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"OESTROGEN FREE" SUBTERRANEAN CLOVERS

—their development and prospects

By C. M. FRANCIS

SELDOM have plants received more publicity than the "oestrogen free" subterranean clovers developed by the University of Western Australia's Institute of Agriculture. The production of oestrogen free clovers has attracted great popular interest, particularly among farmers in the southern sheep raising districts.

Bred to overcome the subterranean clover infertility problem in sheep, the new strains could have an important influence on the future of Western Australia's sheep raising industries.

The first of the oestrogen free clovers, Uniwager (UNiversity of WA x GERaldton) is a direct descendent of a single mutant plant selected from a population of 22,000. To produce the mutation, seed of the Geraldton strain had been soaked in ethyl methanesulphonate, a chemical which is very effective in producing mutations (genetic changes) in plants.

Many mutations, such as dwarfing and "yellows", are clearly visible but others involve less obvious changes in the plant's chemistry. Such was the case with Uniwager, in which the mutation suppressed the production of a group of compounds known as isoflavones, the substances responsible for the leaves of all naturally-occurring strains of sub. clover so far tested possessing some degree of oestrogenic (female hormonal) activity. Formononetin is considered the most active of the isoflavones in subterranean clover.

Despite the presence of trace amounts of isoflavones in its leaves, Uniwager has shown no significant oestrogenic activity, and for practical purposes can be considered oestrogen free.

Although Uniwager subterranean clover and its crossbred derivatives have less

Dr. C. M. Francis, the author of this article, was associated with Dr. A. J. Millington in the production of the first "oestrogen free" subterranean clovers. Formerly a research fellow at the Institute of Agriculture, Dr. Francis is now a research officer with the Department of Agriculture.

Uniwager, a chemically-induced mutation from the successful Geraldton strain, is the first of the "oestrogen free" clovers. Developed by the University Institute of Agriculture, this strain was released in 1967 and is available commercially for the first time this season.

Research workers at the Institute of Agriculture have used Uniwager as the basis of a crossbreeding programme to incorporate the "oestrogen free" characteristic into other favoured strains of subterranean clover. This article briefly describes the production of Uniwager and the crossbreeding programme, and discusses future possibilities for the strains produced.

oestrogenic activity than the naturally occurring oestrogen-low strains such as Daliak, Seaton Park, Mt. Barker and Bacchus Marsh, the significance of such differences in terms of actual ewe infer-

Oestrogen free clovers are characterised by the absence of leaf markings as in the leaf on the right.



tility is unknown. Except perhaps in extreme situations they may be unimportant.

Under some situations, such as where phosphate deficiency is severe, the formononetin content of Daliak and Mt. Barker clovers may exceed 1.0 per cent.—a potentially dangerous level. The isoflavone content of Uniwager and its crossbreds under such conditions, though increased, is still very low and the stability of 'oestrogen lowness' is an advantage of the mutant types.

Possible disadvantages of mutation-based colvers

In the past, plant breeders throughout the world have had limited success in producing new types of plants by mutation, and the advantages of the low oestrogen content of the "oestrogen free" clovers may in time be shown to be offset by possible disadvantages of mutants.

Possible limitations which must be considered when the mutant derivatives are compared with naturally-occurring sub. clovers are:

- (1) *Perhaps the isoflavones have a function in the plant.* Because in our present state of knowledge we know of no function for the isoflavones, this does not mean there is not one.
- (2) *Perhaps the chemical permanently damages the hereditary material.* The chemical ethyl methanesulphonate is capable of causing removal or deletion of small sectors of the hereditary material (chro-

mosomes) and such deletions may mean other characters than isoflavones are adversely affected. The effects then might be perpetually transmitted along with the desired loss of isoflavone production.

- (3) *There is difficulty in distinguishing between mutant lines.* The Uniwager 'gene' not only removes isoflavones but leaf markings as well. This side effect makes necessary the use of strain markers such as leaf shape and stem hairiness, which must be incorporated into new crossbreds. The combinations of these are limited and restrict the number of easily distinguishable varieties. With the release of Uniwager, one such combination has already been 'used up' and it seems likely that in the near future only perhaps two or three new oestrogen-free varieties could be fitted into the existing seed certification scheme.

How the oestrogen-free character is transmitted to other strains

The "oestrogen-free" characteristic is simply inherited, that is, if an oestrogen-free strain is crossed with one containing isoflavones the character can be recovered in subsequent generations.

