

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, A DIVISION OF THE NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, A STATUTORY COLLEGE OF THE STATE UNIVERSITY, CORNELL UNIVERSITY, ITHACA

Slotting saw pruning of hedgerow apples improves production and quality

by John C. Cain

Semi-dwarf and dwarf apple trees have many production advantages, the most important of which is bearing at an earlier age and greater production per unit of space in the orchard. The latter is probably due to the fact that the smaller the tree the more surface is exposed to sunlight per unit of tree volume. Thus, more reserve photo-synthate is available for fruit production above that used for tree growth.

In order to make maximum use of these characteristics of the smaller tree, they must be planted as close together in the row as their ultimate size will permit. After the trees fill their allotted space, the orchard will have developed into a hedgerow system well adapted to mechanical pruning.

The fruiting habit of the apple is such that fruiting is principally on spurs that arise from lateral buds on the previous season's terminals. These spurs usually bloom the following spring and generally remain in production for 2 or 3 years before they are shaded out of production by the continuing extension growth (Fig. 1). Thus, the bulk of the crop is normally borne on 3- to 5-year old wood. Annual "opening up" of the tree by thinning out of peripheral branches to let light into the interior spurs may maintain production on these spurs for a greater length of time.

LIGHT EXPOSURE AND PRODUCTION

Annual pruning of the terminal shoots leads to proliferation of new shoots and removes the only source of new spurs. These additional new shoots at the outer periphery of the tree intercept a large

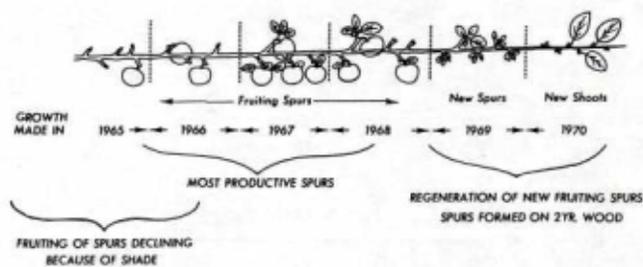


Figure 1—Schematic bearing habit of apple.

amount of sunlight and rob the fruiting spur leaves of their only source of energy—sunlight. Since new spurs can arise only from lateral buds on those new shoots formed the previous year, the pruning system must leave a sufficient number of new shoots each year to insure the continued production of new spurs.

The importance of opening up fruit trees by pruning to let light into the interior of the tree has long been recognized. The light intercepted by terminal shoot leaves is of little value except to grow more shoots and to produce more wood. The light directly concerned with the production of fruit is that falling on the spur leaves in close proximity to the potential flower bud. If these leaves fail to get sunlight, the flower bud is not initiated and the spur cannot bear fruit. Continued shading of spur leaves for 2 or 3 years causes them to die out. This is why the interior of large trees is usually devoid of spurs.

Figure 2 shows the total accumulated quantity of light, expressed as a percentage of that available in the open, at different distances within a hedgerow after 3 years of cutter bar hedging. Over 50

per cent of the light is intercepted by the outer 2 feet of the tree where there are practically no spurs.

Light measurements made with integrating light meters over periods of several weeks during the growing season at different positions within normally pruned trees in 1969-1970 show that at Geneva about 30 per cent of the available light is needed on spur leaves to initiate some flowering (Fig. 3) and that about 50 per cent is needed to maintain flowering on one-half of the spurs, the number estimated necessary to maintain good annual production.

(Ten integration periods of 2 - 5 days each)

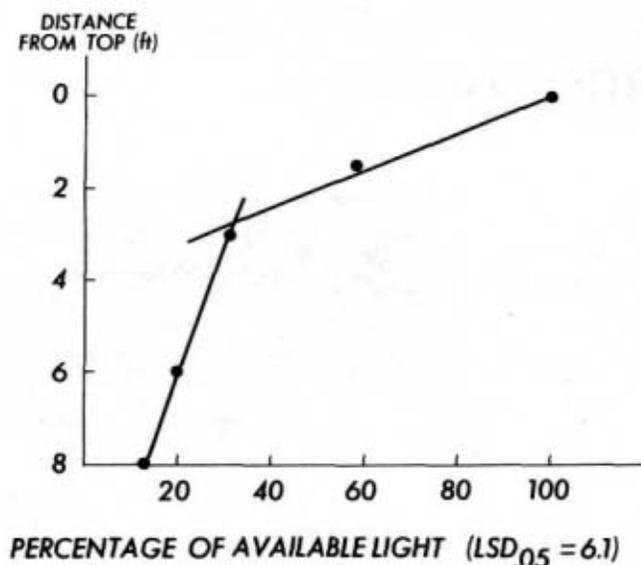


Figure 2—Light gradient within hedged apple trees.

