Diesel fuel from the farm?

In many countries scientists and engineers are developing renewable fuels to replace petroleum products. The most promising candidate for diesel engines is vegetable oil.

A major CSIRO research project is investigating how Australia can most effectively produce significant quantities of distillate substitute from oilseed crops.

The prospect of pouring sunflower oil into engine tanks is certainly attractive. Diesel fuels make up 16% of the petroleum-based fuels used in Australia and, like all such fuels, their price has risen rapidly (92% in the last 2 years).

A local substitute would help ensure regular supplies and — less urgently but no less importantly — help equip us to meet the eventual depletion of the world's reserves of liquid fossil fuels.

These considerations prompted a group of CSIRO scientists to make a detailed appraisal of oilseeds as a possible substitute. The scientists emphasize that they do not expect vegetable oils or any other single 'alternative' fuel necessarily to be the most suitable for all parts of Australia, and they predict that vegetable oils will be used to 'extend' distillate — that is, in blends with distillate rather than on their own — at least for the time being.

Nonetheless, the team is sufficiently enthusiastic about the prospect of growing 'fuel crops' to have advocated an intensive program of research and evaluation that could make a dramatic impact on Australia's agricultural economy within the next decade.

Last September CSIRO adopted the program, calling it Project Crop-fuel. It involves research by several CSIRO Divisions and collaboration with universities, State Departments of Agriculture, industry, and farmers. Over the 5 years initially planned for the project, some scientists will be doing basic research — for example, into plant breeding — while others evaluate aspects of the 'oilseed economy' on farms.

The scientists who carried out the preliminary appraisal were Mr Alan Stewart and Mr Bill Rawlins, of the Division of Chemical Technology, Dr Graeme Quick of the Division of Mechanical Engineering, and Dr John Begg and Dr Jim Peacock, of the Division of Plant Industry.

They calculated that oilseeds could supply enough fuel to reduce the nation's distillate consumption by about 20% within 5 years. What's more, new agricultural technologies could, they argue, increase oilseed production to such an extent that Australia could eventually meet half its current diesel demand from crops without any drop in food production.

Three main species

Mr Stewart and his colleagues concentrated their attention on three crop species — sunflower, linseed, and rape — because the seeds are rich in oil and the plants can be grown widely in Australia. All three crops are relatively new to the country; linseed was introduced here in 1947 and the other two species in the late 1960s. Rapeseed produces an edible oil, and linseed oil finds industrial applications. Sunflower oil is used both as a food and in industry.

The prospect of pouring sunflower oil into engine tanks is certainly attractive.

To replace or extend diesel fuel with vegetable oils would be a major undertaking, affecting the lives and jobs of a great many Australians. In their appraisal the scientists considered the following questions:

- Do vegetable oils work in engines?
- How much would these oils cost?
- What about the 'energy budget'? How much more energy would we get out of the oils than we would expend obtaining them?
- Can Australia grow enough oilseeds to make an impact?
- What research must we do to be confident of our answers to these questions?

Oilseeds have not thrust themselves suddenly into engineers' minds. As long ago as 1928 a Frenchman named Gautier published the results of his experiments using oils from soybean and other plants as fuels.

Just before and during World War II, scientists in England, several British colonies, and the Far East ran test vehicles on such fuels as peanut, cottonseed, soybean, and palm oils. However, when diesel fuel became more readily available after the war it was far cheaper, and the experiments were abandoned. In all, oils from at least 30 crop species have been tried in engines, but generally in short-term tests.

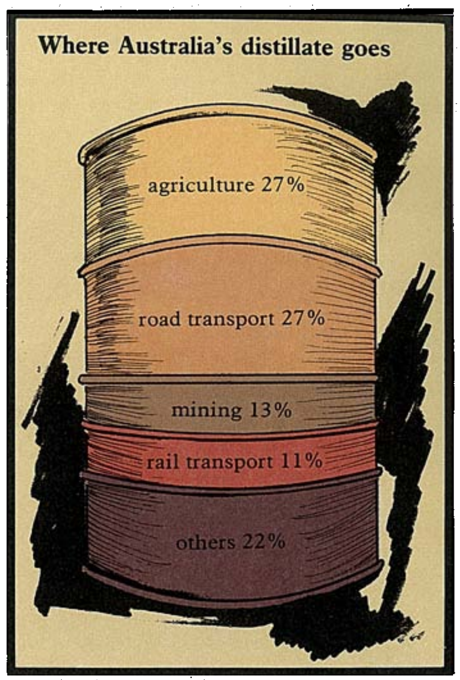
The jumps in OPEC oil prices, beginning in 1973, stimulated renewed interest in plant oils. Some of the more extensive Australian trials have been carried out by Professor James Ward and Mr Des Galloway, at James Cook University, using peanut and other oils, by the Western Australian State Electricity Commission with rapeseed oil, by Mr Gabriel Stecher of Footscray Institute of Technology using sunflower oil, and by Dr Graeme Quick of the CSIRO Division of Mechanical Engineering with oils from sunflower, safflower, rapeseed, and linseed.