For instance, when Geraldton is crossed with Uniwager, in the second subsequent generation (F_2) there will be a ratio of three plants like Geraldton to one like Uniwager. Similarly, if Uniwager is crossed with Dinninup the F_2 generation will

have three plants with isoflavones to one without, and the isoflavone free plant will have half of its genetic material derived from Dinninup. If this plant is crossed again with Dinninup ("back-crossed") the 3:1 ratio will again result in the F_2 and the plant without isoflavones will have 75 per cent. Dinninup genetic material.

Two more backcrosses would result in plants with about 95 per cent. Dinninup genes; in other words, and essentially oestrogen-free Dinninup is possible.

A number of varieties have been so crossed with Uniwager at the Institute of Agriculture. Some of the most promising include:

CROSS	DISTINCTIVE CHARACTERS
Northam A x Uniwager	Three to four weeks earlier flowering than Uniwager; much more vigorous.
Dinninup x Uniwager	About Dinninup maturity; round leaf shape.
Four Leaf x Uniwager	About Woogenellup maturity; smooth stems, four leaves.

The Dinninup and Four Leaf crosses are distinguishable from Uniwager, but the same is not true of the Northam A crosses. A special certification scheme would have to be considered should the performance of these crosses under test warrant their commercial production. Although the Department of Agriculture is not involved in the further development of the Uniwager crossbreds, it is taking part in a joint project with the University and CSIRO to test the "oestrogen free" clovers. The testing programme includes comparisons with new oestrogen-low varieties selected from natural populations (like Daliak and Seaton Park) or selected from crosses between existing varieties.

Widespread use of oestrogen-low clovers may be considered as the first step toward eliminating of clover oestrogen hazard to the breeding ewe. The ultimate solution could well be the use of oestrogen free clovers descended from Uniwager.

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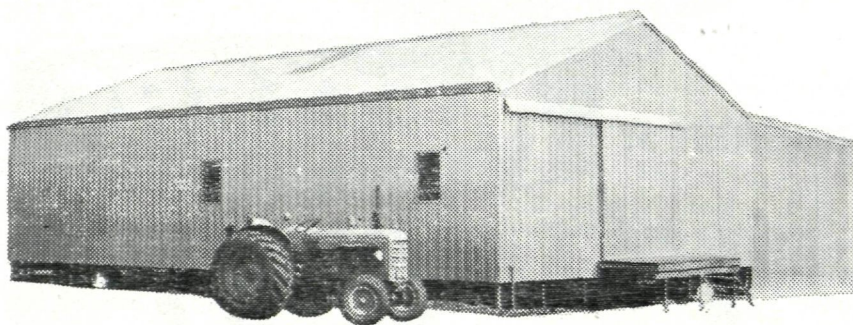
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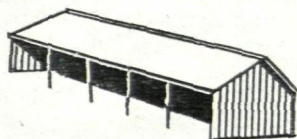
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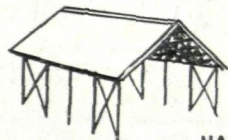
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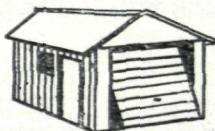
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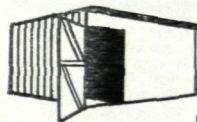
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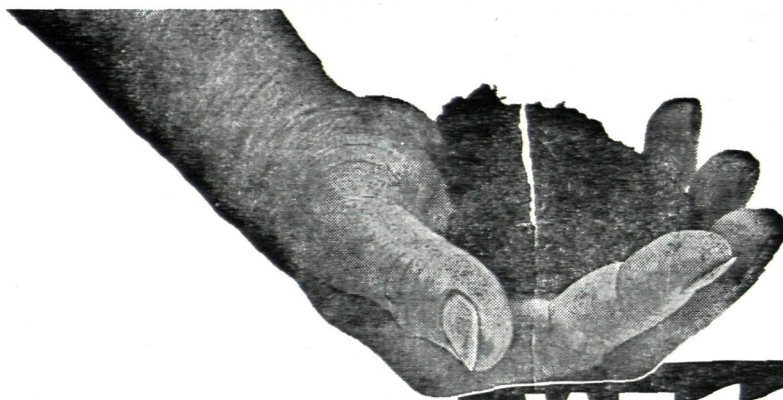
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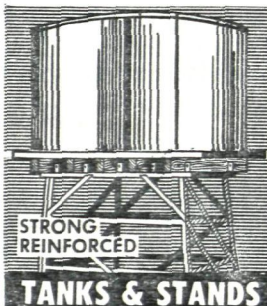
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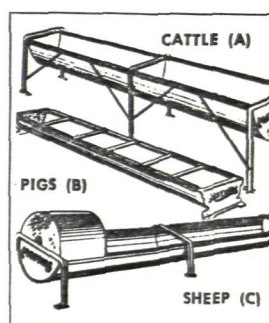


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