Kimberley Research Station progress report, 1964: insect pests and insecticides

K T. Richards

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INSECT PESTS AND INSECTICIDES

By K. T. RICHARDS

FOR the past four years, detailed studies have been carried out in regard to the identification, status, bionomics, and control of insects and mite pests attacking the various crops grown in the Ord River Irrigation Area.

During this period the main pests of the respective crops (in descending order of importance) were:

**Cotton**

**MAJOR PESTS**

- *Prodenia litura* (F.) Tobacco cluster grub; *Earias huegeli* Rog. Rough bollworm; *Heliothis punctigera* Wallengr. Climbing cutworm; *Pectinophora gossypiella* (Saund.) Pink bollworm; *Anomis planalis* (Sw.) Cotton looper; *Austracris guttulosa* (Walk.) Spur-throated locust.

**MINOR PESTS**


**Safflower**


**Linseed**


**Sugar Cane**

- *Gastrimargus musicus* (F.), *Austracris guttulosa* (Walk.).

**Rapeseed**

- *Prodenia litura* (F.), *Heliothis spp.*

**Sesame**


**Castor**

- *Prodenia litura* (F.), *Archaea janata* (L.), Semi-looper, *Heliothis spp., Dichocrocis punctiferalis* (Guen.) Yellow peach moth.
Soya


Although insecticides and other materials have been tested in the control of pests of the majority of the above crops, priority has necessarily been given to cotton pests and their control. Insecticide trials during the 1959-60, 1960-61, and 1961-62 wet seasons have shown that DDT at a rate of a half to one pound an acre will effectively control the Lepidopterous pests with the exception of pink bollworm (where the rate needs to be increased to 2 lb. per acre), Prodenia and rough bollworm. In the case of Prodenia, considerable tolerance to DDT has been indicated, even in early instars. With late-instar larvae, rates up to 6 lb. per acre have, in a number of cases, failed to give satisfactory control (coverage being complete and spraying carried out under dry conditions).

Endrin at 4 oz. per acre has been shown to be effective for control of rough bollworm, spur-throated locust and the loopers. Sevin at 1-3 lb. per acre has proved to be a most effective material for control of most cotton pests including pink and rough bollworms, Heliothis spp. Anomis, Cosmophila, and Acontia. It also gives fair control of Prodenia. However, because this material has until recently been available only as a wettable powder preparation, difficulties have arisen in regard to its use through aerial spraying equipment, where low gallonages are used. A number of other materials including Dipterex, Gusathion, Telodrin, Zectran, and Dimecron have also shown considerable promise in the control of certain cotton pests. Some resistance to Metasystox by red spider has been noted at the Station.

As Prodenia has appeared to be the most destructive pest at Kimberley Research Station and Kununurra during the past four years, a number of trials involving the testing of a large range of insecticides and other materials have been carried out at the Station. These have indicated the effectiveness of Dipterex and Zectran against this pest.

Sprays of polyhedrosis virus preparations have also been tested and show promise against Prodenia but the kill is comparatively slow and the constant supply of adequate diseased larvae is a limiting factor.

Baiting trials at the Station have indicated that an excellent kill of all larval stages of Prodenia can be obtained by use of bait-insecticide mixtures. Materials such as bran, linseed, and cotton seed meals and ground pasture materials have been found effective as the attractant but bran is the most satisfactory. The old formula of bran—B.H.C. has shown to be as effective as any, and more economical than most mixtures. Liquid B.H.C. preparations, at a rate of ½ fluid oz. of 20 per cent. B.H.C. emulsion per 1 lb. of bran laid in a thin trail along the ridges has given excellent results. Pelleted preparations have also been found effective.

On the basis of results of insecticide trials at Kimberley Research Station, spraying schedules have been recommended for the protection of commercial cotton, rice and safflower crops at Kununurra.
INSECT ECOLOGY

By P. E. MADGE

INSECT ecological investigations were commenced in the 1963-64 season to provide a broad-based approach to insect control.