Engine power, torque, and efficiency have matched or come close to performance with distillate.

Some research has been done in the United States of America. For example, Ohio State University has successfully run a school bus on a blend of four parts distillate to one part soybean cooking oil recycled from the school canteen. The most comprehensive overseas work so far seems to be the sunflower program in South Africa, where diesel fuel has been scarce and the government is keen to reduce the country's dependence on imported oil.

On the whole, diesel engines perform with vegetable oils much as they do with distillate, and to the casual observer the only difference is an aroma of cooking oil instead of the pungent fumes of diesel. Engines consume about 10% more fuel by volume when they run on vegetable oils, largely because these oils have a lower heat value. To date, short-term tests have been conducted on engines tuned for distillate, and engine power, torque, and efficiency have matched or come close to performance with distillate.

The three oilseed species considered in the CSIRO study: linseed, sunflower, and rape.



Viscosity problems

The most daunting feature of vegetable oils is their high viscosity, or 'treacliness', which makes them more reluctant to flow than distillate. At 20°C sunflower oil is more than 12 times as viscous as diesel oil. As they are warmed, both diesel and vegetable oils become thinner, but even at 80°C sunflower oil has more than six times the viscosity of diesel fuel.

This high viscosity leads to several problems in engines, including starting difficulties, although another reason for these may be the much higher flash point of vegetable oil (about 320°C, in contrast to 55°C for diesel). The starting problem can be overcome using devices already available, such as glow plugs and fuel heaters.

Alternatively, the problem can be avoided by starting the engine on diesel fuel and switching to vegetable oil when the motor is warm. In South Africa a Mercedes Benz 240D performed satisfactorily for 10 000 km on 100% sunflower oil in this way, using diesel when starting and stopping the engine.

High viscosity may also impair the supply of fuel from the tank to the engine, but this difficulty can be met using larger fuel lines, preheating, and larger filter systems.

The viscosity of vegetable oils can be greatly reduced by chemical treatment (one way is to convert the large lipid molecules into smaller esters), but this adds to the cost.

Prolonged tests needed

One of the attractions of a diesel engine is its long life, typically three times that of a spark-ignition motor. Diesel engines run for 3000 to 10 000 hours between major overhauls. Before vegetable oils can be seriously considered for general use in engines, they must prove themselves in endurance tests.

So far no Australian research group has tested pure vegetable oils for more than a few hundred hours, and perhaps the biggest question mark hanging over the crop-fuel project is our ignorance of how engines will react to prolonged operation on these oils.

From short-term tests, we can predict that one of the biggest difficulties to overcome will be at the injector nozzles. Engines fuelled with 100% vegetable oils have suffered coking of the combustion chamber and of the injectors, and this has led to gumming of the piston rings causing them to stick, along with dilution and deterioration of engine lubricating oil.

One answer, at least for the time being, may well be to blend vegetable oils with diesel fuel. Mixing seed oils and distillate has caused no reported problems, and blending the two would go a long way towards alleviating the viscosity problems. A 1 : 1 blend of sunflower oil with distillate has a viscosity less than three times that of pure distillate at 40°C, although the viscosity of pure sunflower oil at that temperature is nearly nine times that of distillate.

The CSIRO researchers do not feel that pure vegetable oils should be considered a practical proposition yet. Research and evaluation, they say, should be concentrated on blends with distillate, both to minimize the need for modifying fuels and engines, and because vegetable oils will become available as fuels only gradually.

How many cents a litre?

It is no accident that seeds contain stores of energy. If a seed is allowed to germinate, its embryo draws on this energy store for its growth. The embryo also needs protein to incorporate in its new tissues, and seeds must supply this too.

Oilseeds such as linseed and sunflower seed store their energy mainly as oil rather than as starch, and this is why they attract the attention of scientists looking for alternative liquid fuels.

