

DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

MINI-CONFERENCE

ANNUAL MEDICS:

Establishment, management and general
utilization.

Convenor:

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INSECT CONTROL IN ANNUAL MEDICS

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1. Introduction

Since the establishment of annual medics in South Australia they have been remarkably free of insect pests. This could explain some of their success as part of the agricultural system of this State. The introduction of annual medics seems to have been largely unaccompanied by their insect pests. It has only been with the appearance of sitona weevil that annual medic pastures have been seriously threatened by an insect.

Sitona weevil is by far the most serious pest in annual medics and redlegged earthmite and lucerne flea can cause serious concern. The other pests are spasmodic in their appearance and generally are of little importance.

All rates of recommended insecticides are given in Appendix I.

2. Red-legged earthmite and lucerne flea

Attack by these two pests are not as frequent or severe in drier areas explaining why medics are attacked less than subterranean clovers.

Unlike some other agricultural pests, cultural control measures for red-legged earthmite and lucerne flea are of limited assistance. Crop rotations are of little real value, but burning with a hot slow fire will give good control. Fallowing achieves some control, but such areas are rapidly reinvaded.

In South Australia the predatory snout mite is largely ineffective in controlling lucerne flea. No effective parasites or predators are known for red-legged earthmite.

Because of the general inadequacy of cultural techniques we rely heavily on insecticidal control for these pests.

All insecticides currently in use are effective only against the active stages of these pests. They will not kill either overwintering or winter eggs.

The most desirable time to use insecticides is during the 2-5 weeks after the opening rains. During this period, under ideal conditions, all overwintering eggs of both pests have hatched and winter egg-laying has not begun, so all are in susceptible stages of development.

Present recommendations for spraying are with phosmet, lindane, technical maldison or dimethoate.

An alternative to spraying is by seed treatment with dimethoate or demeton-s-methyl. Both are systemic insecticides and have been shown to control both flea and mite when applied as a seed dressing prior to sowing. Treatment is cheap and convenient, particularly where it may not be possible to get on the ground to spray after seeding. Seed treatment must not be carried out where seeds are to be inoculated with Rhizobium cultures. On present knowledge it would seem that seed treatment is of only limited value where sowing into a weedy seed bed.

Resistant varieties have not been considered since they would offer little control for such widespread pests with large host ranges.

3. Weed webworm

Weed webworm is a native insect which is always present in very low numbers. Every now and then it flares up and causes a problem with pastures in March. These build-ups seem to occur following a dry winter or exceptional January-February rains. These rains will have caused early germination of medic and the decision to spray or not will depend on whether these medics are worth saving.

If there is a particular feed shortage they may be worth saving.

The old recommendation is for spraying with D.D.T. However if there is a high risk of residues - as with dairying or where animals are being finished for slaughter - we suggest the use of trichlorphon. This is only a suggestion since no field trials have been done on this insect. Such trials would be impractical since the insect only appears in pest numbers every few years.

4. Aphids

If conditions through winter are mild and dry then aphids can increase in numbers. This increase usually only continues for a short time and by the time the problem is recognized, treatment is carried out too late.

There are four stages when sitona weevil could be attacked by insecticides - egg, larva, pupa and adult. The eggs of insects are usually not susceptible to insecticides. Even if they were susceptible, insecticides are an impractical proposition since eggs are laid from April to August-September, necessitating several sprays. Similarly with larvae, they occur over many months and would require several treatments unless a persistent insecticide was used. The addition of persistent insecticides to the soil is not recommended because of resultant residue problems and because such a practice on a wide scale would almost certainly result in resistance to pesticides. By late September the majority of sitona that are likely to survive are in the pupal stage. If these pupae were killed with insecticide the population emerging from that paddock would be drastically reduced. However the paddock could quickly become reinfested with newly emerged sitona adults from adjacent areas, rendering the treatment useless. The other fault with spraying at this stage is that damage by larvae has already been done. Chemicals are available which kill sitona adults but because of adults' mobility and very wide distribution reinvasion is highly probable. The cost of treating adults is limiting in the ordinary pasture situation but could be economic where a seed crop is being protected.

The next control technique we have available to us is the introduction and release of parasites. Sitona weevil has been considered as a likely prospect for biological control because it is an introduced pest and is not particularly troublesome in the areas of its origin. Dependence on parasites alone may not offer a completely satisfactory alternative to chemical control. The fundamental nature of biological control is such that, in many instances, the control will not be perfect. At certain times the parasite population may drop and the pest population will rise temporarily above the tolerable levels set by man's economic requirements. In some cases the parasite may provide a significant degree of control but not sufficient to keep the pest below tolerable levels. In these cases of partial control, integrated control procedures can provide supplemental control as needed by chemicals or other methods.

The third approach we have to controlling sitona is with resistant varieties. At present the only resistance found in annual medics has been a partial resistance to adult feeding; the plants are still attacked, but only if other food is not available. Such resistant varieties could be useful with lower density weevil populations. Another draw back with resistant varieties is that with

Stock feeding on aphids can become photosensitized but this is not lethal. Aphids are vectors of subterranean clover stunt virus which is known to attack annual medics. If aphids do become a problem then they could be sprayed with demeton-s-methyl.

5. Lucerne pod borer

Lucerne pod borer or Etiella can be a problem in annual medics but treatment is only worthwhile where a seed crop is involved. Dr. R.J. Banyer when working with the Department of Agriculture found Etiella to be a problem on the black self-mulching soils of the lower-north. Medicago intertexta was attacked and it was suggested that its susceptibility was due to its later maturity. M. rugosa and M. scutellata were also attacked, probably because of their smooth pods. Commercial barrel was attacked but there was no penetration of the seed.

The present recommendations of parathion for Etiella in lucerne crops would also apply to annual medic seed crops.

6. Sitona weevil

Sitona weevil was first recorded in South Australia in 1966 and is now established over most of the agricultural areas of the State. It is a serious pasture pest because of defoliation of legume pastures in spring and probably more importantly because of the insidious loss of soil fertility in annual medic areas due to the soil-dwelling larvae feeding on nodules.

6.1 Integrated control

Our aim for controlling sitona is by the use of an integrated control programme. Integrated control is a pest management system that utilizes all suitable techniques in a compatible manner to reduce pest populations and maintain them at low levels, below those causing economic injury. Integrated control achieves this by combining the techniques in an organized way, by making control practices compatible and by blending them into a flexible, evolving system.

The techniques we have available to us for the control of sitona weevil are parasites, resistant varieties and insecticides. The idea is not to use one of these techniques by itself but to combine them into an integrated control programme. Each technique has its own drawbacks and so must be supplemented by the others.

very large populations of sitona there may be rapid selection of insects which will attack the resistant varieties. These factors indicate that resistant varieties by themselves are unlikely to solve the problem. The introduction of parasites could reduce sitona numbers to a level where resistant varieties become economically significant.

In some years both techniques may not reduce the population to a tolerable level and then we envisage the judicious use of chemicals.

The usual procedure is an integrated control programme is that chemicals are phased out in favour of biological aspects of control. What we are proposing is the reverse; biological control will be introduced since the use of insecticides is not feasible. Then, as numbers of sitona are reduced, it may be possible to usefully introduce chemicals into the control system.

It is clear that all avenues of research on control must be left open if an integrated and satisfactory control system is to be evolved.

6.2 Current Research

There are three groups of people involved in current research on sitona weevil: the entomology and plant breeding sections of the Department and C.S.I.R.O., at Montpellier, France.

6.2.1 Resistance testing

Murray Mathison of the plant breeding section has been studying introduced lines of annual medics and Jemalong for resistance to adult feeding. The screening process involves a preference rating comparison with Jemalong using caged adult weevils on seedlings grown in flats of soil or on trifoliolate leaves cut from plants in the field. Four to five weevils per plant are needed to indicate clear preferences. More than 3,000 accessions have been screened and low through to moderate levels of resistance found in 10 of the 26 species examined. Of the agronomically useful species the best resistance so far appears in Medicago rugosa and M. scutellata. However, plants of even the most resistant line are eaten to some extent where large numbers of starving adults have no other choice of diet. It is hoped that higher levels of resistance may be found among the progeny from crosses between

resistant lines from a species. As well as screening of introductions, tens of thousands of seedlings of Jemalong have been examined without finding a resistant natural mutant.

6.2.2. Parasites

Dr. Aeschlimann of C.S.I.R.O. is concerned with the search for parasites and evaluation of their effectiveness. To date, one trip has been made to Spain to collect parasitized adults, and the parasites have been reared through.

6.2.3 Biology

I am concerned mainly with the biology of sitona weevil, particular emphasis being placed on aspects involved with biological control.

Adult Biology

With the assistance of groups of farmers at Narridy, Salter Springs and on Yorke Peninsula it has been shown that egg development begins in late February and may be complete by early May if food is available. Without food this may be delayed by six weeks.

In 1972 old and new generation adults overlapped by 3 to 7 weeks although the proportion of the population which overlapped was small. Egg laying continued to within one or two weeks of the death of old adults.

Old and new generation adults may overlap by 3 to 7 weeks, although the proportion of the population which does overlap was small. Egg laying continued to within one or two weeks of the death of old adults. New adults began emerging from the 8th to 15th October and 97% had emerged by mid November. Adult activity continued until mid-December.

Larval Biology

Irrigation bench cultures indicated higher survival of larvae in loam than in sand. Further refinement in rearing techniques will be necessary to permit mass rearing.

Larval damage assessment studies will require closed pots to prevent root escape.

Field Sampling

A sample unit of 108 cm² used for stratified random sampling indicated a mean larval density of 25 per 1000 cm² in a paddock of annual medic at Roseworthy. However the density indicated by emergence traps for adults was approximately 10 times higher, indicating deficiencies in sampling techniques.

Toxicity of Maldison

As an "incidental" contaminant in grain, sitona presents a local problem. Previous work showed that 8 ppm maldison was toxic to sitona adults, but as much of our export grain has only 2-3 ppm maldison at the time of export, information was required on the toxicity of low concentrations. Although the results were not conclusive because of high natural mortalities, trials indicated that levels of 5 ppm maldison are probably required to kill adults.

7. Conclusions

From this talk it is clear that we can give little advice to the farmer about the tolerable level of infestation or the tolerable level of damage. There has been practically no progress rationalizing pesticide use against any Australian pest based on careful and thorough assessment of the damage it causes. A great deal of research needs to be done to determine just what are these economic - injury levels.