Because of the immediate threat of the insect Prodenia litura to all broad-leaved crops, a large proportion of the total effort was directed towards preventing insect build up by the application of existing knowledge and towards analysing the character of the infestations which did in fact occur.

A sanitation period of three weeks, involving the destruction of all broad-leaf crops and residues, was imposed at the end of the 1963 dry season. Subsequent isolated foci of infestation on pigweed in cropping areas and around buildings were treated immediately. It is believed that these measures prevented the early build-up of Prodenia, which only became serious in March.

During the season the timing of insecticide applications was based on the results of routine weekly insect surveys of all cotton experiments. Initial insecticide dosage rates were \( \frac{1}{2} \) lb. DDT plus \( \frac{1}{4} \) lb. Endrin active ingredient per acre. These rates were later increased to \( 1 + \frac{1}{2} \) lb. respectively; the higher rate gave a satisfactory kill of Prodenia during the major outbreak in late March.

There was strong evidence to suggest that the late March infestation was the result of large flights of adults migrating from the commercial farms, where cotton had been planted early and had “cut-out” by mid-March.

Provisional principles for the control of Prodenia on Station are:

1. A closed season of three to four weeks before the first cotton crop is sown.
2. Effective weed control during the closed season and the cotton growing season, both in the crop and in surrounding areas.
3. Routine weekly insect surveys to estimate pest abundance.
4. Insecticide applications timed according to the results of the surveys.
5. Destruction of cotton plants as soon after picking as possible.

WEEDS AND WEED CONTROL

By P. J. VAN RIJN

UNTIL 1960, pre-irrigation followed by tillage and where possible subsequent inter-row cultivation, were accepted as standard techniques for weed control at the Station.

However, they were not fully effective in preventing weeds from becoming a serious problem particularly on long cropped land. In 1960, an intensive study of weeds and methods of their control was initiated. It was established that pigweed (Triandthema portulacastrum and Portulaca oleracea), Chloris grass (Chloris barbata), and awnless barnyard grass (Echinochloa colonum) are the main weeds of upland crops. Barnyard grass (Echinochloa crus-galli) together with awnless barnyard grass, and, in the wet season, nut-grass (Cyperus spp.) are the main weeds of rice. Contaminated crop seed and agricultural machinery as well as irrigation water were found to be important in spreading weed infestation (van Rijn 1962).

The results of experiments on chemical weed control in crops are summarised in Table 8.
Table 8.—Successful chemical weed-control methods based on Experiments in 1960-64 period

<table>
<thead>
<tr>
<th>Crop</th>
<th>Main Weed Species</th>
<th>Herbicide</th>
<th>Rate lb. per acre A.I.</th>
<th>Time of Application</th>
<th>Remarks</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Trianthema portulacastrum, Portulaca oleracea, Phyllanthus madrasaspitonus, Sida spp., and Sesbania spp.</td>
<td>Diuron</td>
<td>½</td>
<td>3-4 weeks before Nov.-Dec. planting</td>
<td>Minimum disturbance of soil at sowing essential. Effective throughout most of growing season Period of effective control shorter than that of Diuron</td>
<td>van Rijn (1964c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diuron</td>
<td>1-1</td>
<td>Pre-emergence</td>
<td></td>
<td>van Rijn (1964c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dicryl</td>
<td>3-6</td>
<td>7-10 days after emergence</td>
<td>Effective throughout most of growing season</td>
<td>van Rijn (1964c)</td>
</tr>
<tr>
<td>Rice</td>
<td>Echinochloa crus-galli, E. colonum, Cyperus spp., (wet season)</td>
<td>STAM F-34</td>
<td>3-6</td>
<td>2-3 weeks after emergence</td>
<td>Excellent control</td>
<td>van Rijn (1963a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CIPC</td>
<td>4-8</td>
<td>Post-emergence at weed appearance</td>
<td>Good control</td>
<td>van Rijn (1964b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EPTC</td>
<td>1</td>
<td>Pre-sowing</td>
<td></td>
<td>van Rijn (1964b)</td>
</tr>
<tr>
<td>Safflower and linseed</td>
<td>Chloris spp., Echinochloa colonum, and Portulaca oleracea</td>
<td>Diuron</td>
<td>3-1</td>
<td>Pre-emergence</td>
<td>Good control</td>
<td>van Rijn (1964a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCA</td>
<td>4</td>
<td>Pre-emergence</td>
<td>Good control</td>
<td>van Rijn (1964a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCA</td>
<td></td>
<td>Early post-emergence</td>
<td>Good control of grasses but not pigweed</td>
<td>van Rijn (1964a)</td>
</tr>
</tbody>
</table>

