Light lands in Western Australia. 1. History and future prospects

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BECAUSE of the scattered distribution of light lands of the agricultural areas of Western Australia among the better soils, and their large total area, it is not surprising that attempts to develop these unattractive soils for agriculture started many years ago.

In 1921 a conference was held in Perth to discuss methods of utilising the large tracts of light land intermingled with the heavier soils on which development had been concentrated. It was recorded in the conference report that there were about eight million acres of light land alienated for settlement, all in districts of good rainfall and much of it near railways.

Low Soil Fertility

The low inherent fertility of these sandplain soils was recognised, and the conference agreed that crop rotations, fertiliser usage and animal husbandry practices would have to be developed to build up the fertility of these soils if a successful and permanent agriculture was to be established.

None of the delegates, either farmer or scientist, was able to put forward any firm plan which could result in a successful agriculture on these lands.

Many delegates referred to the fertility-building capacity of legumes but none could point out a single case of success with any particular species, or describe how to go about growing that plant on a field scale. Cultivation methods for cereals, fallowing procedure, times of seeding,
Heavy applications of superphosphate are required to establish subterranean clover on new sandplain country. The clover will persist only where soil phosphate reserves are adequate for its requirements. The plot on the right received dressings of 168 lb. per acre in each of the two previous seasons.

varieties and so on were discussed at length—with wide and often conflicting points of view and experience by farmers. Some claimed fair success but many had failed or had only achieved a low level of production.

The usual experience was that light land would produce a profitable crop (usually wheat) in the first or second year, with fallow. In later years yields tended to decrease and the land failed to respond to applications of superphosphate either to sown crops or as pasture topdressing.

WONGAN HILLS RESEARCH STATION

An outcome of the conference was the establishment in 1924 of the Department of Agriculture's Light Lands Experimental Farm at Wongan Hills, in a 14-inch rainfall district.

Cereals

The first crop—sown on fallow—was grown in 1925, and returned a wheat yield of 16.9 bushels an acre.

From then on for almost the next 20 years our experience was the same as that of farmers. The first two or three crops after clearing—all sown on fallow—produced reasonably satisfactory yields of from about 12 to 17 or 18 bushels an acre, depending mainly on seasonal conditions. The best crops were usually grown in seasons of moderate winter rainfall, in say June and July. When the rains were too heavy crops were poor, probably because of water logging and leaching of the limited supplies of available nitrogen.

From then on cereal yields gradually declined. Stock carrying capacity was low—and the flocks required hand feeding in summer and autumn.

Cropping Difficulty

Erosion by both wind and water developed as a major problem. Because the level of soil organic matter declined under the fallow-cropping system, with little build-up in the two volunteer pasture years, boggy and difficult seeding conditions were common. In some cases it became impossible to complete the cropping programme.

From this beginning at Wongan Hills an intensive programme of experimentation was pursued. Dr. Teakle (now Professor of Agriculture at Brisbane) took a leading part in planning and organising the early work.

Superphosphate

Hundreds of experiments were carried out. These showed the importance of
superphosphate, applied at the rate of between 120 lb. and 150 lb. per acre, for economic cereal crops, and made it possible to recommend the best varieties of cereals for different times of sowing with reasonable confidence.

Under the conditions at this station fallow was shown to raise yields by 50 per cent.

Potash was shown to have no effect on yields, but 56 lb. of sulphate of ammonia per acre increased yields by about three bushels an acre.

Legumes

From the beginning it was obvious that a legume-based rotation was essential for the development of a sound agriculture on these sandy soils. Many species were tested with little success. Among these were several lucernes, about 50 lupin varieties, numerous clovers and a number of medics.

Not until 1945 was it shown that a productive legume pasture could be grown at this station.

It is safe to say that until then there was not a single successful light land farm in Western Australia. Nobody was at all confident of developing a sound, prosperous agriculture on the light lateritic soils of the State.

As late as 1938 a Parliamentary Select Committee appointed to enquire into the light land problem was not enthusiastic about the potential of light lands in Western Australia, especially those with 20 inches or less annual rainfall.

It was concluded that light land could not be farmed economically on its own, and should be developed only in association with better quality holdings.