APPENDIX I - CONTROL RECOMMENDATIONS FOR PESTS OF ANNUAL MEDICS

Pest	Host	Insecticide	Rate per hectare
Aphids	Forage crops	Demeton-S-methyl (e.g. for a 25% product)	.07 kg a.i. (.28 l)
Lucerne pod borer (<u>Etiella behrii</u>)	Seed crops	Parathion	.14 kg a.i.
Sitona weevil (<u>Sitona humeralis</u>)	Lucerne, clovers	Azinphos ethyl (e.g. for a 40% product)	.21 to .28 kg a.i. (.53 to .70 l)
		Fenitrothion (e.g. for a 50% product)	.28 kg a.i. (0.56 l)

Minimum inter- val-last applica- tion to grazing, harvest or hay- cut	Approximate cost per hectare	Remarks
7 days	\$2.30	For limited control e.g. to permit grazing of heavily infested crops.
14 days	70¢	Effective control depends on reducing moth numbers to minimise egg laying. Spray after each wave of seed setting when moths are active. Should be applied only by operator familiar with hazards. Spray when bees not foraging.
21 days	\$2.10 to \$3.84	Concentrate highly toxic. Keep out of spray drift. Delay treating forage lucerne until significant leaf damage occurs. Treat legume seedlings as damage becomes apparent. Toxic to bees.
7 days	\$2.07	Delay treating forage lucerne until significant leaf damage occurs. Treat legume seedlings as damage becomes apparent.

APPENDIX 1 (Contd.)

Pest	Host	Insecticide	Rate per hectare
Red-legged earthmite (<u>Halotydeus destructor</u>) and lucerne flea (<u>Sminthurus viridis</u>)	Crops and Pasture	Phosmet (e.g. for a 15% product)	.04 kg a.i. (.25 to .35 l)
		Lindane	.14 kg a.i.
		Technical maldi- son (e.g. for a 96% U.L.V. product)	(.28 l)
		Dimethoate (e.g. for a 40% product)	.02 to .04 kg a.i. (.05 to .09 l)
Weed webworm (<u>Loxostege</u>)	Seed treat- ment Barrel medic	Dimethoate	per 100 kg seed .189 kg a.i. (.63 l)
	Pasture	DDT (e.g. for a 25% product)	0.35 kg a.i. (1.4 l)
		Trichlorphon (e.g. for a 60% product)	0.42 kg a.i. (0.70 l)

Maximum inter- val-last applica- tion to grazing, harvest or hay- cut	Approximate cost per hectare	Remarks
7 days	32 - 50¢	Only use low rate 2 to 5 weeks after opening rains.
14 days	93¢	For combined control of earthmite and pasture cockchafer. Not effective against lucerne flea. Apply as spray or topdress with lindane - superphosphate. When using a "spinner" drive no more than 5 to 6 metres apart.
7 days	76¢	Ultra low volume application by aircraft or suitable ground misting equipment. Not effective against blue oat mite. Toxic to bees.
1 day	32¢ to 64¢	Rain within 24 hours may reduce effectiveness.
-	per 100 kg seed \$2.99	
49 days	74¢	Do not feed residues to dairy cattle or animals being finished for slaughter.
2 days	\$2.10	This is only a suggestion. No experimental work has been carried out.

DiscussionSitona weevil

Most discussion centred about the use of insecticides to control Sitona.

It was suggested that where Sitona infestation was severe in early autumn it may be economical to use Azinphos ethyl to save valuable autumn feed especially as the spray is possibly effective against red-legged earth mite and lucerne flea.

Although it was realized that the chemical control of Sitona was extremely limited because of the life cycle and mobility of the weevil, in the establishment of medics, a strategic spraying may well be worthwhile to prevent destruction of the young pastures.

In answer to a question as to the effect of drought on Sitona, Mrs. Moulden said that such conditions do control insect numbers because there is insufficient food to allow the larvae to fully develop into virile adults thus adversely affecting adult egg-laying capacity.

In answer to a further question on the effect of high summer temperatures on Sitona weevil it was explained that during such times weevil numbers were not adversely affected as the insect was capable of going virtually into a state of rest during these periods.

Weed Webworm

There were varying views on the extent to which this insect can damage pastures. Several considered that damage particularly early in the year was not serious, however others considered that damage could be severe.

Control measures included spraying with DDT or heavy grazing although in heavy infestations the web on the pasture will make it quite unpalatable.

Although Trichlorphon was included as a suggested chemical control for weed webworm, several extension officers were of the opinion that it should not be included until such time as it had been tested for that purpose.

Chemical control is often useful where the control of isolated infestations is desirable to prevent spreading to uninfested areas.

USING ANNUAL MEDICS IN THE FARMING SYSTEM AT
ROSEWORTHY COLLEGE

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1. Introduction to Roseworthy

Activities tend to be viewed as only being possible at Roseworthy, under Government sponsorship, but similar farming systems are being used with success commercially. The availability of finance is one area open to criticism, but production is influenced by a limited, but flexible budget. I believe that with a planned approach to medic production, finance should not be the limiting factor for the majority of farmers.

The availability of labour through the student work force is an exceptional situation, but agricultural operations were attempted with commercial units, justifiable in terms of normal economic management.

1.1 The farm

Area 1200 ha. approx 80 ha buildings, roads orchard etc.
570 ha cereals
80 ha fallow
430 ha leyland or seeded pasture
40 ha pure medic seed.

1.2 Rotation

This was essentially flexible, with an aim to crop alternate years or two years in four. The rotation of any one area was influenced by previous history, paddock reaction to a particular treatment or season, the level of weed infestation and general farm requirements.

1.3 Soils

All the range of Mallee Soils, with areas of red brown earths and pockets of heavy black earths in low lying areas.

1.4 Rainfall

440 mm average (from 220mm to 660 mm).

1.5 Main weeds

Soursob, emex, wild oats, fumitory, capeweed, wireweed.

1.6 Insects

Red-legged earthmite, lucerne flea and Sitona weevil.

1.7 Stock

Approx. 3000 sheep
 200 cattle including a 45 cow milking herd
 700 pigs
 3000 poultry

2. The aim of the medic programme

2.1 To lift fertility

A vigorous policy of medic establishment was pursued and increased production was a continuous process. However reduced yields occurred in paddocks lacking medic establishment and maximum production from the total cereal crop was not attained in the majority of years, because of lack of nitrogen, not necessarily moisture e.g. Harvest 1971-72 when the barley crop average for 292 ha was 2.622 tonnes ha one paddock of 21 ha with a poor medic establishment history yielded only 1.740 tonnes ha.

2.2 To improve soil structure

Another limit to maximum production prior to intensive use of medics was areas of hard setting soil. In establishing medics, in particular Jemalong medic, a noticeable improvement in soil structure occurred. This resulted from a two fold effect of increased total root growth as well as increased surface trash incorporation in conjunction with shallow soil cultivation. The total area of soil affected by surface sealing was gradually diminishing. Combined with this a programme of 'patching out' areas with gypsum for \$5.88 ha was economically feasible.

2.3 To provide quality fodder

2.3.1 Paddock grazing

Differing rates and selected varieties of barley and oats were used to overcome lack of medic growth in autumn and early winter and to supply a range of requirements for the various stock types. Spring feed was never a problem and often cereals could be reduced by heavy grazing during winter allowing medic to dominate in the spring with obvious advantages. Wimmera ryegrass occurred naturally in some pastures and gave good spring feed but it has drawbacks. Its inclusion in the pasture can involve a spray application to control it in the following crop year as it is difficult to prevent it seeding in a pasture even with heavy grazing. An imbalance of Wimmera ryegrass: medic can occur in spring also with a consequent crowding out of medic and a reduction in nitrogen fixation.

One of the essentials when using grasses and cereals in this way is to remain aware of their influence in a cereal root disease cycle. Carrying capacity credited to medic pastures at Roseworthy however would not have been possible without this inclusion of cereals.

2.3.2 Fodder conservation

Conservation of fodder of one type or another, as silage or just standing dry feed was essential to cater for the variety of livestock. The best quality baled medic hay was milled and incorporated in pig rations, the roughest cereal dominant hay as a bloat preventative measure in succulent pasture. Embodied in this conservation programme was a valuable weed control factor which is one of a number of factors often overlooked in evaluating fodder conservation.

3. Methods of pasture establishment

3.1 Dry seeding

3.1.1 Straw incorporation

This I considered was the key operation in the whole farming programme and it followed almost without exception a cereal crop. Although incorporation of straw is desirable, any operation should have pre-determined primary and secondary aims and with dry seeding it is pasture establishment, therefore anything which inhibits medic establishment should be dealt with. Excess straw can be one of these factors and the judicious use of stock combined with trash harrowing and or burning is essential.

3.1.2 Seeding method

Seeding commenced in mid March using a trash seeder unit fitted with a small seed box and sometimes followed by cover harrows and almost always by a culti-packer. "False starts" to the season can reduce plant numbers but high seeding rates combined with compaction after seeding proved successful. The culti-packer proved ideal as it leaves a surface capable of handling both heavy and light rains. Light rains evaporate from the increased surface area while heavy rains are more readily absorbed. Placement of medic seed relative to soil movement from discs or tyres is important to avoid establishment in double spaced rows and at too great a depth. High ground speed and cover harrows aggravate this, but placement of the medic seed in soil at rest is feasible by extending hoses and a more even spread rather than row seeding can be achieved with modification to working methods and the machine.

3.1.3 Seeding rates

The rates varied from 7-11+ kg ha according to requirements from the crop, seed size, anticipated natural regeneration, amount of cereal to be used or whether it was for pure seed or otherwise.

3.1.4 Cultivars used

*Hannaford

Hannaford was used in early establishment at light seeding rates, persisting well on the more alkaline and lighter soils under a system of natural regeneration, but did not persist well on the heavier and hard setting soils especially against a programme of fodder conservation with little re-seeding.

*Jemalong

This was used with a great deal of success on all areas, only lacking vigorous growth on patches of acid soil in both low lying areas and on some shallow sand over clay rises.

*Harbinger

This medic was tried where deeper sand existed, but with little success. The bulk produced did not equal that from Jemalong with which it was always mixed in equal quantities.