In the dry season satisfactory weed control can be achieved in irrigation channels and drains by delving and burning. In the wet season chemical weed control is needed. It was found that Monuron at rates equivalent to 12-16 lb. per acre A.I. (active ingredient) and Simazine at 12 lb. A.I. per acre controlled most weeds. Their effectiveness was increased by burning weeds and delving channels prior to spraying. To avoid crop injury, irrigation channels should be sprayed at least a fortnight before sowing and Monuron should not be used for channels supplying rice, while Simazine should not be used for those supplying cotton (van Rijn 1963b).

Cockatoo sandy soils carry eucalypt open forest vegetation and regrowth of tree suckers occurs after clearing. Deep cultivation with a majestic plough is successful in controlling suckers. Experiments with herbicides show that 2, 4, 5-T at 6 lb. A.I. per acre controlled regrowth of Eucalyptus ferruginea and Acacia mangium, partially controlled Eucalyptus tetrodonta, and failed to control Erythrophleum chlorostachys. Monuron at 30-40 lb. A.I per acre effectively controlled the suckers of the first three but not of the last species.

Apart from proper botanical identification, the work on weeds has been concerned mainly with chemical control techniques. This will continue, but in future more emphasis will be given to ecology of the main weed species to gain the knowledge needed to develop other, possibly cheaper methods of control.

AGRONOMY OF PASTURE AND FODDER CROPS

By D. B. PARBERY

INTRODUCTIONS

EARLIER reports mentioned the wide range of pasture and fodder plants tried at Kimberley Research Station since the station began (Anon. 1958; Anon. 1960).

In an attempt to classify the performance of many of these plants, together with more recently introduced species and varieties, several hundred legumes and grasses were planted in the nursery on Cununurra clay during 1963 and 1964. All plantings were duplicated on natural and fertilised soil, and grown under...
irrigation. A smaller selection of plants was introduced on Cockatoo sand, grown under rainfed conditions.

Plantings on the clay were divided according to season, i.e., the hot-wet (November-April), the cool-dry (May-July), and the hot-dry (August-October). Tropical and sub-tropical species were planted in the first and third seasons, while temperate species were grown in the cool dry.

On Cununurra clay, several plants grew well during the hot-wet season. These included Cenchrus ciliaris, Chloris gayana, Chloris barbata, Panicum maximum, Sorghum almum, Hyparrhenia rufa, Bothriochloa insculpta among the perennial grasses; Leucaena glauca, Stylosanthes gracilis, Cajanus cajan, Phaseolus atropurpureus var. Siratro, and Clitoria ternatea among the perennial legumes; Sorghum spp., and the millets among the annual grasses; and Phaseolus lathyroides, Sesbania speciosa, Vigna sinensis, and Dolichos lablab among the annual legumes.

Outstanding performers in the cool dry season included Lolium multiflorum, Lolium perenne, Dactylon cynodon var. Bermuda, and Eragrostis chloromelas among the perennial grasses; Avena sativa, Triticum aestivum, and Hordeum vulgare, among the annual grasses; and Melilotus indica as well as the vetches among the annual legumes.

On the Cockatoo sand, during the hot-wet season, several plants grew and yielded well. These included Cenchrus setigerus and Cenchrus ciliaris among the perennial grasses; Phaseolus atropurpureus var. Siratro among the perennial legumes; Pennisetum typhoides among the annual grasses; and Dolichos lablab, Vigna sinensis, and Stylosanthes humilis among the annual legumes.

