The elimination of cultivation in apple orchards: a new approach to orchard soil management

S E. Hardisty
The elimination of cultivation in apple orchards: a new approach to orchard soil management

Cover Page Footnote
Mr. S. T. Smith, Senior Soils Research Officer of the West Australian Department of Agriculture, and members of his staff, installed the soil moisture equipment at Greenbushes and prepared the results of the measurements. Mr. H. Rowan-Robinson of Bridgetown and Mr. N. Lindsay, of Greenbushes, can rightfully claim to be pioneers of this method. The author is particularly grateful to Mr. Lindsay for the opportunity of carrying out the soil moisture trials at Greenbushes.

This article is available in Journal of the Department of Agriculture, Western Australia, Series 4:
IMPORTANT DISCLAIMER

This document has been obtained from DAFWA's research library website (researchlibrary.agric.wa.gov.au) which hosts DAFWA's archival research publications. Although reasonable care was taken to make the information in the document accurate at the time it was first published, DAFWA does not make any representations or warranties about its accuracy, reliability, currency, completeness or suitability for any particular purpose. It may be out of date, inaccurate or misleading or conflict with current laws, polices or practices. DAFWA has not reviewed or revised the information before making the document available from its research library website. Before using the information, you should carefully evaluate its accuracy, currency, completeness and relevance for your purposes. We recommend you also search for more recent information on DAFWA's research library website, DAFWA's main website (https://www.agric.wa.gov.au) and other appropriate websites and sources.

Information in, or referred to in, documents on DAFWA's research library website is not tailored to the circumstances of individual farms, people or businesses, and does not constitute legal, business, scientific, agricultural or farm management advice. We recommend before making any significant decisions, you obtain advice from appropriate professionals who have taken into account your individual circumstances and objectives.

The Chief Executive Officer of the Department of Agriculture and Food and the State of Western Australia and their employees and agents (collectively and individually referred to below as DAFWA) accept no liability whatsoever, by reason of negligence or otherwise, arising from any use or release of information in, or referred to in, this document, or any error, inaccuracy or omission in the information.
THE ELIMINATION OF CULTIVATION IN APPLE ORCHARDS
—A NEW APPROACH TO ORCHARD SOIL MANAGEMENT

By S. E. HARDISTY, B.Sc. (Agric.), Horticultural Adviser, Bridgetown

THE idea of eliminating cultivation in orchards suggests a reversal of accepted local practice in orchard soil management—but there is plenty of evidence to show that a non-cultivation system has much in its favour.

In this article the advantages and disadvantages of the three main forms of orchard soil management are discussed and experimental evidence is presented in support of non-cultivation.

An alternative method, "winter sod" culture, is proposed for irrigated orchards.

The three main forms of soil management are (i) mulching, (ii) sod culture, (iii) clean cultivation. In many apple growing areas in the world the systems are preferred in the above order.

Sawdust Mulching

Hardwood sawdust has been used on large areas in both an irrigated and a non-irrigated orchard in the South-West of Western Australia. The benefits of sawdust mulch follow from maintaining a high level of soil moisture and from an unrestricted development of apple roots in the topsoil under the mulch. At least 700 cubic yards of sawdust are needed for an acre of orchard so that availability and transport costs restrict its use.

While the evidence is in favour of mulching as a form of soil management the practical difficulties in obtaining an efficient mulching material have limited the commercial use of this system.

Mowing or Sod Culture

Sod culture is a system of regular mowing of the grasses and clover growing normally in the orchard. Where plentiful irrigation supplies are available the perennial New Zealand white clover has been used in a few local orchards.

A variation of this system developed locally relies on subterranean clover growing only in the winter-early summer period. This system, which will be discussed in detail, is referred to as "winter sod."

CLEAN CULTIVATION

Clean cultivation is the standard means of soil management in West Australian orchards. This aims at destroying with a disc cultivator or rotary hoe the winter cover crop and subsequent summer weeds. Thus competition for available soil moisture and soil nutrients between the tree roots and the roots of the ground cover is eliminated early in the growing season. The loss of soil moisture by evaporation is reduced in some soils by the production of a fine surface tilth after proper cultivation. Furthermore the breakdown of the cover crop in the soil gives a short term increase in fertility early in the season.

However there are many problems associated with clean cultivation. Clean cultivation aims at weed free, finely worked orchard soil conditions from blossoming to fruit harvest. These conditions are not generally achieved on hillside orchards in the South-West. Too often this ends up as "partial cultivation" having the disadvantages of both the cultivation and mowing systems.