*Paragosa

This gave added production from the low lying areas of heavy black earth areas and has potential but its future appears to be hinged with Sitona weevil control for they appear to favour this medic.

3.1.5 Sub clover and medic mixture

This approach to maximise production from pastures is feasible on areas of borderline pH using species such as Geraldton and Clare which are suited for these pH levels. It can mean spot sowing in some areas or even half or whole paddock treatment.

3.1.6 Spraying pastures

3.1.6.1 Insect control

*Redlegged earthmite and lucerne flea

In most years spraying is essential for a quality stand of medic. If early spraying was not carried out it often became necessary in the winter or even spring to avoid leaf loss. Systemic sprays with a minimal stock removal time were used.

*Sitona weevil

The carry over of mature insects into the autumn could become a problem. In one infestation of this type in the autumn of 1972 a spraying with 280mls of azinophos ethyl resulted in an excellent Jemalong medic pasture and a relatively heavy seed set even though the year was a dry one.

As a general comment on dry seeding, I suggest it utilizes all winter rainfall, it makes good autumn and early winter grazing possible while providing better use of plant and labour. The practice also leads to flexibility of production.

e.g. at Roseworthy, it has resulted in such yields as

2.69 tonnes oats per ha
6.28 tonnes cereal-medic hay per ha
30.13 tonnes green fodder per ha.

3.2 Undersowing of cereals

This practice is feasible where soil fertility is low and little tillering and cereal growth is expected and where post seeding spraying is not anticipated.

The efficacy of this method is doubtful in areas where heavy stubble after reaping shades the soil resulting in a preponderance of hard seed.

3.3 Seeding as a crop

This is the only method suitable for certified seed production and the place for it in the rotation is after a period of intensive cropping e.g. following 3 crops or a fallow followed by 2 crops. Herbicides such as Trifluralin, 2,4-DB and Barban are most useful.

Compaction before and after seeding is essential for good germination, plant survival and efficient harvesting.

4. Grazing Management

4.1 General pasture weed control

Set stocking, with a lift in grazing pressure to control weeds is probably the best answer to weed control. If grazed hard enough, the winter weeds are severely checked, until the spring growth of medics, when competition completes the control.

"Spray grazing" using 2,4-D amine appeared too severe on Jemalong medic, with MCPA being less effective on the weeds that required control. Prometryne used early in the life of medic gave good control of capeweed.

A grazing flock of mature wethers or dry ewes are essential for weed control.

If conserved fodder is required, sheep must be removed in time to get hay into a windrow before the October hatching of Sitona weevil.

4.2 Grazing and pure seed production

The aim is to keep the plant close to the ground and open to sunlight. High bulk crops are often less productive and certainly more costly to harvest. Removal of stock is essential where pugging is likely and at the early flowering stage.

5. Harvesting of medic seed

The approach at Roseworthy was conventional, with no modifications to the standard suction machine. Yields of 440 kg ha were achieved.

Attempts to reduce harvesting costs by burning were made after mid February and following an overnight rain. The Jemalong pods were still damp when the trash was dry. Although some seed was charred and the percentage of dead seed slightly higher in the finally cleared sample it still passed the certification test. The area only required meshing prior to reaping. Nights of heavy dew could perhaps be used in the same way. The precise timing of the burn is critical.

6. Some general comments

6.1 Reliance on natural regeneration has been a drawback to successful medic use in the higher rainfall areas. Re-seeding at high rates is essential unless a previously satisfactory seeding down has been observed and intensive summer grazing avoided.

Where soil is not open textured and seeding has occurred, a light cultivation will improve germination especially on hard setting soils.

6.2 A farmer should be encouraged to view a medic pasture primarily as a nitrogen source in the farming system, not primarily as a source of fodder.

6.3 The small seed harvester would make an ideal machine for syndicated ownership.

6.4 Bank managers should be made more aware of the role legume pastures play in the cereal farming system. Extension aimed at banker education would in many cases be more fruitful than perhaps directed solely at the farmer.

Discussion

Mr. Norton explained that the use of gypsum on hard setting soils at R.A.C. was economically justified because of the obvious advantages of soil structure. The hidden advantages i.e. soil structure and long term effect of better pastures made it well worthwhile.

Regulating depth of seeding is not particularly important for pastures as the seed is usually dropped on the surface and incorporated by cover harrows and cultipacker.

Insect control was necessary to maintain a good upright pasture.

In relation to spray-grazing, old dry ewes were more effective than wethers in the control of Salvation Jane.

Although not normally recommended, the practice was fairly widespread in the Mallee where crop growth was generally lighter. Under such circumstances it can be economical.

Some farmers never reseeded and yet their pastures were excellent. Under other situations regeneration is unreliable. We should be able to be in a position to advise fairly confidently as to whether reseeded is necessary or not. Does drought or certain soil types or climatic conditions have a direct bearing on future regeneration?

Several officers considered that a germination test of a sample area of the paddock by artificial watering in the autumn may determine the viability of medic seed for the coming season and therefore give an indication of whether reseeded would be advantageous or not.

The results could be very misleading.

In reply to a question on how to determine whether reseeded is necessary or not, Mr. Norton said that from his experience, one could make a relatively accurate assessment by general observation as follows -

An assessment of the seed set in the paddock following a medic pasture.

If heavily stocked at seeding time seed could be reduced to a level where reseeding was advisable.

When in doubt, reseeding should be carried out as an insurance rather than as an added expense as viewed by some farmers.

1956 was a good year followed by 1957 poor, 1958 good, 1959 poor. 1960 was a good season but eelworm infestation was severe. This could possibly be explained by the fact that where alternate years of cropping and pasture were carried out, pasture years would have coincided with the poor years of 1957 and 1959 and therefore soil nitrogen would have been in most cases severely depleted by the 1960 cropping year. A run of poor pasture years would certainly indicate re-seeding of medics for optimum nitrogen fixation and subsequent cereal yields.

Can good medic pastures do away with fallow? Mr. Norton said not entirely. Much depends on the many soil types and environmental factors.

Mr. Norton further stated that good medic years can normally be expected following an early break in the season. Poorer medic pastures with a much higher percentage of grasses usually follows late seasonal breaks. Under these latter conditions controlled grazing and pasture management was essential for medic domination.

FIELD EXCURSION

Two properties were visited on the field excursion. The first was that of Mr. Adrian Pearce of Tickera. Mr. Pearce's property was 566 hectares of undulating deep sand over light clay having an average annual rainfall of 300-330mm.

Until 1956 there had been no sowing of annual medic on his property. Low applications of superphosphate and constant fallowing, with poor regeneration of naturalised medics had resulted in the property being in a poor state.

In 1956 sowing of medics was started and the first cultivar used was Hannaford at the rate of 2.24 kg/ha. In 1964 a programme of medic sowing was started in earnest, sowing the paddocks with the poorest naturalised medics and lowest production. 243 hectares have now been sown with improved cultivars.

A close watch is kept on paddocks that have been sown with medics and a decision to reseed is based on observations of preceding years production and seed set.

He tries to maintain pure medic stands, avoiding carry over of diseases which may occur when cereals are grown in a medic stand.

The success of his programme is apparent in that he has had a 9-10 kg/ha increase in average crop yields, has been able to eliminate fallow and close up his rotations to 2 years and has been able to make silage and bale hay.

His cropping and stock figures as shown below are also an indication of improvement.

1962-63

700 sheep
20 cattle
202 ha crop
202 ha fallow

1973

350 sheep and 200 lambs
250 cattle
283 ha crop
no fallow

From 1958-1970 112 kg/ha of superphosphate was applied each year but from 1970 onwards he has been applying 168-180 kg/ha of prescription mineral fertilizer. The prescription being mineral phosphate, serpentine, copper and zinc. He thinks the mixture is more beneficial to pastures than superphosphate but has noticed no difference with crops.

The first paddock he showed us had a natural stand of Medicago truncatula var. longeaculeata and had never been sown with a medic cultivar. Although the stand looked very good and had a high stocking rate since the opening rains (260 ewes, 60 lambs and 60 cows on 47 ha) account must be taken of the above average rainfall (359 mm this year). In a drier year this paddock performs disappointingly with high brome and barley grass content. As it had the best soil on the farm and

returned reasonable yields in cropping years it was left until last to be sown with an improved medic cultivar.

The second paddock was one sown with Cyprus. In 1965 it was sown at 1.7 kg/ha. Mr. Pearce uses registered seed and his sowing rates are from 1.1-3.4 kg/ha, lower rates on better naturalised medic areas. He has found the germination from these rates satisfactory. This paddock had a poor naturalised medic stand, was on a poorer soil type and produced low yielding, diseased crops but is now one of the best on the property. This year the stand of medic was excellent although he said it was not a good year for Cyprus, being more suited to Hannaford and Jemalong which mature later than Cyprus.

The third paddock was a very sandy paddock and he considered it one of the worst on the property before it was sown with medics. It had been overrun with mignonette, barley grass, brome grass and soursob. In 1967 the whole paddock was sown with 1.7 kg/ha of Hannaford. In 1969 the western half of the paddock was sown with 1.7 kg/ha of Harbinger and 1.7 kg/ha of Jemalong. There was an excellent stand of medic this year (60 cattle from opening rains until last week of June. 130 cattle since then on 36.4 ha). An interesting observation was that the cattle always prefer the half of the paddock where the three varieties are sown. This paddock has shown a high increase in crop yields, the rotation has shortened to two years and a drop in barley quality indicates higher fertility levels.

Mr. Pearce has found that Harbinger, Hannaford and Jemalong dominate in a poor year and thinks it probable that these cultivars will also dominate in a good year when seed has built up.

Finally we saw two crops side by side. One on a paddock with poor medic history and the other with a good medic history. The difference was marked with the crop on the better medic history paddock being denser and freer from disease than the other.

The second property visited was that of Mr. Duncan Correll of Clinton Centre. This was an undulating property of loamy mallee soils in a 380-406mm average annual rainfall area. This year he had received 356mm to the date of the excursion.

Mr. Correll practices re-seeding of medics sowing mixtures of two or three cultivars for pastures and on six paddocks that lend themselves to medic harvesting he sows pure stands of medic to reap for seed. He grows seed crops every second year but harvests them only if the season is good and he is able to carry his stock on other pasture areas.