Their economic potential does not stop there, however. The meal remaining after the oil has been extracted has a high protein content and is fed to pigs, poultry, and, to a lesser extent, cattle. The seeds that provide 1 tonne of oil produce 1·1–1·7 tonnes of meal as a by-product.

At present Australia consumes all the meal produced from its oilseed crops. If the industry is to expand, markets will have to be found for the additional meal. One solution would be to export it.

This should not prove too difficult. International trade in oilseed meals is both large and expanding: in the 4 years from 1974–75 to 1978–79, world trade rose from 13·3 to 19·6 million tonnes a year. Brazil's exports have grown by 4 million tonnes in 4 years, so there seems no reason why Australia should not be able to sell oilseed meals overseas.

About 60% of the oilseed meal traded internationally is from soybean, and the high-oil seeds such as sunflower, although they are a little less attractive because they contain more fibre and less protein than soybean, can all produce satisfactory meals.

The CSIRO researchers have calculated that the quantity of oilseeds needed to reduce distillate consumption by 10% would generate about a million tonnes of meal.

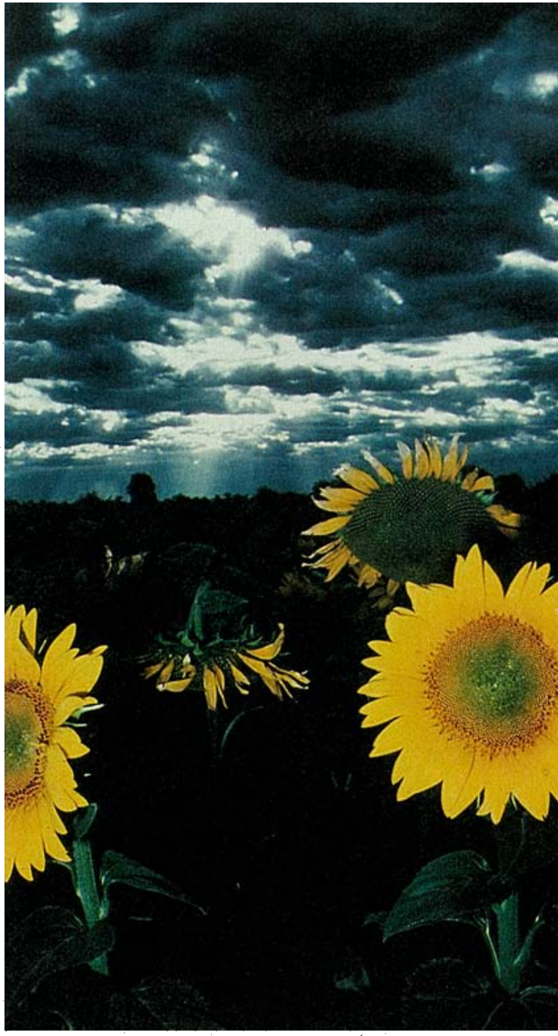
If distillate prices continue to rise rapidly, vegetable oils could well be competitive within 5 years.

The home market could expand considerably, too. In this country meals are fed only to animals reared intensively, and their potential as a feed for grazing stock merits investigation.

In estimating the cost of crop oil, then, the scientists have calculated the costs of growing, transporting, and processing the seeds, and subtracted the estimated value of the meal obtained as a by-product. The estimates for processing assume that crop residues would be burnt to provide energy within the processing plant; this would lower fuel bills but involve further harvesting, transport, and storage costs. One of the options costed was partially dehulling sunflowers and burning the hull fragments as fuel.

After allowing for all expenses, including the capital costs of plant and equipment, the estimated costs of a litre of oil were 44 cents for linseed, 47 cents for rapeseed, and 59 cents for dehulled sunflower.

The contribution from sales of meal ranged from 16 cents for sunflower to 28 cents for linseed. The costs exclude excise, which does not apply to agricultural fuel.



Sunflower often gives a higher return in dollars per hectare than wheat.

The wholesale price of distillate in rural centres in July 1980, when these calculations were performed, was 27 cents a litre. Although this is markedly cheaper than any of the vegetable oil estimates, if distillate prices continue to rise as rapidly as they have over the last few years, vegetable oils could well be competitive by the time the field evaluations have been carried out — say, within 5 years.

Oilseeds *v.* wheat

Will farmers feel sufficiently attracted to oilseeds to grow the necessary quantities? One important consideration is that even if vegetable oils do not for some reason become a major liquid fuel, there will still

Vegetable oils could soon be helping to run diesel machines.