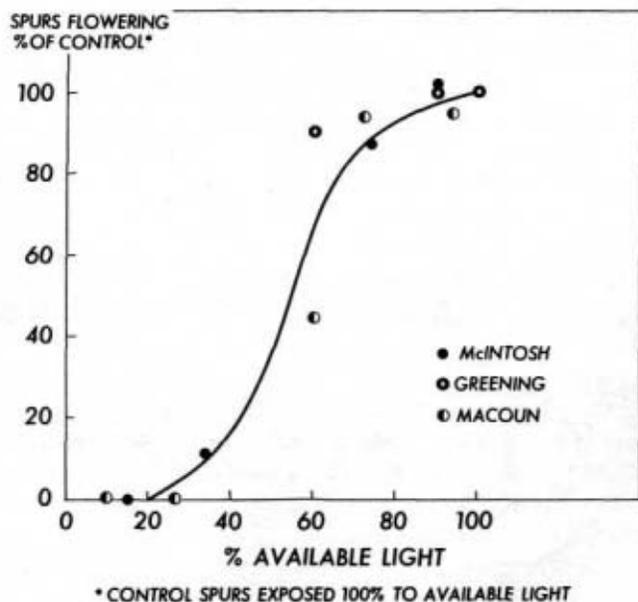


Figure 3—Effect of light on flowering of apple spurs.

Thus, the pruning system should: (a) insure that the maximum number of spurs are exposed to sunlight at least half of the time and (b) provide for the continuous renewal of the spur system. The latter can only be accomplished by permitting some terminals to grow 3 to 4 years without being cut.

SLOT PRUNING MECHANICALLY

The alley space between hedgerows can easily be maintained by annual pruning of the sides of the tree with a cutter bar mounted on a fork lift. However, experience has shown that within a very few years the outer periphery of the tree becomes so dense with new growth that the interior spurs become shaded out and production declines unless considerable hand pruning is done to open up these dense walls.

Experiments were begun at the New York State Agricultural Experiment Station, Geneva, in 1968 with a slotting saw (1) designed to do this essential pruning mechanically. Instead of selectively heading back branches over the entire wall surface into 4- to 5-year old wood, a continuous slot is cut about 2 feet into the side of the tree along the entire length of the row. The following year a similar slot is cut immediately above the previous one. The process is continued for 4 years with no further pruning, and the cycle repeated. The initial slots are about 2 feet wide. Thus, if the side of the hedge is greater than 8 feet high, a second starting slot should be made about 8 feet above the first.

Since only one-fourth of the tree is cut in any one year, the new shoots arising from the pruning cuts are less vigorous. These are permitted to grow 4 years without any further pruning and to develop maximum fruiting potential. The successive slots permit the penetration of light into the tree and maintain good fruiting, good fruit color, and continuous production of new fruiting spurs.

Figure 4 shows the cutter bar pruner that is no longer needed except for initial shaping of the hedgerow at 5 to 6 years of age and occasional topping to limit height.

Figures 5-8 show various aspects of the slotting saw. The saw has been previously described (1), but certain aspects of mounting, guard, and guide have been modified as shown for easier operation. It is normally driven at about 2 mph, and two trips are needed with the 16-inch saw to open 2-foot wide slots.

The 16-inch saw is mounted directly on the output shaft of a hydraulic motor and is powered by a PTO driven auxiliary hydraulic pump with a 5-gallon oil reservoir and pressure relief by-pass to prevent damage if the saw is stalled. The pump is