He has rejected several cultivars namely: Harbinger, Hannaford and Tornafield. He is undecided about the value of Jemalong. Hannaford, he felt was duplicated in Borung and Cyprus which he now grows and felt that the winter production of

Tornafield was not good enough. He also grows snail medic and Paragosa although he finds Paragosa poor in a year of low rainfall. He feels that mixtures provide better average production with varieties dominating depending on the season.

Medics are included in a barley, peas and 2 year pasture rotation, reseeding each year of pasture. This rotation is flexible, according to stock needs. Sowing of medics is carried out either before or after the opening rains but Mr. Correll is not sure which is the more desirable. He feels that good cultivation is essential in establishing a good medic stand and believes in discing weeds under to a depth of 8.0cm. He finds this very effective in controlling barley grass and a number of other weeds. Sowing is done with two combines, one sowing a mixture of oats and Cape barley and another following behind dropping the medic mixture between the rows of the oats and barley. 67 kg/ha of superphosphate is used. He has been using this rate of phosphate for 10-15 years, applying it annually over his whole farm.

Sowing of pure stands of medic is preceded by an application of 0.115 litres Treflan and 0.17 litres Avadex per hectare. Mr. Correll estimates it costs him \$13-\$15 per ha to establish a pure medic stand and he also estimates that it costs him 11¢ per kg to produce seed.

Careful grazing helps him with weed control and to maintain better medic stands. He never allows cereals to mature in a pasture as diseases may carry over into the crop year but he grazes hard or "zero grazes" at a stage when the animals would selectively graze the cereals. Mowing is another method he uses to maintain his medics. Cape barley can form a canopy and smother medics, so mowing is used when this might happen.

Another method he uses to maximise production is to apply \$5 worth of urea per hectare over all pasture areas as a spring dressing. He broadcasts this on the pasture while it is raining. He claims this application increases stocking rates (carries 1 sheep/acre) and thus allows an increase in cropping area.

The first paddock inspected was a very good stand of Borung. He had sprayed this paddock with a mixture of 45.9 gm Tribunil and 22.9 gm MCPA per hectare but there was some evidence of spray damage and he said he would not use any more hormone type herbicides on medics. The Treflan-Avadex mixture controlled the wild oats very well, except on combine wheel marks where there was poor incorporation of the spray. Some weeds were present and Mr. Correll said that Jemalong was slowly invading the paddock and because of its poor winter growth allowed weeds to establish. When the Borung matures and drops its seed he will cut and windrow and then remove it all from the paddock to the threshing area straight away. In this way he hopes to avoid mature wild oat and sheep weed seeds.

The next paddock was an excellent seed crop of Paragosa. Mr. Correll admits that it is probably too bulky for a seed crop and should have been grazed to allow a better seed set. The paddock was sprayed with Tribunil and half the paddock was sown

with inoculated seed, but he feels that this was not necessary as there was no difference in establishment of the uninoculated area.

The last paddock we inspected was one containing a mixture of oats, Cape barley, Merredin and Westerwolds ryegrasses and medics. This type of pasture responds very well to nitrogen applications and provides very good stock feed. The oats he finds to be useless in a dry year and Cape barley can be an embarrassment in a good year. The two ryegrass cultivars were very satisfactory and were not a problem in a cropping year if they are not allowed to mature.

Points arising from the excursion to the properties of Mr. Adrian Pearce of Tickera and Mr. Duncan Correll of Clinton Centre

Why were those particular sites chosen?

These properties were chosen because they had a range of soil types and related medics. We were able to see Cyprus on a sandy soil and a localised medic on Adrian Pearce's property. Mr. Duncan Correll differs from the district particularly. They both differed in their approach and in their thinking with the Department of Agriculture.

What of the use of urea on Correll's property?

It appeared to be warranted on cereal crops.

Urea boosted grass dominant paddocks, such as Tama ryegrass.

Correll resows his pasture, why is it necessary?

If a paddock is 50/50 grass-legume, only half the sward is fixing nitrogen.

One must be careful about what appeared to be uneconomic practices, as he has made a lot of money with hard work.

He has his son and is syndicated.

Practices may have been masked in this favourable year, and may be more dramatic in a leaner year. D. Correll may have been better off not to resow this year, as the season made management difficult.

Pearce and Correll both lean towards stock rather than cropping.

Are farmers rejecting or questioning the extension of the Department of Agriculture?

We must ask these questions to fit our thinking with those of farmers.

Duncan Correll has high inputs for medic seed production, e.g. the use of herbicides.

F.A.M.I.S. suggests that farmers in this region who kept away from extremes of inputs, and had lowered inputs were more profitable.

WEED CONTROL IN MEDICS

P.M. Kloot and M.J. Catt,
Senior Weeds Research Officers.

1. Introduction

In the past and even now to a large extent, the pasture years of rotations used in South Australian cereal areas have been very much the "poor relation" in the farmer's financial planning and management. Typically, whatever germinated was utilized and only lip service was paid to the ideal of a planned legume component in the sward.

At this stage of the Conference it would be rather impertinent to explain why legumes are needed but it would be more to the points perhaps, to outline why weeds are not needed in medic stands.

For the purpose of this talk, medics can be divided into the following groupings -

- *medic seed crops
- *medic pastures

- **regenerated
- **stubble sown
- **undersown

In medic seed crops weeds are undesirable mainly because of the adverse effects of weed competition. These are usually associated with the establishment phase. In some cases weeds can cause physical harvesting problems or entail extra cleaning costs because of weed seed contamination. The presence of certain weed seeds could cause downgrading of the medic seed.

Medic pastures may contain proclaimed noxious weeds and the landholder, by virtue of a Notice served upon him, could be obliged to control such weeds. Another possibility is the presence of poisonous weeds which the landholder wishes to eliminate. In both these cases, while cheapness of treatment is desirable it is not necessarily essential, nor is selectivity relevant.

But more to the point the presence of weeds is likely to lower the quality of the pasture, although recent work in Victoria would raise serious doubts on this score. Also as a good stand of medic is necessary to build up soil nitrogen for future cropping years, weeds crowding out medic render this process less efficient. It has also been found that wireweed at least, appears to inhibit medic germination by means of a water-soluble substance present in the leaves and stems.

Whilst many farmers would argue against it, the basic position is adopted that it is desirable to control weeds in medic pastures and in this paper, weed control in medics will be examined within the totality of the mixed farming system. The subject is so complex and full of "ifs and buts" that to deal with it in a paper such as this is somewhat similar to asking someone to give a comprehensive talk on "The Cause of World War II" in fifteen minutes.

Many of the weeds encountered in the legume farming system are very similar to medics. Their origins, habits and seasonal responses may be very close to those of medics and it is not surprising that a farming system which is being developed to encourage medic growth has, concurrently, led to an upsurge in such weeds. As a corollary it is clear that any control measures designed to reduce populations of these weeds, are highly likely to adversely affect medics.

Another basic problem which must be clearly understood is that medics as a group are sensitive to herbicides. In particular, the cheap herbicides which economically are the most attractive for broad-acre use are particularly severe on medics. Selective weed control in medics for all practical purposes is confined to high return situations. For medic pastures intended for grazing or conserving as hay, herbicides highly selective for medics are not feasible.

Even with these two fundamental difficulties, effective weed control is possible. Two factors tend to facilitate this. Firstly, landholders who are genuinely interested in improving their medic stands are sophisticated enough to have already had some experience with herbicides i.e. the adviser is not starting from scratch. Secondly, and much more importantly, the use of rotations introduces flexibility into control techniques. A weed which may be impossible to remove selectively from a medic pasture can be tackled in a different phase of the rotation. The classic example is that of soursob infesting medic pastures. This weed may be selectively removed during the cereal phase and the beneficial effects continue in the pasture years.

2. Principles of Weed Control

Before proceeding to details, attention is drawn to a number of principles of weed control which are particularly applicable to the subject.

2.1 Ultimately a good medic stand depends on a favourable ratio of germinable medic seed compared to similar weed seeds at the beginning of the season. Whilst no figures for our ley regions are available, on the basis of overseas work, there are probably thousands of kilograms of weed seeds per hectare.

The numbers of seeds would probably be in the order of tens of millions. So even if only a small proportion of this is able to germinate in one year, the numbers of weeds that emerge are incredibly large. The consequences of this are fairly obvious and would in any case have been dealt with by a previous speaker.

2.2 Allied to the first point, the cliché "Nature abhors a vacuum" must be reiterated. It is absolutely fundamental in formulating any weed control procedure that the removal of one plant always leads to the invasion by another into the vacant space. The aim of any weed control programme should be to ensure that the new plant is a desired species and not another weed. In this context, transplanting is out of the question, so medics must be introduced as seed.

2.3 Annual weeds are extremely efficient seed producers. Nevertheless this process is amenable to modification which is generally worthwhile in the long term. Competitive effects are still played out to the full so any effect will not show up until the seed reserves have been substantially depleted. This is a difficult point to make in extension because no obvious effect is apparent for some years. Furthermore unless the weeds mature somewhat earlier than medics or stand taller, slashing of the weeds prior to flowering will adversely affect medic seed production.

Nevertheless the technique is cheap and may be performed quickly.

A refinement is to use low rates of hormone herbicides to disturb the flowering and seed production processes by a hormone action. The same problem of adverse effects on medic arises.

2.4 It is desirable to control weeds as early as possible after they have germinated. The decision between earliness of treatment and successive germinations must be faced. Traditionally this dilemma is solved by successive cultivations for seedbed preparation.

2.5 As far as herbicides are concerned, the general rule is that annual weeds are more susceptible as seedlings (i.e. compared to approaching flowering) but established perennial weeds are more sensitive close to flowering. This is explicable in terms of translocation streams.

2.6 Contact herbicides e.g. diquat, paraquat, bromoxynil, affect mainly those tissues to which they are applied with only very limited translocation to other parts of the plant. Therefore in a pasture situation, best results are obtained on very young weeds which (a) have almost all their leaf and stem surfaces exposed and (b) have only a poorly developed root system.

2.7 Translocated herbicides affect growth processes. Low rates, repeated if necessary, are usually preferable to high rates which can destroy phloem tissue and consequently completely or substantially prevent translocation.

