PROCEEDINGS

SEED PRODUCTION AND MARKETING OF TROPICAL PASTURE SPECIES FIELD MEETING, CSIRO PASTURE RESEARCH STATION, SAMFORD, APRIL 3 1981

A meeting was organized on various aspects of tropical pasture seed production and marketing, to examine the reasons for the present shortage of seed and the consequent high prices. The various speakers explored user, grower and seedsman aspects of these problems. Opportunity was also provided to inspect the newly completed controlled pollination unit, the small seeds handling equipment and the CSIRO seed storage facilities at Samford.

SEED SUPPLY, QUALITY AND COSTS—A USERS VIEWPOINT

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It is easy to be critical of the tropical pasture seed industry. If a farmer plants 50 ha of Siratro (3 kg ha^{-1}) and Callide Rhodes grass (3 kg ha^{-1}), seed would cost $5000 on today's prices, plus fertilizer and working costs. A mixture of glycine (3 kg ha^{-1}) and green panic (3 kg ha^{-1}) would cost $1700. To add 1 kg ha^{-1} of Safari Kenya white clover seed to the latter would increase the cost of seed to almost $3000, even if the seed were available. Whittet kikuyu seed has now risen to over $30 kg^{-1}.

In these circumstances the average farmer reduces seeding rates, adapts his pasture to the seed that is available and hopes for a good season and establishment so that the pasture will seed-down and thicken-up over the next couple of years. This exposes his land to a weed problem by not getting a good ground cover, early. Conversely, he can reduce the area to be planted to fit in with his bank balance and slow down his whole development program.

Up to now he has had to send seed away for analysis or take the word of his seed merchant as to the germination percentage and purity of the seed he is buying. Certified seed is not normally available even if he could afford it!

Seed labelling is about to improve. I also hope that these moves lead to better packaging and storage of seed and that the improved labelling gives some information as to inoculant requirements for legumes and how to treat the seed prior to planting to improve germination. Heat, hot water or acid treatments to reduce hard seededness, are not understood by many farmers.

There is criticism of Australian seed in a number of South East Asian countries because of its quality and packaging. The packaging and labelling could be improved but the main problem is the loss of viability of seed on the wharf, where it is often held in bond for long periods in hot, humid conditions. Grass seeds should be air freighted wherever possible. An exporter must remember that if germination is poor it will always be *his* fault. In general, tropical legume seeds are available locally in these countries at a very reasonable price.

In the "Top End" of Australia, with its distinct wet and dry seasons, some pasture improvement is still going on. Verano stylo is replacing Townsville stylo which has been badly hit with anthracnose. Again one has to buy seed without any guarantee of germination percentage or of the level of hardseededness. Farmers do not have equipment to treat this seed in large quantities. If the cattle industry remains strong there will be a big market for tropical legume seeds in the "Top End" if quality seed can be supplied in quantity at a fair price.

The price of seed for tropical pasture species appears to be related too much to scarcity and not to the cost of production. I do not suggest stopping the laws of supply and demand, but would like to see some dampening of the wildest fluctuations.

Availability depends on seasons but also on how much comes onto the market from opportunist seed producers, and how much has been consigned to overseas orders. There do not appear to be enough production and market research and planning. Blame does not belong to any one section of the industry, but it is high time that the scientists, the growers and the seed merchants got together and put the tropical pasture seed industry on a firm base. If large fluctuations in price, quality and availability are avoided then farmers interested in tropical pasture species can plan ahead with confidence as their temperate counterparts have been doing for years.

SEED PRODUCTION RESEARCH—AGRONOMIC ASPECTS

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An adequate supply of good quality, reasonably priced seed is a basic requirement for the widespread use of any pasture plant. Lack of commercial seed, however, has prevented a number of grasses and legumes from being sown widely after release: *e.g.* the Rhodes grass (*Chloris gayana*) cultivars Callide and Samford, and fine-stem stylo (*Stylosanthes guianensis* var. *intermedia*). Seed production research is therefore essential to support the continuing flow of new pasture species and cultivars into commercial use.