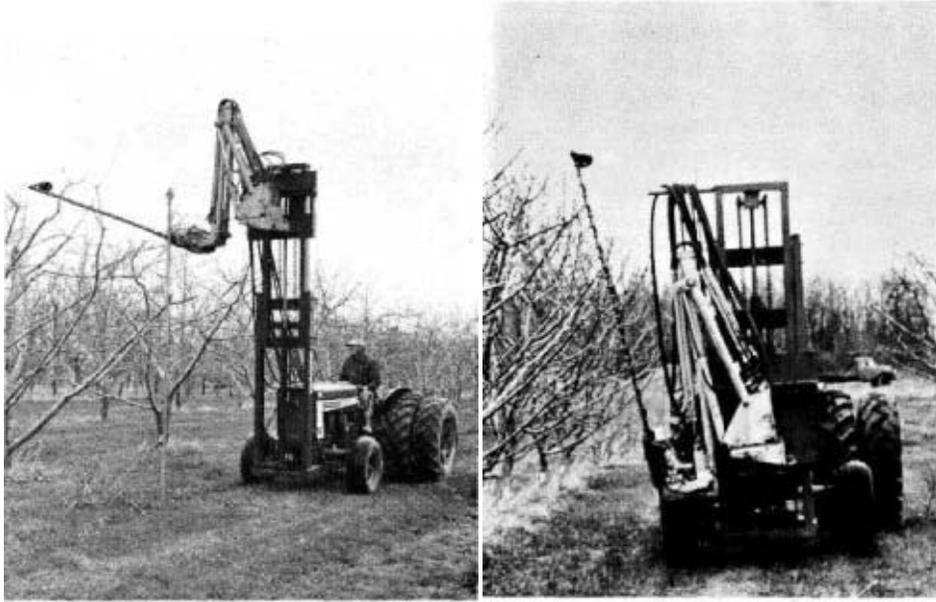


Figure 4— The cutter-bar pruner. Hydraulically operated and mounted on a 10-foot fork lift. The blade may be operated either vertically or horizontally up to a height of 16 feet.

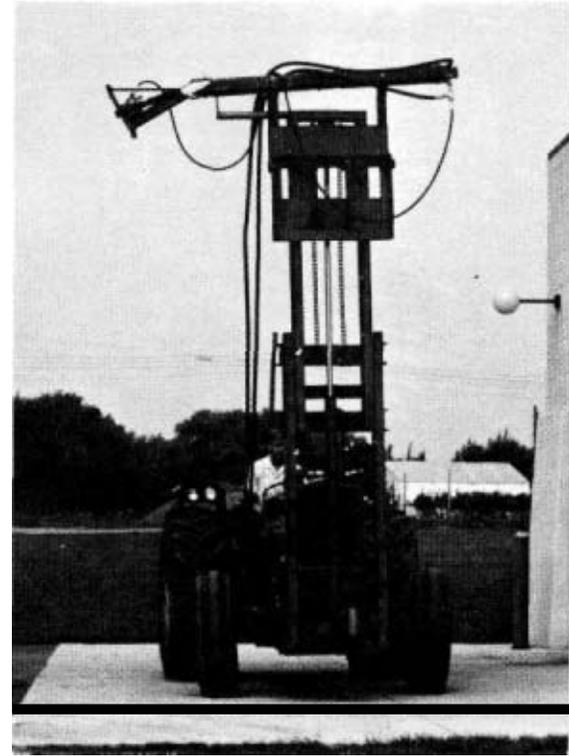
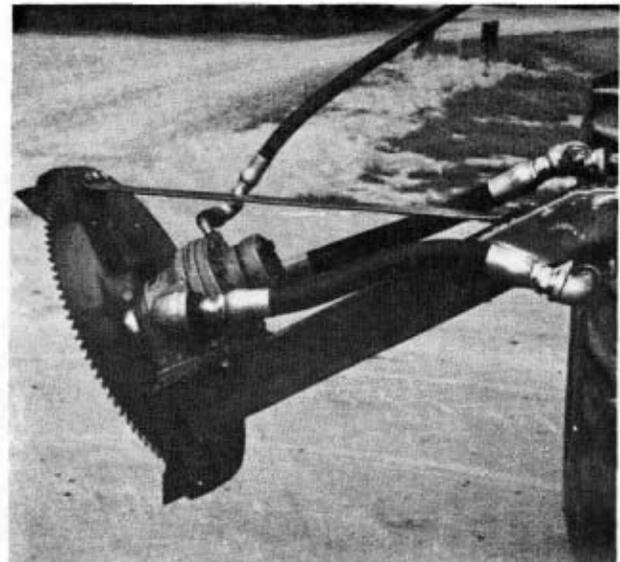
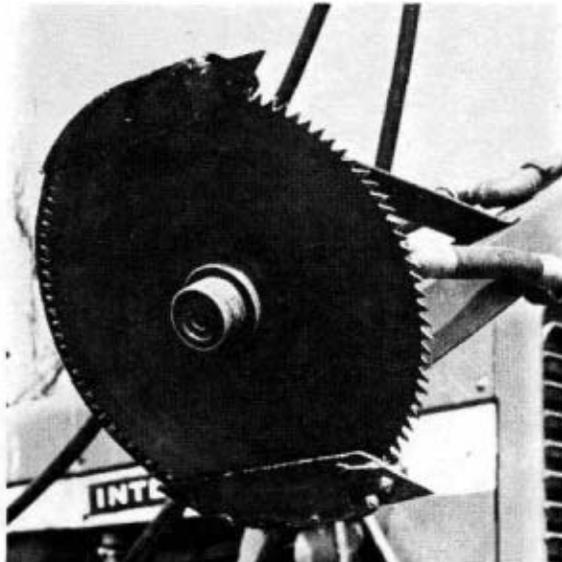
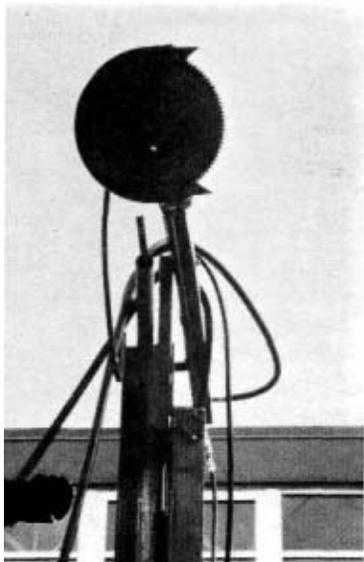