3. Preparation for Medics

Whether the medic is intended for seed or fodder, thought must be given to controlling weeds in the legume in previous years of the rotation. The use of diuron for soursob control in cereal years has already been mentioned and field observations indicate that within certain areas the control of soursob combined with the sowing of medic would be a tremendous step forward in pasture improvement. In some areas of the Lower North, it would make medic seed production feasible over a greater area.

But other examples spring readily to mind. Cruciferous weeds such as mustards, wild turnip, radish, charlock and so on, are cheaply and effectively controlled in cereals. They are difficult however to control selectively in medics. A concerted campaign on these weeds in cereal years must benefit subsequent pastures.

Similarly, composite weeds can be tackled in the same way. The grazing, slashing or cutting for hay of a previous medic pasture can have serious consequences. Where annual grasses promise to be a problem in a crop, it is often found that the paddocks are grazed heavily in the spring to reduce seeding. This has an adverse effect on medic seed production. Even worse is that attitude that in a poor medic year, one lets the pasture seed but in a good medic year when seed production would boost soil reserves, it is cut for hay. This would be acceptable if medic sowing in the pasture years was routine. But its not and there's the problem.

As was suggested earlier, the rotational system has the great advantage that preparation can be made in years prior to the pasture phase. Consequently, it is clear that to gain the most advantage from this technique it is advisable to keep the medic out of the system until it is actually needed. Thus from the weed control point of view (which is not necessarily the over-riding factor) it is better not to undersow a cereal crop with medic as it reduces the weed control options in that year. Rather use the year for reducing weed populations and sow the medic at the beginning of the following year.

The herbicides to be used in these preparatory years are those currently recommended on the "Cereal Spraying Chart" or in other publications. Where crops have been undersown with medics, the restrictions on types and rates of herbicides as shown in the "Chart" must be adhered to. Apart from what is on the chart the following information that has come to hand since publication is passed on. The tolerance of undersown medic to "Lasso"(R) is 1.6 pt/acre; for dinoseb EC it is 4 pt/acre up to the third trifoliate leaf stage. Manufacturers suggest that medics will tolerate 0.75 lb/acre of linuron. These writers have not seen anything to support this. Does anybody here have any field observations on this matter?

4. The medic phase

Any serious attempt at growing medic seed crops must involve the use of trifluralin (Treflan (R)) - 1.4 l/ha of commercial product (1 pt/acre). Double incorporation is essential, the second working preferably at right angles to the first. As ultra-violet light causes breakdown, prompt incorporation is essential on bright sunny days, especially if the temperature is over about 15°C. This chemical controls virtually all annual grasses, wireweed, fat hen, chickweeds and so on but no crucifers or composites which explains the earlier emphasis on these weeds. Wild oat control is not satisfactory and where this weed is likely, a different approach must be adopted.

But it is suggested that the use of trifluralin may have wider application than just seed crops. Where it is desired to obtain a medic dominant pasture quickly or on Eyre Peninsula where wireweed proves so difficult it may be worthwhile to give the medic a good start with such a pre-treatment. Other problem situations could be considered.

Where wild oats threaten, the use of diallate (Avadex (R)) is recommended 2.8 l/ha of commercial product (2 pt/acre). Post-emergent applications of barban (Neoban (R)) 0.7 l/ha of commercial product (0.5 pt/acre) if carried out properly are apparently satisfactory but this should be considered only as a salvage situation. It would not be applicable to large-scale fodder stands.

Post-emergent removal of grasses by herbicides is not feasible. Firstly, Kerb (R) is selectively effective but the price (\$14 per lb - usual rate 2 lb product per acre) is ludicrous. Paraquat is not recommended for post-emergent use in medics. However under very special circumstances it may be used, but only after a personal assessment of the situation. The use of paraquat must be restricted to these situations where the medic is effectively shielded from the herbicide by prolific grass growth. Upon reflection, such a situation lends itself to heavy grazing anyway.

The treatment of broad-leaved weeds could involve 2,4-DB (Embutox (R), Bexone (R)), bromoxynil (Buctril 20 (R), Brominil (R)), methabenzthiazuron (Tribunil (R)) or even MCPA (many brands). Methabenzthiazuron is a difficult herbicide because of the precise timing that is required. 2,4-DB should not be used on Paragosa medic. Harbinger medic is more tolerant of bromoxynil than is Jemalong. The choice of herbicide depends upon the weeds, and particular medic species present. The preceding information indicates certain variations in tolerance between species and cultivars, but at present our knowledge is very meagre. Yet it is this information which may explain why certain reactions appear to be so variable.

Whilst the above treatments are definitely useful in seed crops, they may have a use in fodder stands. Some examples would be the use of bromoxynil for pheasant's eye or yellow burr weed control or methabenzthiazuron for removing capeweed. A specialised case is the use of paraquat for removing onion weed. The important point here is to examine the spatial relationships. If the onion weed is effectively shading the bulk of the medic, treatment is indicated. If not, then this technique should not be recommended.

For broad scale treatment of weedy pastures (as long as no poisonous weeds are present) the use of the spray-graze technique is worthwhile. Heavy grazing as a weed control device is well-known, but the pretreatment with low rates of hormone herbicide e.g. 0.35 l/ha (0.25 pt/acre) of ester 2,4-D or amine 2,4-D greatly improves results. This method is even better than selective herbicides because less feed is lost. It works on most weeds that form rosettes e.g. capeweed, yellow burr weed, salvation jane, horehound and some thistles. Timing is important as it is essential that the grazing (preferably by sheep) be terminated by the time the spring flush begins.

5. Some Ideas Meant to be Thought Provoking

- 5.1 Adoption of definite weed control procedures in years prior to medic as outlined earlier.
- 5.2 Elimination of undersowing crops (as outlined earlier).
- 5.3 Sowing of medic seed in every pasture year at least until regeneration is assured.
- 5.4 Use of more expensive herbicides on broad acre basis. Is it likely to pay?
- 5.5 Use of trifluralin in a regenerated pasture for a cleaner stand. Is it feasible?
- 5.6 Will the flexibility found in rotational farming give a greater degree of weed control than is found in the South-east and will the industry develop here at the latter's expense?

Discussion:

Mr. Kloot began by pointing out that the presence of weeds was a symptom not a cause, where a weed problem exists it is because something that occurred previously was not right. The ley farming system introduces the possibility of controlling weeds in one phase of the rotation which assists the other phase for example, soursob control in the cereal phase but not in the pasture. However broad acre pasture weed control is unlikely to be economic though technically possible.

Slides of horehound, capeweed, woolly salvia, Trifluralin weed control in Jemalong and Carbetamex for grassy weed control were then shown, highlighting various points.

The point was raised that the cereal recommendation chart gives herbicide tolerance ranges for medics that are too high. This was countered by the fact that medics are a secondary consideration in a cereal crop. It was suggested that the 1974 chart give correct tolerances with regard to the cultivar and stage of growth.

The next issue was that not all weeds germinate in the crop phase in the ley farming system. What information do we have on how many weed seeds germinate each year and how much seed is set? Mr. Kloot said 5 years is a rough guide for seed longevity in the soil and he also pointed out that in the pasture year the weeds are not controlled. The meeting was reminded of the value of grazing animal to control weeds and that cereal growers only think of weeds in the crop not in the pasture.

MEDIC SEED PRODUCTION AS AN ADJUNCT TO MIXED FARMING

D.C. Ragless
Senior Seed Production Adviser

1. MEDIC SEED PRODUCTION IS A PAYING PROPOSITION

Returns from seed production on a number of northern cereal farms have equalled those from wheat and on several farms have provided a higher gross margin than wheat and consequently now provide the major source of income.

Costs of seed production are higher than wheat but so are returns.

Profitability of annual medic seed production is determined by the yield of clean seed, the cost of producing it and the price obtained for the seed.

Table 1 shows the range of production costs which are normally encountered which could range from \$35.70 per hectare to \$148.40 per hectare. To put these figures in perspective, most successful growers, who do not hesitate to spend money on seed crops if it is warranted, consider it costs between \$60-72 per hectare on average, to grow first rate seed crops.

Table 2 shows the effect of both yield per hectare and price per kilogram upon gross returns. Yields can realistically be expected to fall between 110 kilograms per hectare and 440 kilograms per hectare and price within the 44-66 cents per kilogram range. Yields below and above the usual range and prices both higher and lower than realistic have been included for interest. Normally I would consider yields lower than 110 kilograms per hectare to be unrealistic. It is acknowledged that prices have, during the 1970-72 recession, for some medic seed, fallen to below 30 cents per kilogram. These prices however, were excessively low and growers should not have been prepared to accept them. In fact, during the time these prices applied some growers were obtaining considerably more. Last season many growers received over 88 cents per kilogram which, while most rewarding, must not be considered as part of the normal range.

If we take 55 cents per kilogram for seed as a reasonable price, which I believe we can, and \$64 per hectare as an average cost we must get a yield of 118 kilograms per hectare of clean seed to break even but at 220 kilograms per hectare, which is not a very high yield, the gross margin is \$57 per hectare which may be compared to a very good "10 bag" wheat crop while a 400 kilogram per hectare crop, which the present top growers achieve in reasonable seasons returns a gross margin of \$156 per hectare.

Those figures support the truism that to make money from seed production, growers must stay with it year in year out and not just try to catch the high prices.