This Committee estimated that there were about 12 million acres of light land still unalienated within 25 miles of existing railways.

DWALGANUP SUBTERRANEAN CLOVER

The discovery and commercial production of Dwalganup subterranean clover by the late P. D. Forrest completely changed the picture.

This early maturing variety of subterranean clover was discovered in the late 1920's and the first experimental plantings at Wongan Hills were made in 1935. But it was not until 10 years later that the problems of establishment were overcome. We were encouraged over these years by the fact that this variety produced some seed and so persisted even in almost drought years, such as 1940.

An important phase of the work in preparing sand plain country is a proper burn. This area near Esperance has been well burnt. Note the good firebreak.
In terms of total growth the early sowings were disappointing. It was not until the importance of heavy dressings of superphosphate was demonstrated and techniques were evolved for eliminating competition from weeds—such as cape-weed—that a heavy stand of clover pasture was produced.

The introduction of this combination of Dwalganup subterranean clover and adequate superphosphate was the first breakthrough in the development of the sandplain soils of Western Australia.

In 1946—after three or four successful experimental sowings—a major improvement programme was started at Wongan Hills Research Station, with the sowing of about 600 acres of Dwalganup subterranean clover. Over the next 10 years the whole of the farm was progressively sown with this plant.

Clover Ley Farming
A ley system of farming—without fallow—was started in 1951. Since then cereal yields have increased by 50 per cent.

In the pre-clover days wheat crops averaged 14.2 bushels an acre; under the clover ley system yields have risen to 22 bushels. Sheep stocking rates have doubled, from about one sheep to three acres to two sheep to three acres.

During the same period similar improvements in production were being achieved on the sandy surfaced jam and york-gum soils of the 16 to 20-inch rainfall belt.

The importance of the Wongan Hills work, however, lay in the fact that Dwalganup subterranean clover was successfully established in a 14-inch rainfall area, giving some idea of the possibilities for the improvement of several millions of acres of sandplain country with similar rainfall.

The results obtained at this station provided a stimulus, on the technical side, to the large sandplain development which has occurred in the cereal and sheep districts since the war.

POST-WAR DEVELOPMENT
With this background further sandplain research stations were later established at Esperance (1949), Newdegate (1955) and Badgingarra (1959) while major experimental work was carried out at Merredin, Eneabba, Gairdner River and Jerramungup. Many smaller experiments were carried out on dozens of farmers' holdings.

This programme was largely on virgin sandplain.

War Service Land Settlement
The experimental areas were widespread and the results were encouraging and often spectacular.

They made possible the War Service Land Settlement projects and an enormous increase in private land settlement ventures—resulting in the area of cleared land rising from about 14 million acres in 1945 to about 25 million in 1961. New land clearings are still continuing at about this rate.

TRACE ELEMENTS
The experiments on newly developed sandplain quickly demonstrated the importance of trace elements, particularly copper and zinc. As a result, copper-zinc superphosphate became the standard recommended fertiliser for the new sandplain.

Sub. clover and oats are both very susceptible to zinc deficiency, while wheat and to a slightly lesser extent, barley, are worse affected on copper-deficient soils. Low copper status of the soil can be reflected in the wool produced even when it is not possible to demonstrate increased plant growth from copper-containing fertilisers.

Some sandplain soils are marginal or only slightly deficient in copper and zinc, while others are acutely so. Spectacular responses in plant growth are made when these acute deficiencies are corrected.

The use of copper and zinc-containing fertilisers has made possible the successful and profitable development of large areas of new land in this State. The recognition of the need for these two elements was just as important as the earlier demonstrations of the value of Dwalganup sub. clover, the techniques for establishment and the need for adequate superphosphate. Since the war some seven million acres—nearly a third of the State's cleared land—has been fertilised with one or both of these elements.
PASTURE ESTABLISHMENT

Many other findings made it possible to work out a plan of light land development and pasture establishment which has enabled the War Service Land Settlement Authority and private farmers to go ahead with confidence and a minimum risk of failure.

One of the first major advances in clover establishment was the development of suitable techniques to reduce plant competition in the establishment years.