Two-Stage Research

Because of the diversity of behaviour in the range of plants used in sown pastures, the same methods cannot necessarily be adopted for all seed crops. Research should therefore be approached in two stages. Growth, development and seed production should be recorded by frequent sampling in a single situation; with grasses, nitrogen requirements should also be evaluated at this stage. Strengths and weaknesses of the particular plant as a seed crop can then be evaluated, and management and possibly environment varied in second stage research to improve production.

Current Agronomic Practices

Current principles have been derived from such research and from field experience. Legumes and grasses are being considered separately because of differences in emphasis between the two groups.

Legumes. The initial objective is a dense vegetative canopy to smother weeds and provide a framework on which a seed crop can develop. Annual legumes such as Townsville stylo (*Stylosanthes humilis*) should be sown early in the growing season; erect perennials—*e.g.* stylo (*S. guianensis*)—may be cut back to thicken the canopy; and twining or scrambling crops like Greenleaf desmodium (*Desmodium intortum*) and siratro (*Macroptilium atropurpureum*) can be rolled with an iron or rubber-tyred roller.

Healthy, productive crops need good nutrition. Phosphorus, potassium and micronutrients should therefore be applied as required.

Effective weed control is a pre-requisite to legume seed production. Weed invasion can greatly reduce yields and make it difficult or impossible to clean seed to the required purity standards. Seed cleaning is no substitute for a weed-free paddock.

Pre-emergence chemicals can be recommended for grass weeds in a number of legume crops, though sub-tropical species are poorly documented. Control is relatively short-term and protects the establishing crop while it forms a smothering canopy. Long-term control of grass weeds is therefore progressively poorer with less-smothering legumes such as fine-stem stylo, jointvetch (*Aeschynomene falcata*), lotononis (*Lotononis bainesii*) and Kenya white clover (*Trifolium semipilosum*);

likewise, seedlings of shrubby stylo (*Stylosanthes scabra*) grow too slowly. Post-emergence herbicides can be used for broad-leafed weed control in several crops. Choice depends on crop tolerance, weed species, cropping history and the stage of crop growth. Rope-wick weeders could also prove both cheap and effective in removing taller-growing weeds from shorter, non-twining legume crops.

Strategic cutting can reduce excessive vegetative growth to give a lower, more uniform framework of branches (*e.g.* short-day stylo cultivars). Defoliation should be as late as possible, while still allowing full recovery of the crop canopy before flower buds are formed; for daylength-sensitive plants, this time is reasonably predictable.

Terminal and axillary shoots of lotononis and Kenya white clover need exposure to light for proper floral development. Swards should therefore be maintained in a short open condition by regular cutting or close grazing until flower buds are produced in late winter.

Irrigation strategy varies for different crops. Siratro and centro (*Centrosema pubescens*) are instances where changes in soil moisture override daylength responses in the field. In districts with a reliable dry season, flushes of seeding can be induced by alternating periods of irrigation and moisture stress.

In contrast, lotononis and Kenya white clover flower during spring and require adequate winter moisture to maintain a strong vegetative framework for the eventual seed crop. Watering should cease with the onset of flowering. This avoids excessive vegetative growth, which encourages head rots and makes harvesting difficult.

Insect and disease problems are generally more severe with legumes than with grasses. There are two major groups of insect pest: lepidopterous larvae feed on pods and flowers and can be controlled with organo-phosphorus insecticides; root-eating coleopterous larvae, however, are more difficult to control.

A wide range of diseases can affect legume crops and suceptible cultivars are generally best grown in districts with a low risk of disease. Chemical measures are rarely practicable under commercial conditions, although benomyl (Benlate ®) has been used to reduce anthracnose (*Colletototrichum gloeosporioides*) on marginally susceptible *Stylosanthes* cultivars in localities where the risk of disease is marginal.

The useful life of a commercial seed stand depends on the increase in soil nitrogen which encourages weeds. Mechanical renovation, plus a pre-planting herbicide, may then be worthwhile, though diseases (*e.g. Rhizoctonia solani*) can increase at this stage.