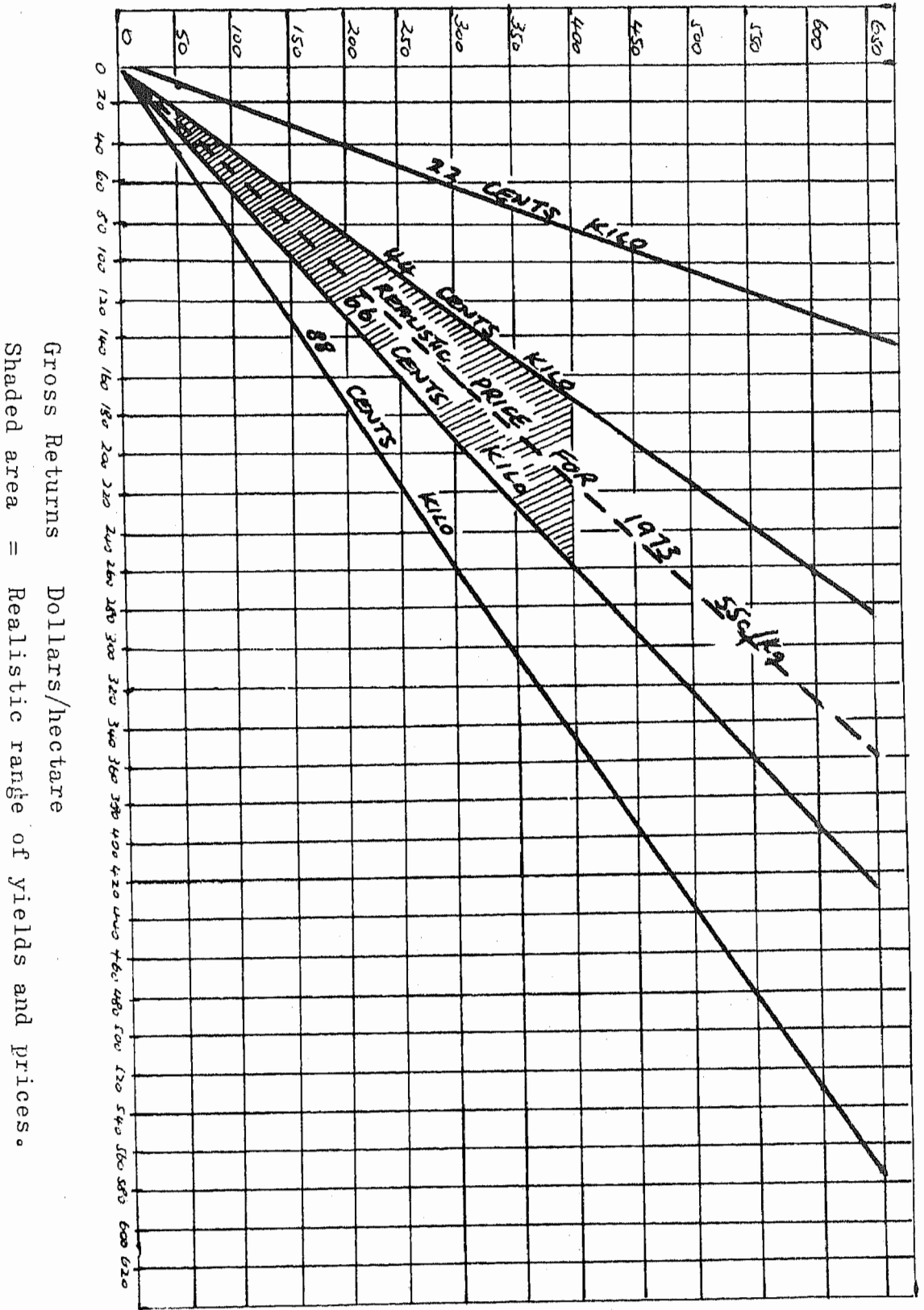
While the costs given have, for convenience, been expressed on a per hectare basis, it must be stressed that the most meaningful cost is that of producing a kilogram of seed. While at a glance the extreme cost quoted of \$148.40 per hectare looks frightening, if the crop yields 500 kilograms per hectare, the cost per kilogram of seed is 29.6 cents. The obviously cheap hectare cost of \$35.70 for a crop if it only yields 100 kilograms per hectare will cost 35.7 cents per kilogram. It must not be assumed that crops grown cheaply will only yield 100 kilograms per hectare or only those which have cost the maximum are the only ones to yield 500 kilograms per hectare. It is not quite so simple.

Table 1: The Range of Costs per Hectare for Production for Medic Seed Crops (see text)

Item	Normal Minimum		Maximum	
Sowing cultivation & drilling	Nil regeneration	-	Cultivation	7.20
			Harrowing	
Seed	" "	-	12 kg/ha	9.60
Fertilizer	100 kg superphosphate	2.50	300 kg superphosphate	7.50
Weed control	Hand weeding	3.70	Treflan & 2,4-DB	24.00
Insect control	Nil	-	2 sprays	9.60
Seed clearing	100 kg/ha crop @ 2.2 cents/kg	2.20	500 kg/ha crop @ 6.6 ¢/kg	33.00
Certification	50¢ inspection) 20¢/sack)	90	50¢/ha) 20¢/sack)	2.50
Sacks	100 kg/ha crop	1.40	500 kg crop	7.00
Harvesting	\$25/ha	25.00	\$48/ha	48.00
	Total	\$35.70		\$148.40

Table 2: Relationship Between Yield & Price on Gross Returns (see text)

Yields in kilograms/hectare



Gross Returns Dollars/hectare
 Shaded area = Realistic range of yields and prices.

2. SEED PRODUCTION TECHNIQUES:

Seed production of medics can be optimised by firstly choosing the most suitable fields and secondly, by correct management.

2.1 Choice of Field

Fields containing noxious or objectionable weeds must, naturally, be avoided. Likewise fields containing other weeds should be avoided if possible, despite the fact that present day herbicides can conquer most weeds in medic crops. These, however, cost money and if they can be minimised, obviously this lowers production costs. Preference should be given to level paddocks free as possible from stump or stones. Poorly structured sandy soils and heavy cracking clays should also if possible be avoided because of lower harvesting recovery on these types.

The ideal field for harvesting is a firm setting level, weed, stone and stump free and is established as dense, true to type medic pasture. This in reasonable seasons, should produce from 220 kg/ha to as high as 555 kg/ha. However, good yields are rarely achieved unless management is good. The following are the most critical factors of medic management for seed.

2.2 Grazing

Except in excessively dry seasons (when seed production is generally impractical), crops benefit from grazing. Ideally grazing should be done with sheep and not be closer than 5 cm. It should normally be stopped as soon as the crop begins to flower. In exceptionally good seasons, especially if the crop regenerated with early rains, later grazing, perhaps until late August is beneficial.

2.3 Weed Control

High yields can be obtained in surprisingly dry seasons if all the soil moisture is available for the medic crop and optimum yields can only be achieved in any year provided weed control is excellent. Excellent weed control in medic crops is virtual weed eradication. The first step to weed control is to have an adequately close rotation. After several years of good medic, experience has shown that a one year crop-one year medic is best. Under this system all weeds, particularly grassy weeds, are usually effectively suppressed. If this is not the case it is necessary to utilise herbicides until the weeds are under control.

2.4 Harvesting

2.4.1 Methods

Today almost all medic seeds are reapt using a Horwood Bagshaw suction type machine. This machine is a big improvement over older methods in terms of convenience and output in relation to the manpower required. These suction machines will in dryland crops reap about half a hectare per hour. Many grower operators find that 100 hectares per year per machine is as much as they can handle while the best operator known to the writer can reap 400 hectares with two machines per season. It is however, still a slow tedious operation and currently the greatest single factor limiting expansion of further medic seed production.

Several improved home constructed machines have been built which are vastly more rapid and produce a better quality seed sample. The major difference with the new machines is that they involve pre-cleaning of the gathered burr material before it goes into the seed thrasher.

It is to be hoped that an enterprising manufacturer may develop a new improved harvester for medics, otherwise serious producers must contemplate building their own "one off" machines.

2.4.2 Rolling

Rolling of crops to make a firm level soil surface is recommended because it will result in easier harvesting and better seed recovery. This is best done when soils are moist at any time from the fifth trifoliate leaf until commencement of flowering.

2.4.3 Burning

Burning of crops to remove top growth prior to harvest is not recommended on medic crops because this always results in some loss of germination and seed storage life and may completely destroy viability.

2.4.4 Ownership vs. contract

New growers are faced with the choice of getting a contractor or buying a machine. Contractors generally work on a share of the crop. With exceptionally heavy yielding crops the ratio may be lowered to half each. A more business-like hourly charge is used by some contractors. This varies from \$25-48 per hectare and does not include breakdown, repair or service times.

The advantages of getting a contract harvest are well known, namely that it avoids purchase of additional plant and

further demands on farm labour. This disadvantage is that when one farmer wants a contractor everyone wants him and it may not be possible to get the job done at the right time. It is not a drastic problem with medic seed crops because from when seed is mature in November or December it is not prone to damage and can be left for some months in the field without deterioration.

Currently a suction harvester costs over \$5,000 new. Most cereal farms would have a tractor and other equipment needed to operate such a harvester. Secondhand suction harvesters are currently selling for between \$1,200 and \$2,000, depending on age and condition.

If a good contract harvester is available at rates of up to \$48 per hectare the contractor is more economical than ownership and operation, however, at higher rates growers should carefully cost the possibility of operation of their own machine. The availability of labour to operate a machine is a deciding factor, if extra labour has to be hired growers should also carefully assess the economics of ownership.

Farmers contemplating buying suction harvesters and are short of capital, should give consideration to leasing a harvester. This does not use capital and converts the whole of the cost of operating the harvester to a taxation deduction. The overall cost however is not usually cheaper.

Consideration should also be given by seed producers to forming a machinery syndicate for purchase and operation of a clover seed harvester, especially when there are several small producers within a district. This form of ownership compared to individual ownership reduces capital investment and reduces costs by fully utilising the harvesting capacity of the machine each season.

2.5 Marketing of Seed

There are three basic methods of selling medic seeds. Each has advantages and disadvantages.

- * Co-operative marketing
- * Merchant marketing
- * Direct selling.

Co-operative marketing is gaining popularity, particularly with producers whose major income is from seed production. The advantages are that growers have control of their seed stocks and they have averaged higher prices than from merchants and get a small first advance payment immediately seed is delivered. The disadvantage is that growers do not get full cash payment for seed quickly.

Merchant marketing has the advantage that growers receive prompt cash in full for seed sold. The disadvantage is that merchants only buy what seed they need and when seed is freely available growers sometimes have difficulty to find a merchant who is buying.

Direct selling is popular with small producers who can usually get a ready sale to local farmers at retail prices. Its disadvantage is the grower has the work of weighing up smaller packages, despatch, and must carry the accounts and absorb bad debts.

Contract production of medic seed is not generally practiced. This is a pity because this form of marketing and production ensures supply to merchants, and, for growers a market at a known price.

More vertical integration in the seed industry would help promote production and price stability and should be encouraged.