The usual practice in the higher rainfall districts was to sow from two to four pounds of clover seed with the cereal crop, but this proved quite unsatisfactory at Wongan Hills. Sowings on fallowed (old land) were equally unsuccessful because of weed competition, particularly from cape-weed.

Finally the procedure of sowing the clover on stubble land with a disc harrow-disc drill combination was worked out. This almost always gave good establishment in the first year, with first-class stands of clover in the second or third years.

Sowing Rate

At Esperance, it was shown that pasture grasses should be sown at low seeding rates to reduce competition with the clover, so that a reasonable stand may be achieved in the second or third year. Many farmers now sow as little as ½ oz. of Wimmera rye grass with from 6 to 8 lb. of sub. clover an acre on new land in the southern districts.

Scrub Residue

Another major finding at Esperance was that good land preparation is essential for clover establishment on new land.

It was shown that as much as possible of the scrub residue should be eliminated before the clover seed is sown. This is usually best achieved by rolling and burning the scrub, ploughing and leaving the land as bare fallow for eight or nine months, with further ploughing and disc cultivating to prepare a good seed bed.

If too much scrub residue remains clover nodulation is often poor, presumably because native soil microbes “antagonise” the rhizobial root-nodule bacteria. This is further accentuated by the absence of fallow and inadequate seedbed preparation.

The Place of Crops in Development

In the southern areas, rapid establishment of a good stand of pasture for early grazing was originally the main aim of land development, but the use of cereal crops early in the process of development of light land has now become standard practice in most districts.

From the practical aspect, this has a number of advantages:

- It brings in some revenue in the developmental years, which would not be the case if stock grazing was the initial intention.
- It allows better seedbed preparation for the clover with the destruction of the harsh native vegetation.
Native poison plants can be largely eliminated by the additional cultivations and stubble burnings.

The phosphate status of the soil can be improved through the residues remaining from fertiliser applied with the cereal crops, and cultivation ensures a better distribution of the phosphate throughout the soil—a factor of some importance in clover establishment.

**ECONOMIC CLIMATE**

It was fortunate that an understanding of the requirements for successful development of sandplain was achieved when the economic climate was ideal. The post war booms in wool and to a lesser extent cereals, jointly exercised a big effect in the sheep and wheat areas of Western Australia. Income tax rebates were responsible for much investment in the improvement of land for agriculture.

Farmers throughout the State are continuing light land development with energy and confidence. In the Esperance area, despite the failure of the Chase Syndicate, the development programme is being continued by another company on a much sounder basis, with every prospect of success. It should be remembered that this is a commercial venture which is expected to be a financial success yielding profits to the company.

There are sound reasons to anticipate that light land development will continue at its present rate for several years and finally until all suitable types have been turned to agriculture.

Light land development has been successful in Western Australia because of a whole range of technical advances through the efforts of numbers of scientific workers. But it is not suggested that all the problems for the final development of these lands to their maximum potential have been solved.

**PROBLEMS FOR THE FUTURE**

Some of the problems for future research and study are:

- The development by breeding and selection of earlier and better legumes for the rainfall areas below 14 inches.
- The production of varieties low in oestrogen content to eliminate the sheep infertility problem of sub. clover dominant pastures.
- The development of better grasses for more balanced pastures.
- Soil, plant and animal mineral studies for the correction of present deficiencies or those which must be expected to occur in the future.

The long term requirements for phosphate will require continuing study. Many problems of diseases and pests of plants and animals will arise in future years on these newly developed lands, requiring research by plant pathologists and veterinarians.

**The Deep Sands**

The problems of the development of the poorer types of sandplain—the deep leached sands—are far from solved. Perhaps they may never be, and we will have to recognise that some of these soils have no agricultural potential. However, they still offer a challenge to the scientist.

**Management**

From the long term point of view, economic production from these light soils will require the development of a rotation for each particular region. This will involve investigation of the frequency of cropping, the place of the different cereals, alternative crops, the type of animal production and so on, coupled with efficiency of farm management in all its aspects. These are major considerations for study in the coming years.

Grey sand overlying gravel is a common profile on sand plain. The better types have some clay in the subsoil. Where the soil is a leached white sand, and there is no evidence of clay within two feet of the surface, the land may not be worth the cost of developing...
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