The disadvantages of cultivation are:

Loss of Soil Structure

Continued cultivation affects the soil physically by destroying soil structure
Now! 1 Pump does 2 jobs!

BLASTS FIRES
FILLS TANKS

125 P.S.I.*
WITH 3/16" NOZZLE!
6,600 G.P.H.
WITH 5ft. SUCTION!

Now! 1 Pump does 2 jobs!

FIRE QUENCHER!

Here now is the perfect firefighting combination! The South Pacific FIRE QUENCHER gives you all the pressure you need to blast tree-top fires and fog spray ground fires . . . plus a handy high volume output for other jobs such as tank filling and de-watering.

2 STAGES, with twin impellers placed back-to-back give greater efficiency, guarantee a smoother-running pump.

SELF PRIMING and completely trouble free. Most dependable pump you'll ever own.

DIRTY WATER is no problem. Handles mud and grit better than any other firefighter.

The South Pacific Fire Quencher is approved by firefighting authorities. We'll gladly demonstrate its unmatched performance.

MAIL COUPON FOR FULL INFORMATION

WESFARMERS TUTT BRYANT PTY. LTD.
Railway Avenue, Bassendean, W.A.

Please send me, without obligation, more information on the "FIRE QUENCHER"

NAME
ADDRESS

We are also W.A. Distributors of REX SELF PRIMING PUMPS—Australia's best-selling, most complete pump range.

WESFARMERS TUTT BRYANT PTY. LTD.
RAILWAY AVENUE, BASSENDEAN, W.A.
TELEPHONE 79 1616

Please mention the "Journal of Agriculture of W.A." when writing to advertisers.
and by developing a plough sole. Irrigation problems are intensified on hillside orchards which have been affected by soil erosion and by loss of soil structure because it then becomes difficult to obtain sufficient penetration of the applied water without excessive run-off.

Repeated soil disturbance by implements exposes the top soil to heat and air and most of the soil organic matter—that is, the built-up soil fertility—is lost to the atmosphere. The destruction of soil organic matter is cumulative over the years.

That the organic matter in the soil is depleted is also shown by the poor stands of volunteer cover growth during winter.

Excessive dust in the summer and water-logged orchard soils in winter, too wet to work until late spring, are other undesirable results of cultivation.

**Soil Erosion**

Sudden heavy falls of rain on cultivated hillside orchards in summer or in early autumn cause soil erosion in almost every season. In the life of an orchard considerable gullying and sheet erosion occurs and the lowering of the orchard soil surface exposes the tree roots to further damage by cultivation equipment.

**Consequent Apple Dieback**

Destruction of tree roots in over-cultivated orchard soils is thought to be an important cause of dieback in apple trees. The severing of main roots by offset discs working close to the tree is all too common. Field surveys have repeatedly shown that dieback is closely associated with root damage.

**Summer Weed Control**

Following irrigation or summer rain repeated cultivation is required for control of summer weeds such as fat hen and crab grass. The positioning of tree props in mid-summer stops cultivation and allows unrestricted growth of weeds on the loose soil surface. These seed-bed conditions are not produced with mowing and weed growth in the mid to late summer period is less vigorous with mowing than with partial cultivation.

**MOWING OR “WINTER SOD”**

As a result of trials and demonstrations over several seasons a system of regular mowing of a sub. clover sward through the late winter and early summer period has been evolved. For convenience this method of soil management is called the “winter-sod” system.
Certain advantages of this system have already been referred to indirectly. They are:
- Improvement of soil structure.
- Elimination of soil erosion.
- Prevention of a major cause of dieback (root damage).
- Better weed control in late summer.

Other advantages are:
- Increased soil fertility.
- Even, firm surface.

**Increased Soil Fertility**

The improvement of soil fertility by dominant clover swards is well known. It is more evident in second and subsequent seasons of operations in apple orchards than in the first season when supplementary nitrogen fertilisers are recommended.

It has been established that a clover sward benefits new land at the rate of 100 lb. of nitrogen—equivalent to 5 cwt. of sulphate of ammonia—per acre in the first year. As organic matter and associated fertility in the soil is built up from decaying plant material there is of course a much slower rate of nitrogen accumulation in the soil. Early in the first season of non-cultivation in an orchard the apple tree requires additional nitrogen as it competes with the new sward. In subsequent seasons the tree benefits from the increased fertility and becomes adjusted to the new system. Fertiliser requirements are lower under long established winter sod.