3. MEDIC SEED MARKETS:

3.1 Local

During the 1970-72 rural recession local usage of medic seed declined. Today however, with good markets for livestock and the possibility of eased wheat quotas usage is increasing, particularly because of the growing realisation that heavier seeding rates are necessary to achieve good results. Production for the last two years has been approximately 160 tonnes and 100 tonnes respectively - this is less than present local usage. An acute seed shortage has been masked because of carry-over seed from four and five years ago.

3.2 Export

It comes as a surprise to most Australian farmers to find that our method of cereal cropping, namely to grow a largely self-regenerating legume based pasture in rotation with the cereal crop and integrate grazing sheep, is a land use system little understood or used elsewhere in the world. Countries surrounding the Mediterranean Sea and parts of South Africa and South America have similar, and in some instances, almost identical climates, soils and topography to counterpart areas of southern Australia. For these reasons, many of the best Australian medic varieties have been developed from seeds originally in the Mediterranean region. The development of pastures in these regions has lagged behind Australia for political, sociological and economic reasons.

Today, however, the value is appreciated by governments in many countries and several major international donors of aid. Experimental sowings of medics and large scale farmer demonstrations

are proceeding. These are proving spectacularly successful.

If not hindered by lack of seed it is likely that an area larger than that sown in Australia in the last fifty years will be sown in the Mediterranean area alone in the next ten years.

Consequently, the demand for seed will be enormous. Already one North African country is negotiating for annual supply of medic seed, greater than our present seasonal production.

Sales of seeds at very low prices to some countries during the last few years have given rise to the belief that these countries can only, or will only, buy at prices current during the 1971-72 Australian rural recession.

There is however, no valid reason why higher prices, which would remain fully attractive to our growers, should be any deterrent to export sales. Recent sales at vastly higher prices and the high reselling retail price for seed in the countries concerned are evidence of this.

4. FURTHER READING:

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Discussion

Mr. Ragless stressed that there were a host of anomalies in the seed production field and so it was hard to determine exact costs. He quoted one grower who said it cost him under \$74 per ha to produce clean packaged seed. A 220 kg/ha seed yield has a similar Gross Margin to a 2000 kg per hectare wheat crop.

Cleaning costs for a producer who reuses his own seed would range from 2.2 cents per kg to 6.6. cents per kg.

Duncan Corrells' 11¢/kg guess of his seed costs was recalled.

Mr. Ragless thought that 11¢/kg harvesting cost for a Horwood Bagshaw harvester would be reasonable and Duncan Correll uses one. He also said it was unknown to get a 90% pure sample off the harvester from a medic seed crop. He said barley grass was an important weed in seed crops and he favoured reseeding where Treflan can be used. Resow at 3-9 kg/ha. He also saw inefficient harvesting machinery as a retardant of higher seed yields. There was a great need for better harvesting machinery. Where burning is used to remove top growth if too much grass is present the fire is hotter and pods are destroyed. One crop that was burnt had a seed germination of 80% at first but dropped to 10% in 6 months, so there are risks in burning. Mr. Ragless went on to say that the current situation was that more seed was needed to keep pace with domestic demand because export markets can easily take all the Australian medic seed crop. He also said that there is no market for mixed seed with merchants. A Horwood Bagshaw harvester cost about \$5,800 and second hand machines are in big demand.

Has Mr. Oswald of Eyre Peninsula tried to market his machine? Mr. Ragless replied that he had tried to, but to no avail. He now has a provisional patent on his machine.

What features of Oswald's machine are novel?

It used a broom for a pick up and the soil and sticks were removed before entering the thresher. Mr. Ragless said there were 20 contract harvesters now in S.A. and no Barrow Linton machines in operation. He said burrs can be removed if a winnower off a cereal header is employed. Comments were made on the difficulties of harvesting a mixture of medics because seed weight and ease of threshing vary so much that it would be very hard to set up the machine. Tornafield is easy to thresh.

Harvesters may only be 50-75% efficient but with a 112 kg/ha crop 56 kg may be missed, with a 448 kg/ha crop still only 56 kg/ha may be missed. Mr. Ragless stressed that harvesting time per unit area is too long and it would be better to have a 2 week rather than 3 month harvest. However a better harvesting machine would not save 7-11 cents per kg.

BRIEF DISCUSSION TOPICS1. Inoculation, lime pelleting, prill coating

Mr. E. Crawford said inoculation was needed where the soil was acid and on some areas of Eyre Peninsula this practice was desirable. There was no evidence in S.A. of the value of prill coating which is used in N.Z. but it may be of use in certain areas. Mr. Bicknell asked if inoculated seed can be treated for insect control and Mr. Higgs said no. He added that there was a distinct possibility that with better inoculum strains more nitrogen per hectare could be fixed. The problem was also to get a sufficient population of a new strain into the soil and for it not to be swamped by the old strains already present.

Most inoculum work is on soyabeans and subclovers, not medic he added.

Mr. Mathison then indicated that inoculation of some cultivars gave no significant difference in a certain experiment. Paragosa does require a specific inoculum in some situations and Murrayland could also require a different inoculum.

Mr. Matz then related a story about poor legume growth on an isolated area of his district where N had contributed to better growth and plants were not well nodulated. Mr. Higgs suggested that Mr. Matz document the area involved and what has occurred and then the matter could be looked into by research officers.

2. Waterlogging tolerance

Mr. E. Crawford showed details of waterlogging tolerances. Subclover, M. polymorpha and M. intertexta proved to be the most tolerant and this factor can have a vital link with nodulation. Mr. Higgs mentioned that the capacity of plants to tolerate waterlogging depends on their ability to transfer oxygen to the roots from the tops.

3. Salinity tolerance

Mr. E. Crawford presented salinity tolerances and commented that M. intertexta was found growing in samphire in the Middle East. Mr. Mathison asked if we should look further at salt tolerant species and Mr. Michelmore commented on Melilotus growing well on saline soils. Mr. D. Crawford said areas of salty flats in the Upper South East where Melilotus does well could be looked at while Mr. Potter added that areas of Eyre Peninsula could be investigated. Mr. Michelmore commented that at Cobar N.S.W. ripping to give a better physical soil surface helps repasture saline areas and at Cobar M. polymorpha was the most popular variety. Mr. Higgs concluded that W.A.R.I. could be interested in medic salinity tolerance.

4. Frequency of resowing

Mr. Webber felt that forward planning was essential that farmers should assess the last pasture year's seed production. The types of assessment that good farmers make are quite adequate. Mr. Mathison felt some farmers needed help to assess this.

Mr. Ragless pointed out that some seed producers have reseeded but Mr. Matz noted that some farmers have never resown. Mr. Higgs observed that stocking pressure will influence resowing as seed will be eaten over the summer months. Mr. Webber said that the rotation was important, too as a F.W.B.P. rotation removes the medics whereas C.P. does not. Mr. Bicknell felt that in the main cereal areas reseeding is not often needed where stock pressure was not great, but if the pasture year of a rotation was a drought, resowing may be needed.

Mr. D. Crawford emphasized too that superphosphate is vital to get a good seed set and yet so many pastures are not top dressed. The two farmers visited on the excursion felt that only 3 out of 10 neighbouring farmers top dressed pastures and Mr. Crawford found in two group surveys in the Upper North that only 2 out of 34 farmers had adopted this meritorious practice.

Mr. Webber added that more information on amounts of superphosphate needed by medics would be worthwhile.

5. Deferred grazing

Mr. McAuliffe enquired as to how widespread this practice was in medic areas but Mr. Matz felt it was not widespread. Mr. Webber said that self sown or stubble sown cereals are usually stocked first to let the medics develop more and Mr. McAuliffe added that the cereals were far more palatable in the early stages.

6. Fungus diseases

Mr. E. Crawford said that Cyprus was more susceptible than other cultivars to black stem rot and in W.A. he had seen Tornafield decimated by it. This fungus is seen as lesions on the stems which then snap off. Mr. Hincks noted that it had been severe in M. polymorpha, M. minima and Jemalong in the Crystal Brook, and Koolunga areas. Mr. Mathison, at Northfield in an ungrazed situation, had seen it affect all varieties. Mr. Ragless said it seemed to be worse in Jemalong and that some African countries specified seed to be reaped from fungus free crops. Mr. Michelmore felt it was rare in short crops but Mr. E. Crawford disagreed but confirmed that a dense crop would be more susceptible. Mr. Higgs concluded with the information that seedling damping off can occur in wet conditions.

7. Toxins

Mr. E. Crawford presented the following short paper on coumestrol. Coumestrol is the oestrogenic compound present in annual medics capable of affecting animal performance.

Bennett has shown that levels of less than 40 p.p.m. are not important.

Coumestrol level varies with the stage of growth in annual medics and Francis and Millington showed that within four species of commercial interest viz. M. littoralis, truncatula, scutellata and polymorpha, concentrations increased with

maturity from as low as 1-2 p.p.m. in the cotyledon to second trifoliolate leaf stage up to as high as 335 p.p.m. (in the case of Harbinger) in the mature stage by early February.

Considerable differences between species was also evident with M. scutellata and M. polymorpha having much lower levels at maturity (18 p.p.m. compared with 240 in Harbinger) and 52 and 46 respectively compared with Harbinger (335) by early February.

Samples of maturing runners taken from Parafield in 1965 revealed the following in p.p.m.

Jemalong	2.5
Paragosa	7.5
Cyprus	40.0
Hannaford	50.0
Harbinger	170.0

Of seven cultivars sampled from 10 sites by Mathison in 1970, 57 samples revealed less than 5 p.p.m., the highest being Cyprus with 40 p.p.m. at Kadina. However 6 Cyprus & sites revealed less than 5 p.p.m.

Although varying coumestrol levels have been arrived at by various researchers using the two dimensional paper chromatography technique there does not appear to be evidence in South Australia to suggest that the coumestrol content of annual medic pastures limits production or animal performance.

Discussion revealed that green grazing levels are very low while it is highest in mature stems and pods. Mr. Mathison said levels are higher in plants under stress or in unsuitable areas but facts as to what constitutes unsuitability, are not clear.

Mr. Kloot has found that green wireweed contains a water soluble toxin, mostly in the leaves which can slow down medic germination by 2 days. Mr. Matz said old wireweed areas reduced medic growth and Mr. Kloot added that the problem is increasing and wireweed also competes with the crop. Trifluralin controls wireweed well. Mr. Higgs pointed out that late germinations of wireweed are a problem and Mr. Webber felt that cultivating problem areas seems to lead to less toxicity. Mr. Bicknell suggested a later spray in the crop but Mr. Kloot said this was not possible.