Figure 5—The slotting saw boom mounted on angle iron extension on the fork lift to permit a maximum height of 12 feet. Extension horizontally is by re-mounting the boom in different bolt holes offset from those shown.

Figure 6—The boom is mounted at an angle of about 93° from the direction of travel to prevent cut end stubs from dragging on the side of the saw. Figure 7—Outboard detail of saw showing guides to prevent branches from being partially cut and the cut-away guard to prevent branches from jamming between the guard and saw. Figure 8—Inboard detail of saw showing guard, motor mounting, and the 20° bend in the boom permitting the saw to cut the hedgerow wall at an angle of 20°. This is approximately perpendicular to a maximum number of the branches to be cut and approximately parallel to the natural slope of the side of the trees.



driven by chain and sprocket from the tractor PTO and should be capable of delivering about 15 gal/min at a tractor speed of 1.5 mph.

It is considerably more economical to construct and can be operated at about twice the ground speed as the cutter bar. If used carefully and systematically, as indicated above, it can replace nearly all hand pruning after the hedgerows are established.

RESULTS OF SLOT PRUNING

After 3 years of comparison of the slotting saw with cutter bar pruning of adjacent rows of 'McIntosh' hedgerows 12 feet high, slot-pruned trees had greater light penetration into the tree, about three times as many new spurs, and over six times as many bearing spurs in 1970 (Fig. 6, Table 1). The fruits were well colored, whereas most of the fruit from cutter bar pruned trees were from interior shaded areas and were poorly colored. Production was about 30 per cent greater on slot-pruned trees in 1970, but it is expected that this difference will become greater as the interior spurs on the cutter bar pruned trees continue to decline in productivity with fewer new spurs being formed.

These experiments have been described more completely elsewhere (2).

REFERENCES

1. Cain, John C. and K. E. Ryan. 1969. A slotting saw for mechanical pruning. *Food and Life Sciences Quarterly* 2(3): 9-11.
2. Cain, John C. 1971. Effects of mechanical pruning of apple hedgerows with a slotting saw on light penetration and fruiting. *J. Amer. Soc. Hort. Sci.* 96(5): 664-667.

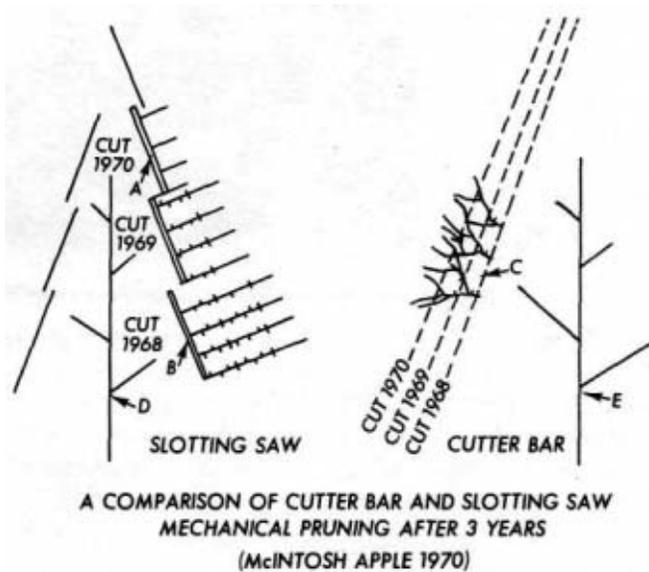


Figure 9—Schematic shows approximate growth status and mechanical pruning schedule with the slotting saw and cutter bar.

Table 1. The effect of mechanical pruning on light penetration and fruiting of 'McIntosh' apple after 3 years.

Location ¹	Slotting saw		Cutter bar		LSD ²
	A	B	C	D-E	
% light	52.9	32.3	21.0	13.7	7.4
Spurs/twig		7.4	2.8		1.2
Spurs flowering		5.9	1.7		1.1
Spurs fruiting		3.1	0.5		0.6
Bu/tree		5.6	4.3		1.2

¹ Refer to Figure 9.

² Least significant difference at 5%.