The introductions are being evaluated in terms of dry matter and protein production, particularly during the dry season, as well as for general growth vigour, persistence, disease and pest resistance.

Perennial Pasture Evaluation

The performance of Clitoria ternatea as a possible perennial pasture legume for the Ord was discussed in the previous report (Anon 1960). Following the earlier work, a larger-scale evaluation trial was put down preceding the 1962-63 wet season in an area where Clitoria from the previous experiments had associated itself with Chloris barbata. Dry matter and crude protein production from the pasture mixture was studied under three watering regimes, three cutting frequencies, and three nitrogen applications between April 1963 and March 1964. While the pasture gave highest production under a two-weekly watering and a two-monthly cutting system (3-6 tons of dry matter/acre), it showed a marked response to nitrogen fertiliser under all conditions. Although Clitoria nodulated freely, it shared with the grass the response to nitrogen. Under the two-month cutting system, dry matter production increased from 3 tons per acre per year to almost 6 tons per acre per year with 4 cwt. per acre per year of ammonium sulphate applied in split dressings after each cutting.

Since Clitoria does not seem to make nitrogen available to its associated grass as a temperate clover would do, it may be more practical, and economic, to grow pure stands of more highly producing strains of this legume. The protein content of the plant is satisfactory and it is highly palatable. No evidence of bloating has been recorded.

Annual Pasture Evaluation

Two sorghum species, used successfully for grazing in other tropical countries, were tested over one year. They were grown with irrigation except during the wet season, and given different rates of nitrogen fertilisation.

Both Sudan grass and Sorghum almum grew well but developed early symptoms of nitrogen starvation, even on plots which received dressings in excess of 6 cwt. per acre of ammonium sulphate at planting. It was found that Sudan grass could be successfully ratooned throughout the year, as long as it was not cut later than flowering stage. However, it is unlikely that production from either plant will be satisfactory without heavy top-dressings of nitrogenous fertiliser, after cutting or grazing. Grazing of the Sudan grass by the Station's dairy herd presented further problems in that the irrigation banks
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quickly broke down under trampling, and the plants themselves were damaged when grazing occurred during or soon after rain or irrigation.

**Annual Fodder Crops**

All members of the *Sorghum* genus grew well when planted in the introduction nursery. They proved to be outstanding in that all could be cut several times in one year without replanting.

Annual production from the leading fodder sorghum introduction exceeded 80 tons per acre of green chop, or 19 tons per acre of dry matter, containing 1 1/2 tons per acre of protein when cut six times in the year following planting.

Grain sorghums also did well. Alpha yielded 7,500 lb. per acre of grain (9 per cent. moisture) when harvested twice within the year, as well as 30 tons per acre of green chop (4 cuts), or 9 tons per acre of dry matter, averaging from 7 to 8 per cent. protein content.

The potential for sorghum on the Ord is generally noteworthy when it is considered that 6 fodder cuts or 3 grain harvests could be taken from fodder and grain varieties, respectively, without replanting, in any one year period.

While several annual legumes established only the vetches resisted Prodenia caterpillar attack. Of the vetches, the purple-flowered variety was superior. These crops produced well during the cooler months of June, July and August when night temperatures rarely drop below 50° F. and day temperatures remain in the 80's and 90's.

Excellent results were obtained from purple vetch in combination with an early and late maturing oat. These combinations produced an attractive crop, suitable for grazing or conservation as hay. When cut at the cereal dough stage, hay yields in excess of 3 tons per acre were recorded.

**DRI Y SEASON CEREALS**

By D. F. BEECH and D. B. PARBERY

TEMPERATE cereals and fodder crops have been grown successfully under irrigation during the dry winter.

**Wheat**

Yields from 2,000 to 3,000 lb. per acre have been obtained, the optimum planting time being from May until early June. The response to nitrogen fertiliser as ammonium was linear up to 4 cwt. per acre.