Oilseed products and by-products

Australia already has a well-developed oilseed industry. Its most familiar products are probably the cooking oil and margarine on the shelves of your local supermarket, but both the oil and the protein in a seed find a surprisingly large number of industrial and domestic applications.

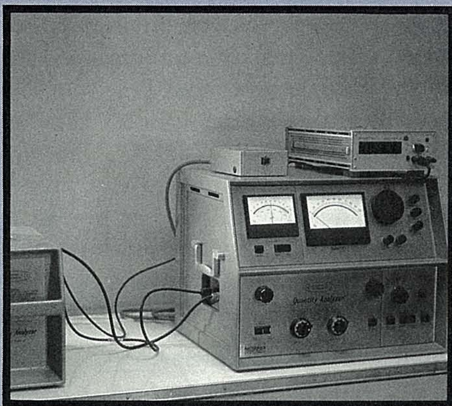
The industry has come a long way since the first seed, grown overseas, was crushed in Sydney in 1908. Eight firms now operate 11 plants, seven of them in rural areas, which produced 94 000 tonnes of vegetable oil in 1977–78.

Freshly harvested seed is transported to a depot for storage. On arrival, samples of the seed are analysed for their water content; if the seed is too wet it may start to germinate in storage, becoming so hot that some of the oil breaks down chemically. Damp seed has even been known to undergo spontaneous combustion.

Just as wools are classed on their fibre width and other factors, so oilseed is sampled for its oil content and chemical quality. In a modern plant this can be done quickly and automatically using nuclear magnetic resonance.

In due course the seed is taken to a crushing plant, where its oil is extracted and the protein fraction becomes meal.

The oil can be extracted mechanically by screw presses handling up to 30 tonnes of seed a day. Once forced out of the seed, the oil is filtered, and the rest of the seed is made into meal to be fed to livestock. Alternatively, the oil can be extracted using the solvent hexane. This method is particularly suitable for soybean, which is grown more for its protein than its oil.



Nuclear magnetic resonance equipment is used to assess the oil content of seeds.

Solvent extraction is more efficient, removing more oil and producing a higher-quality meal.

Seed with a high oil content is usually lightly pressed before being treated with solvent. This technique, called pre-press solvent extraction, speeds up production because the press expels some of the oil, leaving less to be extracted by hexane.

The solvent is subsequently recovered from the oil by heating; hexane boils off at 65°C.

Small solvent extraction plants work on batches of seed, but larger plants can operate continuously, and are therefore more efficient. Some continuous plants crush up to 2000 tonnes of seed a day.

Most vegetable oil is destined for the kitchen as cooking oil or margarine, but some finds its way into industry to be used as a lubricant, to help make a wide range of products including bitumen, polyurethane foam, and PVC plastic, or even to help kill algae in swimming pools.

Oils intended for consumption must be refined, but diesel engines can run on crude degummed oils, which keep longer in storage and are cheaper to produce.

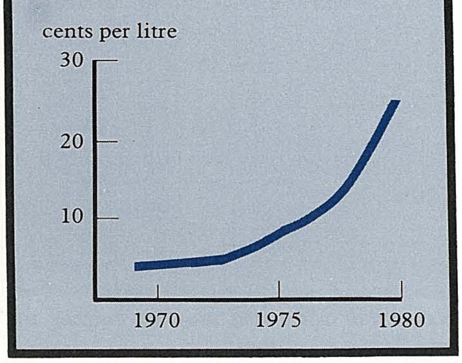
be a large demand for oilseeds, their oils, and meals.

The tonnage of oilseeds and their products traded throughout the world is about the same as that of wheat, and the oilseed trade is worth much more. The necessary investment in oilseed production and processing should therefore be recoverable whether or not the oils get into diesel tanks.

Oilseeds are minor but significant crops in Australia. The CSIRO researchers carried out an interesting investigation into the relative returns from wheat and rapeseed in New South Wales.

These are the bulk duty-free prices that farmers pay.

How the price of distillate has risen



The scientists examined the records from those shires that consistently produced more than 1% of the State's oilseed production — in other words, those areas where farmers had experience with oilseeds and were not 'dabbling' in a new crop. They found that, over the four seasons 1975–76 to 1978–79, rapeseed would have yielded a higher return in dollars per hectare than wheat on almost as many occasions as wheat would have come out on top.