Once the winter sod is established the feeder roots of the trees explore the topsoil, which becomes much darker in colour, with improved texture. Whereas continued cultivation and soil erosion had depleted the organic matter content of many orchard soils in Bridgetown, sections under mowing have shown dramatic increases in soil organic matter.

**Even, Firm Surface**

The rough terraced soil surface resulting from continued cultivation impedes efficient spraying, thinning, and picking operations. An even, firm surface resulting from mowing is more pleasant to work on and this is proving an important factor in its favour. Growers like it and as there are no harmful effects it is possible that much of the popularity of soil management system arises from this personal preference.

**Which Type of Sub. Clover**

The strain of subterranean clover used does not seem to be important, although Yarloop has given the best results in the Bridgetown-Manjimup area. Dominant stands of Dwalganup, Geraldton, Mt. Barker and Tallarook have all been maintained in various local orchards.

The vegetative growth of a clover plant is reduced after it has flowered and set seed. For the purpose of this soil management system, clovers which finish active growth early are to be preferred. Because of the good bulk of winter growth obtained with the moderately early flowering Yarloop strain, this has been the most commonly used variety. It is possible that the earlier flowering Geraldton strain could be quite useful, but Yarloop is preferred.

A change from cultivation to mowing has produced in many instances a dominant sward of Mt. Barker sub. clover without deliberate sowing or preparation in the autumn.

Where irrigation facilities are adequate Mt. Barker and Tallarook have been successfully used. These late-growing clovers leave a denser thatch of dried plant material on the surface and a fairly effective mulching is achieved. This appeals to many growers.

However because of the added fire risk and longer active growth of the later-maturing varieties the recommendation for early maturing varieties still stands.

**What are the Disadvantages of Winter Sod?**

Not all the features of orchard husbandry associated with the winter sod system are favourable when compared with those of clean cultivation, although the case for winter sod is supported in most circumstances, provided irrigation is available.
Fire Risk

Repeated close mowing carried out when growth of the sward is succulent reduces the bulk of the dead grass cover on the soil. When dry this organic material is not a severe fire hazard. Orchardists who have used this system are satisfied that reasonable safety exists with adequate precautions such as fire breaks.

Growth of Couch Grass

When couch is present in eroded orchards rarely is it adequately controlled with cultivation. The growth of couch is favoured under mowing, although, being cut short, it never grows rank. There are indications that with sub. clover and irrigation, couch is not very detrimental to the health of the apple trees.

The application of herbicide, usually an amitrol/atrazine mixture, around the butts of the trees, is particularly useful in reducing the growth not reached by the mower, and produces bare soil conditions under the trees.

Less Soil Moisture in the Orchard

Winter sod is only successful where adequate irrigation can be provided. However, because the ground cover in mown orchards dries off from mid November onwards, so long as the reserve of soil moisture can be built up at this stage moisture requirements during the rest of the growing period are similar to those under clean cultivation.

Is Mowing Practical in Non-irrigated Orchards?

Severe soil erosion on a non-irrigated cultivated orchard in Bridgetown led to a trial mowing of a few sections of the orchard. Vigorous ten-year-old trees were severely stressed for moisture during the growing season under these conditions; older trees with less vigour were not so severely stressed. This confirmed that unless soil moisture can be replenished with irrigation, cultivation is preferable.

Effect on Fruit Colour

Over the past decade at least 75 per cent. of new plantings have been of the Granny Smith variety.

Western Australian fruit-growers are more concerned with maintaining the green colour in Granny Smiths than increasing the red colour in red varieties, although they would no doubt like to control both. Field observations have shown that good colour in red varieties is usually associated with poorer colour of adjoining Granny Smiths.

However, colour in red varieties has not been adversely affected with mowing except where excessive quantities of nitrogen have been given. On many orchards growers have obtained better colour in red fruit with mowing.
The revolving of the seasons has brought us once more to the time for seeding. It's autumn seeding time, and Elders-GM have a full range of pasture seeds for all districts. Wherever you farm and whatever the quality of your soil, Elders-GM have a seed for every soil. Quality is important when you're buying seeds, that's why Elders-GM seeds are either Government certified or Government tested approved. This guarantees seeds with purity, strain and the highest germination possible. Elders-GM are also marketers of lime pelleting and inoculating materials. If you want thorough technical advice regarding pasture improvement, contact Elders-GM.