8. Nutritive values

Mr. E. Crawford showed data on the changes in digestibility and crude protein content with time of sampling of some medics and reference was made to the following research papers.

8.1 Changes in nutritive value throughout the growth cycle of snail medic.

R.M. Jones and M.S. McLeod.

- 8.2 Digestibility and crude protein changes in ten maturing pasture species.

J.C. Radcliffe and M.J. Cochrane

- 8.3 Digestibility of Medicago tribuloides (Barrel medic) pods.

J.E. Vercoe and G.R. Pearce.

The importance of cutting hay early was emphasized. Mr. Higgs said the mineral values of medics must be looked at in regard to their nature and availability. A legume dominant pasture has less mineral deficiencies than grassy ones he pointed out.

9. Recent registrations

Mr. Mathison said that Ghor and Murrayland were two new registrations.

10. Acceptance of New cultivars

Mr. E. Crawford said there was an acceptance "lag" in medic cultivars and Mr. Hincks proposed that drought, "rural depression" and high seed prices reduced Harbinger's acceptance in the mallee. Mr. Webber added that acceptance takes time and Mr. Bicknell wondered if medic plots like the cereal variety plots throughout the state would give greater acceptance. Mr. Ragless said that new cultivars have not been effectively promoted and the seed trade views new varieties as intruders that reduce sales of older established varieties.

Mr. Webber felt that the acceptance of Hannaford and Jemalong is satisfactory and Mr. Matz stressed the seed price factor.

Mr. Webber emphasized that piecemeal advice was useless and that it must be a whole farm approach. Mr. Mathison saw acceptance problems with the intensive C.P. medic system of farming coupled with finding suitable cultivars.

Mr. McAuliffe concluded that with the right place and right cultivar plus no reseeding, extension has been relatively easy.

11. Current research

Many areas have been covered in the conference and Mr. Davidson asked if there is a quick way to measure soil N and DM production. Mr. Higgs said the equipment is available but needs trained personnel to use it.

Annual medic cultivar recommendation map of South Australia

Contributions prepared by District Agronomists collated
by E.J. Crawford

The need has long existed for the compilation of a map of the State depicting the limitations of annual medic cultivars and species naturalised in the various environments.

Although Conference agreed that two maps should be compiled,

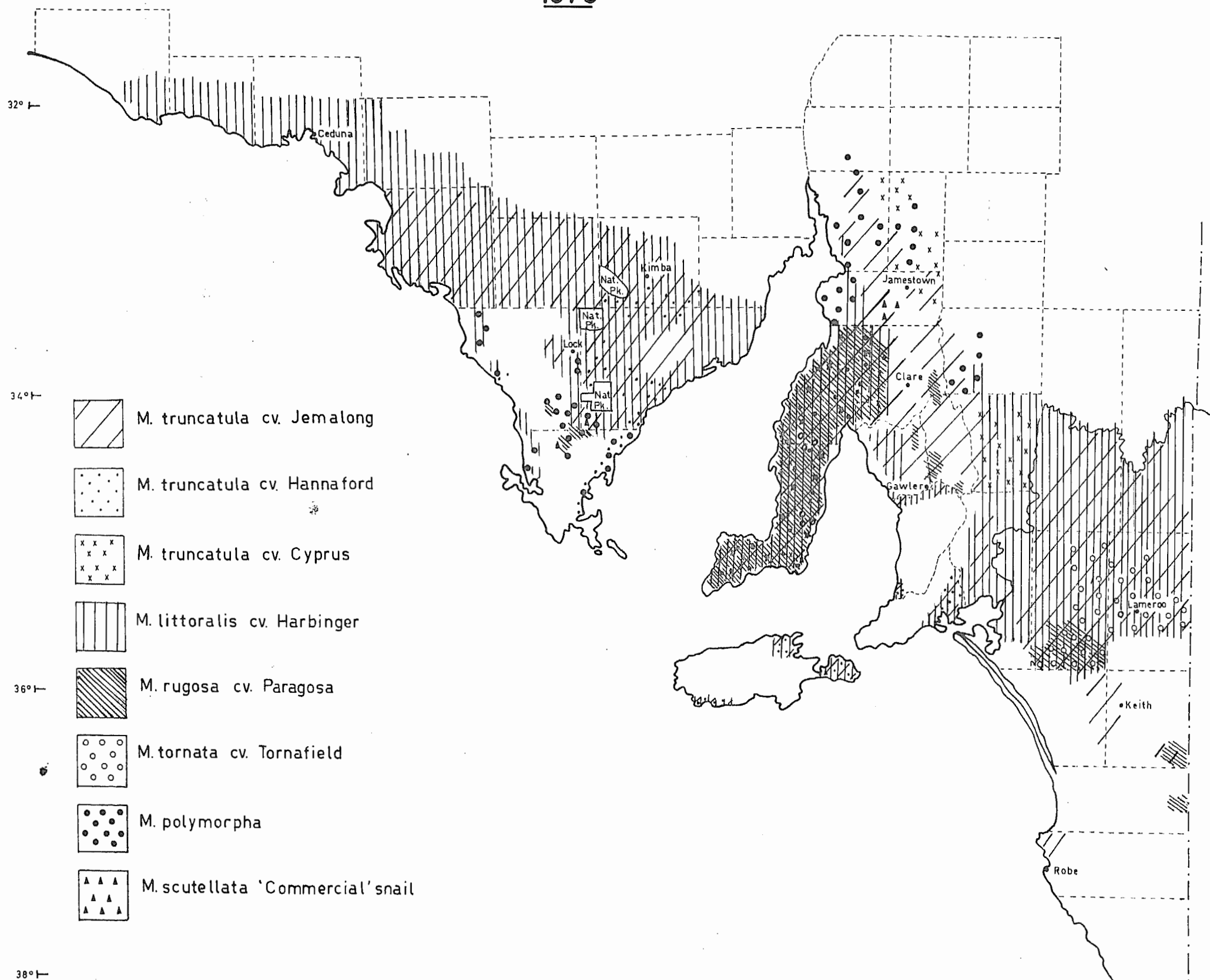
1. a cultivar recommendation map
2. a species distribution map

it soon became evident that it is impracticable to prepare the latter in the short term as the distribution of such species as M. arabica, M. minima, M. orbicularis, M. polymorpha and M. praecox is not fully appreciated and would require several years of survey to ensure accuracy.

It was subsequently agreed to make a post conference request for information to compile an annual medic cultivar recommendation map.

RECOMMENDATION MAP OF SOUTH AUSTRALIA.

1973



M. truncatula cv. Jemalong



M. truncatula cv. Hannaford



M. truncatula cv. Cyprus



M. littoralis cv. Harbinger



M. rugosa cv. Paragosa



M. tornata cv. Tornafield



M. polymorpha



M. scutellata 'Commercial' snail

SUMMARY OF THE CONFERENCE AS EXPRESSED BY AN EXTENSION OFFICER

G.D. Webber

Mr. Webber said that during this excellent conference we had begun with a review of medics in South Australia and the history of the ley farming system.

Medic had made most advances over the sub-clover areas in that time, mainly due to the sil type. State wheat yields averaging 1500 kg per ha five or six times in the past 25 years suggested a ceiling had been reached. Further improvement was possible if that was not an acceptable level of production.

The dollar values of medics in the paper by Mr. Bicknell was good extension material.

The conference gave many methods of optimising production. Various important factors governed regeneration. Resowing should be done more often than now.

DISCUSSION

There was not enough time for technical application of regeneration.

The technical information was very important and there were valuable contributions.

Flexibility of medic systems, e.g. enabled more crops with fertility build-up. Farmers needed flexibility in the future.

More detail was needed on diseases and nematodes particularly eelworm, and the medic value as a control.

We did not get into a problem solving area, and these problems needed defining early to have a more workshop approach. This solving of problems would assist those after a conference.

Has the workshop approach always worked well?

It depends on the degree that it is structured, and the degree of flexibility it allows.

Objectives should be set out in broad terms.

Presentation of papers would still be needed with the discussion.

As outlined in the beginning of this conference, 50% of the time planned was for discussion. Some speakers exceeded their allocated time.

To satisfy peoples' needs, problem solving should be completed. It is possible to structure too much, so it was best to keep the learning situation to meet needs.

SUMMARY OF THE CONFERENCE AS EXPRESSED BY A RESEARCH OFFICER

E.D. Higgs

The conference gave time for reflection on medics.

Advisers were hungry for precise information for farmers. This was not all available, and principles and generalities should be used to the best of their ability.

It was important to define with greater precision the details of information for advisers, e.g. herbage quality - need specific information and also principles.

How can we make a cereal rotation work better? Intensification of cropping, rather than the yield of an individual crop. We should look at the intensification of cereal-pasture frequency.

The main value of the conference was defining the areas that need the most intensive research activity, e.g. defining phosphorus fertilizer requirements in areas of the State; medics that made good colonizers and regenerators; the difficulty of recommending cultivars in some areas, particularly where many cultivars were present.

There were two major research groups, those of Messrs. M. Mathison and E. Crawford.

We should look more at what and where to resow, as well as weed control, and the toxic effects of wireweed with its specific depressing effect of germination.

Crop residues can have immediate attention. Burning could be used. What are burning effects?

Nitrogen and its fixation. There is no real information about crop uptake, medic input, but techniques are becoming available. With this information, it could open up many possibilities, regarding nitrogen losses.

Overall it was a very profitable conference.

DISCUSSION

Mr. Mathison advised that copies of reports can be circulated. Advisors need only to specify the area of interest.

CLOSURE OF MEDIC CONFERENCE

J.D. McAuliffe

Mr. McAuliffe said the conference on medic in a region was to meet the requirements of the Chief Agronomist. This was the second successful regional conference.

The highlights of the conference were the updating of information and the infusion of current data from Messrs. Mathison, Crawford and other researchers with the problems from Advisers.

What was not really covered was the way to get people to grow more medic. We should sell the value of medic. This can be developed.

The state medic maps were important and will be compiled.

This medic conference will result in more team work in this field and more progress will be achieved.

The general organisation of the conference by the convenor Mr. E. Crawford and others, the venue, and the papers presented were extremely good.