A similar study revealed that, on more than one occasion in three, linseed and rapeseed in all States, and sunflower in central Queensland, gave higher returns than wheat. Only rarely did all the comparisons in any one shire favour one particular crop, and the researchers argue that in most shires farmer income would vary less if some of each crop were grown.

Sunflower has not been competing with grain sorghum in New South Wales and on the Darling Downs of southern Queensland, but, say the researchers, sunflower yields would need to be raised by only 20% to 28% to break even with sorghum, and, they argue, active extension and research combined with further farmer experience should achieve these improved levels in the near future.

Australia's average sunflower yield in the five seasons to 1979–80 was 0·67 tonnes per hectare, but farmers with significant management experience in oilseeds are obtaining dryland yields of more than 2 tonnes per ha, and more than 3 tonnes under irrigation.

Australia seems to be passing through an 'experience phase', as an increasing number of farmers stop thinking of oilseeds as opportunity crops and begin to study their particular management needs. It is interesting to examine South Africa's record; farming there has largely completed the experience phase, and the average sunflower yield jumped from 0·5 tonnes per ha in 1969–70 to 1·2 tonnes per ha in 1976–77 — an impressive leap of 140% in 7 years.

Crushing plants

The cost of vegetable oils will depend on, among other things, the balance between transport costs and the economies gained by processing the seeds in large extraction plants rather than small ones. There are already crushing plants in the main oilseed-growing districts (see the box on this page).

It would not pay a farmer to crush his own seeds in a small, relatively inefficient extractor unless he lived in a remote area some 400 km or more from the nearest crushing plant. His oil would cost 7–10 cents a litre more than oil from a commercial plant handling some 90 000 tonnes of seed a year.

Australia already has 11 processing plants. New medium-sized plants would, on average, cost about $6 m each, and some 50 would eventually be needed.

In contrast to petroleum products, home-grown oils would be cheaper in the country than in cities. The researchers estimate that a litre of vegetable oil would cost 2 cents more in capital cities than in the rural districts where oilseeds are grown.

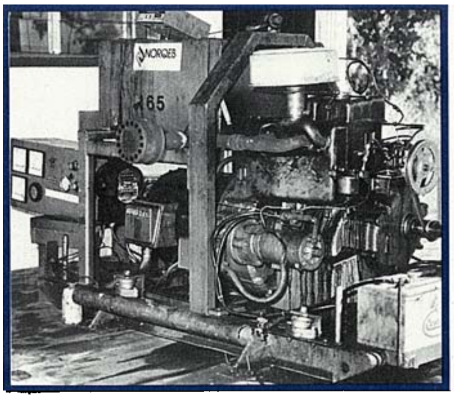
If crop fuels are to be worth while, not only must they be an economic proposition, but the energy budget should also be favourable. The CSIRO workers have calculated that the liquid fuel consumed in growing, harvesting, transporting, and processing oilseeds, together with the liquid fuel that could otherwise be produced from, say, coal used in constructing and running extraction plants, ranges from 29% to 42% of the energy that the oil from those seeds would yield.

Averaging out the different crops, the scientists estimate that the energy equivalent of about 35% of the liquid fuel from oilseeds is used in production, leaving 65% as net gain.

Can we grow enough?

In Australia, dryland oilseed crops occupy only 3% of the area sown with wheat. The oilseed industry is still in its infancy here, but, like most infants, it is growing fast. Over the last 10 years oilseed yields have shown a higher percentage increase than wheat, thanks largely to the introduction of new cultivars and better management techniques.

To ascertain whether Australia could grow enough oil crops to make a significant impact on our distillate consumption, the CSIRO group examined the areas occupied by oilseeds at present and pondered the agronomic options available in the future. They came to the conclusion that a reshuffle of several million hectares of land was on the cards.



This test engine at James Cook University has run for several hundred hours on blends containing more than 50% peanut oil.

Oilseeds in Australia are grown mainly in the wetter third of the wheat belt and in high-rainfall areas. This will presumably remain true. Even so, there are several ways in which oilseed production could be increased.

In international trade, oilseeds are worth much more than wheat.

In the first place, say the scientists, undeveloped land could be brought under conventional cultivation. In the wetter third of the cereal belt 7 million ha are undeveloped, and in the high-rainfall zone a further 2 million are available. If all this land were developed for cropping, in any one year some 3 million ha could be growing oilseeds.

