation. Likewise, in stub cut, the stub left after a cut can trigger lateral bud growth. Lateral branching from below the pruning cut is an indicator of a poor pruning cut. To achieve a smooth and clean collar cut, keep the secateur upside down so the cutting edge of the blade would be close to the pruning cut as possible.

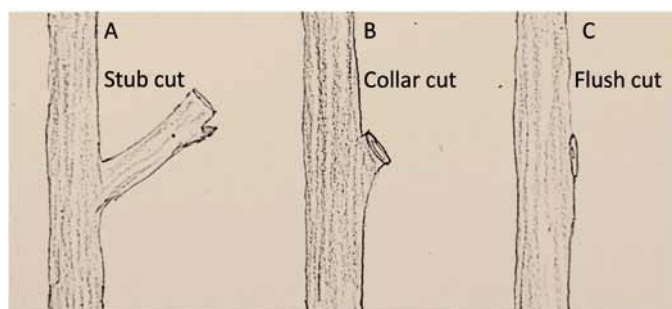


Fig. 8. Different type of thinning cut

Removal of big branches

Position of cut: Position of pruning cut is critical to trees response in wound healing and growth. The wrong position of cut may lead to permanent internal decay. Large branches on apple trees should be removed flush with the collar at the base of the branch not flush with the trunk. The collar area contains some special tissues which divide and allow the tree to seal up the wound once we cut it into the trunk. Begin the cut outside the bark ridge and angle

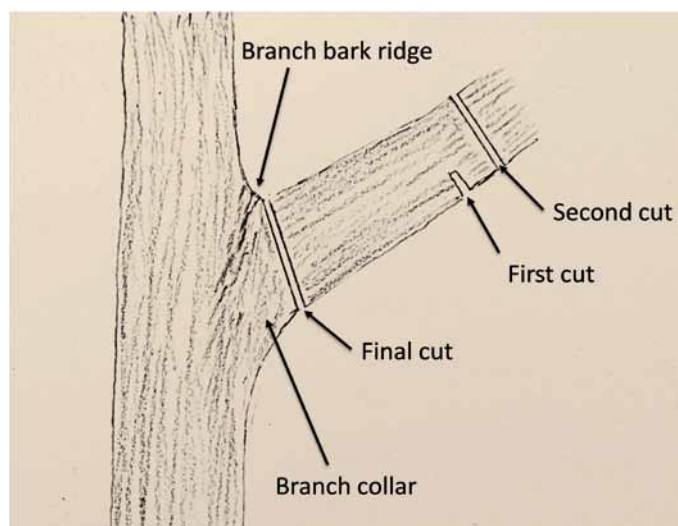


Fig. 9. Three cut method for big limb removal

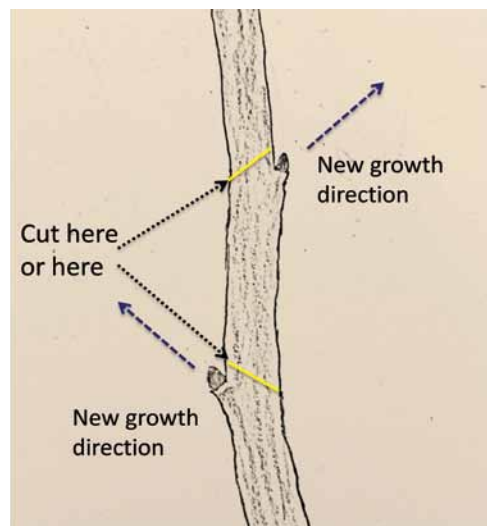


Fig. 10. Pruning stimulates lateral shoot growth close to the cut

it away from the trunk to avoid cutting the limb collar.

Three-cut method: While removing branches above 4 cm in diameter, use a three-cut method. This involves an undercut about 15-18 cm far (depending upon branch diameter), not too deep only cut the bark or some wood. The idea here is to separate the bark, when the weight of the branch falls it will not strip the bark down the trunk of the tree creating a larger injury. Thus always make the undercut first. Next to remove the weight of the branch, make a second cut about 5-8 cm further out from the undercut until the branch falls away. Make a final cut to remove the stub resulting from a second cut. Cut Just outside the branch bark ridge and the branch collar region (Fig. 9).

Heading back: Removal of the terminal portion of the shoot (Fig. 12A). Heading back cut removes the terminal bud that produces plant hormones which normally inhibit shoots development below the terminal bud, thus promote new growth. The heading cut is invigorating and results in strong growth close to the cut. However, it reduces outward canopy growth. Moreover, it is also used to harden long weak branches that are not strong enough to support the fruit load.

Bench cut: Removal of vigorous, uprightly growing branches back to less vigorous and outward-facing side branches (Fig. 12C). Bench cuts are generally used to open up the centre portion of the tree and manage the spread of trees and the spread of the branches outward. Bench cut considerably increases the light penetration and interception.