**Oats**

Yields up to 1,900 lb. per acre (Ballidu) and up to 2,400 lb. per acre (Avon) have been obtained. The optimum time of planting is being studied. Responses to nitrogen fertiliser are obtained with high rates producing attractive hay.

**Maize**

Yields up to 4,500 lb. of grain and up to 20,000 lb. of green crop at the dough stage have been obtained. The optimum of time of planting is from March to early June. These yields were obtained with fertiliser dressings of 2 cwt. ammonium sulphate and 2 cwt. superphosphate.

Two problems occurred with this crop. Because of poor depth-penetration by maize roots in Cununurra clay the weight increase at ear set can cause lodging. *Prodenia* attacks maize at the seedling stage.
CATTLE HUSBANDRY

By J. H. AUTY and A. HENDERSON

SINCE the publication of the last progress report research effort in the field of animal husbandry has been directed to investigation of the feeding value of high protein by-products from the cotton and oilseed industries. This work has been carried out with steers, weaners, and breeders.

In a pilot experiment with two-year-old steers, it was found that when stresses such as water shortage, tick infestation, and phosphate deficiency were eliminated by good management, steers were only able to maintain their weight for the first half of the dry season and lost weight precipitously at the end of the dry season. Steers supplemented with protein meal continued to gain weight throughout the dry season until early rains fell, at which time some weight loss was experienced.

In a follow-up experiment weaner steers were fed over a three year period (a) in all three dry seasons, (b) in two seasons, (c) in one season, and (d) in none. Satisfactory bodyweight gains over the three-year period were made by those steers which had been fed in all dry seasons. In the second dry season, steers which were fed made substantial bodyweight gains, whilst the controls lost weight and many died.

In a feeding trial with heifers, supplementation had little effect on the first calf crop. In the second dry season 50 per cent. of the non-supplemented cows died despite calf weaning in August and relief of water, tick and other stresses. In the third season another cow died. The remaining cows were supplemented with protein and survived. Each of the survivors received 51 lb. of meal.

Based on the results of these experiments, males should be supplemented only for special purposes:

- To have fat cattle for slaughter in late dry or early wet seasons.
- To finish selected cattle at 2\(\frac{1}{2}\) years.

Breeders may be supplemented:

- To build up heifers for their first calf.
- To avoid deaths in all seasons.
- To increase turnover of male and female cattle.

If cattle are to be fed for survival then only 50 lb. of protein meal or its equivalent should be required per beast per annum provided sufficient dry standing pasture is available to supply dry matter requirements. If breeders are to maintain full productive capacity and be brought at last to the butcher, then something less than 300 lb. of meal is required. Definition of exact requirements awaits further research.

In an effort to measure the performance of cattle on range pasture, calves were ear tagged at birth in order to establish time of conception, calving, growth rate, and tooth eruption. Great difficulty with cattle control was experienced. Preliminary examination of incomplete data showed that Kimberley shorthorn cattle have much the same values for age of conception and tooth eruption as cattle elsewhere.

Small trials were conducted to measure the palatability of several oilseeds and of Wyndham blood and bone meal. Contrary to expectations cattle ate blood and bone meal readily when encouraged for a start with linseed meal. All other oilseeds were palatable save mustard seed. Undelinted cottonseed is moderately palatable, but
stock will consume at least 4 lb. per head per day.

Based on experiments at the research station, a large field trial is being conducted on Argyle Station in the East Kimberleys. Three hundred breeders are being fed on whole, crushed, undelinted cottonseed. At the time this report was prepared cattle were eating 4 lb. per head per day.

**PAPERS CONCERNING WORK AT KIMBERLEY RESEARCH STATION**


The Kimberleys must be considered particularly favoured, for the rainfall, though seasonal, is much more reliable than over much of pastoral Australia. The establishment of a cotton industry at Kununurra producing supplements locally means that the troughs in nutrition can now be eliminated with the promise of a major increase in turn-off for the whole region.

**KIMBERLEY RESEARCH STATION**


Thomson, N. J. (in preparation).—Nitrogen fertilisation of irrigated cotton at Kimberley Research Station.


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