This newly developed land would carry oilseeds in rotation with other crops and pasture. The researchers argue that enough wheat could be grown on this land to release 2–3 million ha of existing wheatland for oilseeds. This would raise the area planted to oilseeds to at least 5 million ha without any drop in wheat production.

This tractor is fuelled by sunflower oil.

These oil crops would yield 4 million tonnes of seed, producing 1·7 million tonnes of oil. The net energy gain would be equivalent to about one-fifth of all the distillate used in Australia in 1978–79.

This calculation simply supposes that existing agricultural know-how is applied to a larger area of oilseeds than is grown at present, but there is also considerable scope for raising production and increasing the energy profit margin by changing our farming habits. In particular, the CSIRO group feels that direct drilling could make a great impact.

Direct drilling — also called minimum tillage — means sowing seed straight into the ground without the tilling that conventionally controls weeds. The weeds must be kept in check, of course, and this is presently achieved with herbicides (see the box on page 8).

Advocates of direct drilling contend that, because the former makes fewer passes over the land, the cost (in both dollars and energy) of raising the crop is reduced, and the risk of soil erosion is lessened by the continuous cover of vegetation.

The CSIRO Division of Plant Industry has developed a machine, the Siroseeder, for direct drilling, specifically for the slopes and tablelands of New South Wales. If farmers adopt direct drilling, they should be able to crop more intensively on the gentler slopes, and even introduce crops on steeper slopes that currently carry only pasture.

Together, this new technology and hoped-for new cultivars could, say the scientists, increase the oilseed yield to 8 million tonnes.

Future research

If vegetable oils are one day to play a significant part in keeping Australia's diesel engines running, many questions

For easy comparison, the figure for distillate is taken to be 1 in each case.

How vegetable oils perform beside distillate

	distillate	vegetable oils		
		sunflower	rapeseed	linseed
power at maximum torque	1	1·02	1·03	1·05
calorific value	1	0·95	0·96	0·96
smoke density	1	0·73	0·67	0·83
viscosity at 38°C	1	8·9	9·6	7·5

Mixed cropping promises higher yields for lower costs

Dr Ross Downes, of the CSIRO Division of Plant Industry, argues that the usual methods of direct drilling can be improved upon. Herbicides, he points out, cost both money and energy.

What's worse, weeds often germinate after the initial spraying, and so more chemical has to be pumped onto the land. Even when the weeds are not sufficiently numerous to affect crop yields, they leave seeds that guarantee further herbicide will be needed the following year.

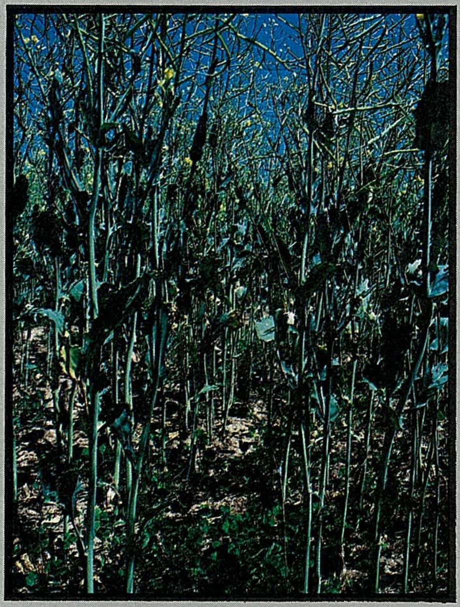
Dr Downes says that, of the various strategies evaluated in Canberra for avoiding herbicides, the only one to be unequivocally effective involved preventing weeds from producing seeds. This is achieved by ploughing the land or, where appropriate, cutting hay in spring before the weeds set seed.

To prevent further weed growth in summer, sheep are usually put into the paddock. By controlling weeds in this way, the farmer can enjoy the benefits of direct drilling without resorting to herbicides.

The farmer can minimize his use of fertilizer, too, says Dr Downes, by adopting a system of continuous mixed cropping. This involves growing a crop and a legume together, the legume forming an understorey and supplying the crops with nitrogen. In winter-rainfall areas the legume could be a naturally regenerating annual such as medic or subterranean clover, and where rain falls in both summer and winter it could be a perennial like lucerne.

Such a system has been studied in the Canberra region by Dr Downes and Mr Peter Flint for three successive seasons. Where the crop and legume are grown together, the yield of each is, as may be expected, somewhat reduced. For example, in the 1979 trials the wheat yield in a paddock undersown with clover was 87% of that in a pure stand of wheat. More strikingly, mixing wheat and clover lowered the clover yield by 60%. However, because both wheat and clover were growing in the same paddock, the total yield from the paddock was greater than from any single species grown alone.