Basic for heading or bench cut

During the pruning of shoots and small branches, always cut back to an intersecting (lateral) branch (bench cut) or a vigorous bud (heading back). While heading back to an intersecting branch, select a branch that forms an angle of at least 45° with the parent branch (Fig. 12C). Moreover, the selected branch diameter should not be more than 50% of the parent branch. During heading back of a shoot/branch, select a bud that is pointing in the direction you want to promote the new growth (Fig. 10). However, keep in consideration that no branch should

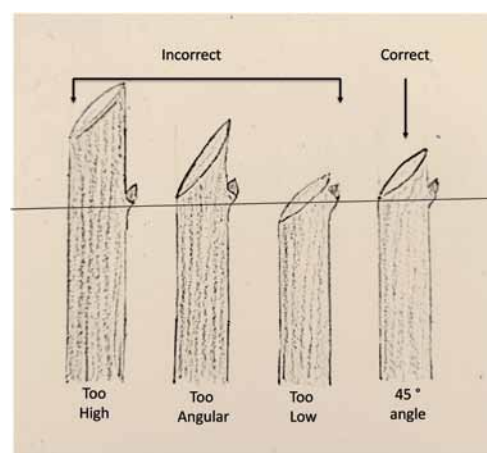


Fig. 11. Proper pruning angle and cut position in relation to bud

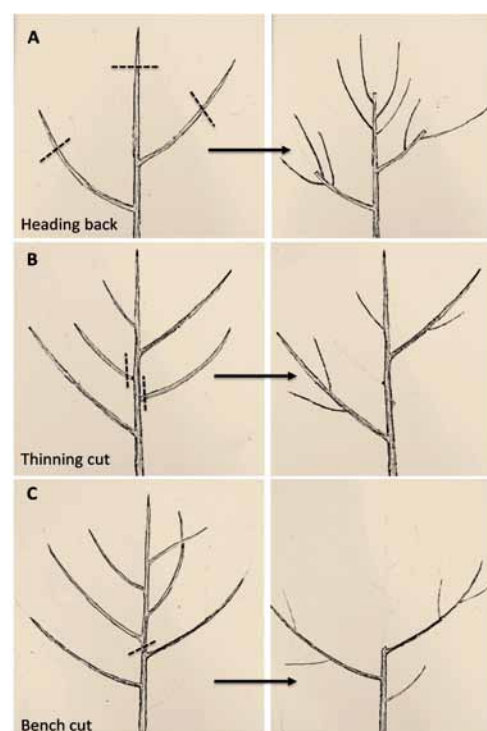


Fig. 12. Type of different pruning cuts and their general growth response

grow towards centre of the tree to restrict air circulation and sunlight penetration inside the canopy. To encourage outward growth preferably select an outward-facing vigorous bud, cut at about 0.6 cm above the bud (for dieback). Further do not leave a stub over the bud or cut too close to the bud. Make a slanting cut (45° angle) in the same direction as the bud to prevent the accumulation of water on the cut end (Fig. 11).

Gardening tool and their care

While pruning trees, it is important to keep the proper tools for the job. Choice of tool according to branch diameter result in clean and precise cuts. Bypass pruner and secateurs are suitable for shoots or branches up to 1.2 cm in diameter. Lopping shears can cut branches of 1.2 cm to 4 cm in diameter. For the branches over 1.2 cm diameter, 6 to 8-point saw (teeth per inch) is most suitable. Pole pruner is useful to cut the branches beyond arm's reach. Chain saw is suited for primary branches (rejuvenation) or tree removal. Other materials required during pruning are gloves, goggles, ladder *etc.* Tools should be of the highest quality and should be sharp. They should be kept in a good condition by lubricating regularly, cleaning to prevent rust, and only employing them for their intended function. Every time before pruning operation tools should be sterilized with Iso-propyl alcohol (dip in alcohol) to avoid disease transmission between trees.

ICAR-Central Institute of Temperate Horticulture is providing training on pruning in apple to apple growers without any charges. Interested farmers can contact Director, ICAR-CITH, Srinagar through Email

(dircithsgr@icar.gov.in) or Telephone (0194-2305044) or Telefax (01942305045) for training.

SUMMARY

Pruning is the most important horticultural operation as far as apple production is concerned. Proper pruning not only improves plant shape but also maintains the fruiting area on apple trees. It also aids in the production of a consistently high yield of superior quality fruits. Formative pruning is critical for achieving the ideal shape of the tree and should be performed following the adopted orchard planting system. However, general formative pruning rules should be kept in mind while performing formative pruning. However, fundamental pruning on a bearing tree should be accomplished before moving on to specific pruning. Apple trees should be properly pruned according to the bearing habit of the cultivar. While pruning the apple trees, it is pertinent that growers should have sound knowledge about the bearing habit of cultivar, type of buds, spur, branch collar, the timing of pruning, type of pruning cut, position of pruning cut, the response of pruning cut, pruning tools, etc, so that maximum benefit from this important operation can be harnessed and quality of the product can be maintained to receive the maximum returns.

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Multiplication of clonal rootstocks of apple:

Technology for production of clonal rootstocks of apple by hardwood stem cuttings using soilless growing medium was standardized. It comprised 30 cm cutting along and treatments (Cocopeat 75: vermiculite 25) under greenhouse conditions with cent per cent rooting.



Source: ICAR Annual Report 2021-22