For successful seeding this season buy from Elders-GM the "Seed House of the West".

Please mention the "Journal of Agriculture of W.A." when writing to advertisers.
Summer Growing Clovers for the Orchard Sward

In some favoured areas with permanent irrigation installations and plentiful water resources New Zealand white clover has been established. This is a satisfactory alternative to the winter sod where sufficient irrigation is available.

SOIL MOISTURE UNDER DIFFERENT SYSTEMS OF ORCHARD SOIL MANAGEMENT

The graph in Fig. 1 shows the moisture relations under the three different systems of soil management. These findings were obtained at Greenbushes in the 1961-62 season, which was an extremely dry growing season.

The reaction to applied irrigation is obvious and the action of the sawdust mulch in conserving soil moisture is well illustrated. However, the main interest is that in spring the ground under mown sward dried out slightly quicker than under cultivation but once both sections were dry then the reaction to applied irrigation was practically identical. This was supported by measurements at the 5 in. 18 in. and 30 in. depth as well as the 9 in. depth shown.

1962-63 was a much wetter year, in which 4 inches of rain were received during November-January compared with 87 points for the corresponding period in 1961-62. More water was also available for irrigation. Figure 2 shows that the soil moisture relations behaved in the same general pattern as in 1961-62.

STEPS TO BE TAKEN TO ESTABLISH THE WINTER SOD SYSTEM

- The orchard soil surface should be carefully levelled by grader blade in the autumn to enable close mowing with less wear on the mower. Two railway sleepers bolted together to form a V and trailed behind a tractor are satisfactory.

- Cultivation should be continued until the young apple trees are well established. The winter sod can be established in the 4th or 5th year.

- Sow Yarloop sub clover at 10 lb. per acre on clean ground, then give a light discing. The soil surface should be consolidated by a light rolling or by dragging a sapling behind the tractor.

- Apply a bag of superphosphate per acre with the clover seed. Molybdenum has been found helpful for clover establishment in some old orchard soils. In view of the small areas, little extra expense is involved in using a combined molybdenum, copper and zinc superphosphate mixture.

- The mower should be of sturdy construction and at least partially offset for mowing under the trees. Slasher types have proved very satisfactory.

- A light mowing is required in late winter to suppress grasses. After this, frequent close mowing is
desirable. Because the mowings are succulent they dry out with little bulk and do not constitute a severe fire risk.

- The winter annuals finish off by mid-November and as the soil surface is not disturbed summer growing annual weeds do not usually flourish.

- Nitrogenous fertilisers are necessary at least in the first season of operations.

- Supplementary irrigation is essential but as little as 5 inches of available irrigation has been successfully used with this system.

### Frequency of Mowing

Frequency of mowing will depend on the season and the personal preference of the orchardist. The first mowing should be mid-winter or at least no later than mid-August, to encourage the clover. The mowings should continue through until early December, when the orchard sward is dying out and propping is beginning to interfere. This means in practice that from five to nine separate mowings are usually made. The mowing could be made along one way only, alternating the direction on each occasion.

It is not a short cut method because, as with all orchard operations, success depends upon the thoroughness of application.

### SUMMARY

The winter sod method is now fairly well established in many South-West orchards and the good results obtained indicate that there is no reason why the system should not be extended, provided orchardists have enough water to meet the minimum irrigation requirements.

### ACKNOWLEDGMENTS

Mr. S. T. Smith, Senior Soils Research Officer of the West Australian Department of Agriculture, and members of his staff, installed the soil moisture equipment at Greenbushes and prepared the results of the measurements.

Mr. H. Rowan-Robinson of Bridgetown and Mr. N. Lindsay, of Greenbushes, can rightfully claim to be pioneers of this method. The author is particularly grateful to Mr. Lindsay for the opportunity of carrying out the soil moisture trials at Greenbushes.
GET YOUR CROP OFF TO A GOOD START

by following these Department of Agriculture recommendations.

○ Sow only recommended varieties.
○ Use clean seed true to type and free of weed seeds.
○ Grade and pickle all seeds.
○ Obtain good weed control.
○ Use a plough for the initial cultivation.
○ Use adequate fertilisers—does the paddock need trace elements or nitrogen?

Department of Agriculture district advisers will be pleased to help with specific recommendations for your area.