The benefit to the farmer becomes clear when we consider that where he might previously have had one paddock each of clover and wheat, he could now have two mixed paddocks. His wheat yield is now down to 87% in each paddock, but because he is cropping in two paddocks, not one, his total wheat production is 174% — in other words, up by 74%. The clover production in such a system would be down by a net 20%.



When rape and clover are grown together, a farm's total yield increases markedly.

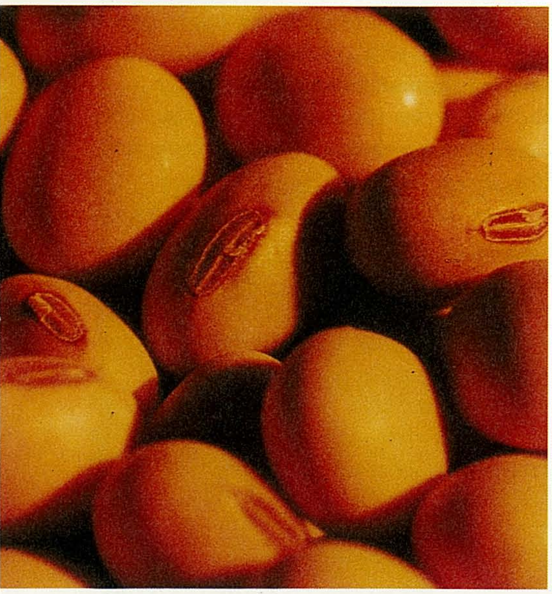
Although continuous mixed cropping is still being evaluated, it seems to hold promise for oilseed crops too. The 1979 trials included both mixed and pure stands of rape and clover.

When mixed, rape yielded 86% and clover 77% of the amounts obtained when they were grown alone. This means that a farmer who had switched from a paddock of rape and one of clover to two mixed paddocks would have raised his total rape yield by 72% and his clover yield by 54%.

Under this system the land can be cropped continuously without any shortage of nitrogen, and so increased yields should, in the opinion of Dr Downes, be realized every year.

Dr Downes suggests that in suitable areas wheat and rape could be grown in rotation, each with a legume understorey. This would help control such diseases as take-all in wheat and blackleg in rape, and also help farmers to make more effective use of machinery; rape is planted and harvested before wheat.

These ideas are of great interest to the scientists involved in Project Crop-fuel.



Soybean provides 60% of the world trade in oilseed meal.

will need answering. Project Crop-fuel includes research in the following diverse areas:

- long-running engine tests
- plant breeding
- evaluation of cropping systems
- exploring wider uses for protein-rich meals
- uses for crop residues

Some of the most crucial questions concern the engine. Nodody has yet found out how engines respond to vegetable oils, either on their own or as blends with distillate, when they are run for a typical diesel engine's lifetime. Researchers at the CSIRO Divisions of Mechanical Engineering and Chemical Technology will be looking at engine performance, modifications and tuning, lubricants, and fuel additives, and at the effects of chemically modifying the oils and blending them with other liquid fuels.

Most of the varieties of oilseed crops grown in Australia were originally imported, and scientists feel there is great scope for breeding locally adapted cultivars, particularly for dryland agriculture. Researchers at the Divisions of Plant Industry and Irrigation Research will be setting out to improve oilseed crops' yields in the drier regions of the wheat belt.

The breeders hope to develop seeds that are easier to process and give higher yields and qualities of oil and meal. The researchers would like seeds with thinner hulls, as the hull has no economic value except as a possible fuel for the crushing plant.

Dehulling lowers the wax content of the oil and probably improves its quality as a fuel, and so hulls that split off the seed more readily would be welcome. And, as with every crop, disease resistance will occupy much of the plant breeders' attention.

If geneticists can make significant gains in all or even most of these fields of research, yields may soon reach the initial target of a 1-tonne-per-ha average over the whole area cropped, and that area may perhaps be extended with the development of new cultivars tolerant of conditions in the drier parts of the cereal zone.

Direct drilling could help increase the oilseed yield to 8 million tonnes.

The Division of Plant Industry will also continue research into crop rotations and systems of mixed cropping that help increase oilseed yields while keeping the costs, in dollars and energy, to a minimum and preserving the long-term stability of the land. The Division is, among other inquiries, investigating ways of using crop residues (particularly the left-over stalks) both to encourage nitrogen fixation by soil bacteria and to produce a straw acceptable to grazing animals.

Harvesting a sunflower crop. Brazil's yield per hectare jumped 140% in 7 years — could Australia's do the same?

Australia's oilseed crops

	production 1978–79 (thousand tonnes)	oil in seed (%)	protein in meal (%)
sunflower	203	40–51	35–44
rapeseed	21	35–45	35–45
linseed	16	35–45	34–40
safflower	52	30–45	30–44
peanuts	52	45–50	40–48
soybean	103	18–21	40–50
cottonseed	87	15–25	36–41


The oil from safflower is one of those tested in engines by Dr Graeme Quick.


Potential energy: ripe sunflower heads.

An estimated nine million hectares of 'undeveloped' land are available for cultivation.

The research teams are keen to start field trials in which farmers grow oilseeds and scientists monitor the yields under different cropping routines, further evaluating direct drilling and the cultivation of steeper slopes.

An essential component of the oilseed exercise is the meal by-product. The Divisions of Animal Production and Plant Industry will investigate ways of introducing meals into the Australian sheep and cattle industries.

Plant Industry researchers are already carrying out trials with sheep, and early results have been encouraging.

When ewes are fed pellets of sunflower meal either before or after early spring lambing, their lambs grow much faster, and many more of these lambs reach market weight at the age of 3 months than those whose mothers receive no supplementary feed.

Other supplements, such as oats, speed up growth by a similar margin, but the researchers hope that the high protein content of oilseed meals will bring the bonus of bigger wool yields.

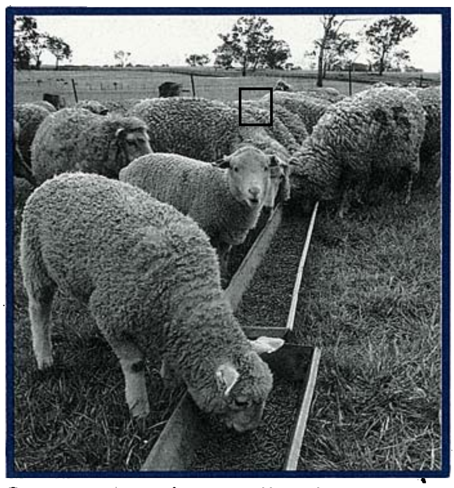
Other liquid fuels

Australia has a number of 'alternative' liquid fuels up its sleeve; why should vegetable oils attract particular attention?

One reason is flexibility. Oilseeds are processed the same way whether they are destined for diesel engines or dining rooms, and so marketing options remain open.

Another point in oilseeds' favour is that they are a renewable resource: provided the soil is carefully husbanded, crops can be grown year after year indefinitely. Moreover, their combustion in engines does not burden the atmosphere with additional carbon dioxide; no more gas can be released than was earlier absorbed by the plants as they photosynthesized the oils.

Siroseeder, developed by CSIRO for sowing seed directly into untilled ground.



Consumers testing an oilseed by-product: sheep eating sunflower meal.

These advantages are also offered by ethanol distilled from fermented plant matter, but vegetable oils look a better proposition on several counts.

The oilseeds would act as useful 'break-crops' in the cereal belt, helping to check the build-up of pests, weeds, and diseases. Extracting the oils is a relatively simple, low-cost process, and does not require large volumes of water, as ethanol production does. What's more, oil extraction consumes much less energy than ethanol production.

Oils are easier to store than ethanol, which is volatile and flammable and attracts water vapour from the air.

But the overriding significance of vegetable oils is that, unlike ethanol, they are promising fuels for diesel engines, which are playing an increasingly important role in Australia's economy. From 1973 to 1978 the consumption of diesel distillate rose from 12·9% to 16·6% of all petroleum products.

It is probably better not to regard ethanol and vegetable oils as rival fuels, but rather as alternatives, both to petroleum fuels and to one another. In some parts of the country, such as the sugarcane districts of Queensland, ethanol may well prove an economical additive or substitute for petrol; but for much of rural Australia, say the CSIRO researchers, vegetable oils offer an exciting, almost immediate, opportunity to reduce our dependence on distillate — and increase employment in country centres.

Of course, as with any agricultural crop, yields will fluctuate from year to year, but a small number of offshore petroleum production platforms cannot promise as secure a supply as several million hectares of oilseed crops — and a crop-fuel industry would bring the social benefits of decentralization and rural employment.

John Seymour

More about the topic

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