Grasses. Management is aimed at producing synchronized, high-yielding crops by promoting head development and restricting head emergence to a narrow time span. Each cropping cycle usually begins with a cleaning cut and the application of fertilizer nitrogen. This combination encourages the early and concentrated production of new tillers. Later defoliation is generally detrimental because it removes this important group of tillers. Kikuyu (*Pennisetum clandestinum*) is an exception: crops are repeatedly mown throughout the growing season at gradually increasing heights to encourage branching and produce more heads.

Nitrogen is the main nutritional determinant of grass seed yield. Established stands require more than first-year crops, and the optimum level depends on species, cultivar, soil and rainfall. Time of application is also important. Head density is the main (and sometimes the sole) yield component which responds, and there is usually only a short time between tiller appearance and floral initiation. Fertilizer nitrogen should therefore be applied as a single dressing as soon as possible after the cleaning cut. If required, annual dressings of other nutrients (mainly phosphorus and potassium) are also made at this stage.

Where moisture and nitrogen are adequate, a closed canopy should be produced quickly to improve crop synchronization, maximize productivity and restrict weed development. Low plant populations will increase in stoloniferous species like creeping bluegrass (*Bothriochloa insculpta*) and Rhodes grass, but relatively narrow rows are necessary for tussock grasses (*e.g. Panicum* and *Setaria* species). Wider rows are advisable when either moisture or nitrogen is likely to be in short supply.

Unbroken periods of good growing conditions allow proper synchronization of development and maximize the various components of yield (*i.e.* head density, head size, seed set and seed size). Satisfactory results are achieved with many grasses under dryland conditions; but particularly with sensitive species such as setaria (*Setaria sphacelata* var. *sericea*), supplementary irrigation improves both yield and reliability of production when rainfall is poorly distributed.

Well-fertilized, established grass seed crops will compete strongly with weeds. Where necessary, most broad-leafed species can be controlled with 2,4-D while contaminant grasses can be removed by spot-spraying with glyphosate (Roundup ®).

Weed control measures are more important during establishment. Pre-emergence atrazine can be used with tolerant crops—signal grass (*Brachiaria decumbens*), green and Gatton panics (*Panicum maximum*), sabi grass (*Urochloa mosambicensis*)—and diuron has given broad spectrum weed control where protective carbon bands were sprayed over the crop rows at planting. "Stale seedbed" techniques are widely applicable; these involve the destruction of up to three successive germinations of weeds with desiccants, followed by sowing into the undisturbed seedbed. Selection of planting time can also help to reduce weed competition.

Apart from ergots, diseases are generally not a problem with grasses grown in Australia, though there are some potentially damaging ones overseas. Lepidopterous larvae, including *Heliothis* spp., armyworms (*Pseudoletia* spp., *Spodoptera* spp.) and the buffel grass seed caterpillar (*Mampava rhodoneura*), can be controlled with organophosphorus insecticides.

Mechanical renovation is occasionally used to prolong the useful life of rundown stands. Greater use could be made of this, particularly with grasses like Narok setaria which eventually become sod-bound and less productive.

Farmer Expertise

Farmer expertise is important because considerable judgment and experience is required to manipulate various crop requirements and limitations in the field. In fact, it is probably better to have a good farmer in a sub-optimal situation than a poorer farmer in the best environment.

Future Research

Some long-standing seed bottlenecks have been overcome (*e.g.* Callide and Samford Rhodes grass, siratro), and close attention is now paid to new releases such as purple pigeon grass (*Setaria porphyrantha*) and Seca and Fitzroy shrubby stylo to ensure a smooth transition into commercial use. Limited seed supplies, however, still restrict the use of many pasture plants (*e.g.* creeping bluegrass, jointvetch, fine-stem stylo), while others such as lotononis and Kenya white clover are only marginally commercial.

Further work is needed on many aspects. In particular, basic physiological studies of underlying processes (*e.g.* individual shoot development, allocation of dry matter production to seed and vegetative organs) would lead to a much better appreciation of the limits and the possibilities for pasture seed production.

WASTE IN GRASS SEED PRODUCTION

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A good crop of green or Gatton panic, to use a convenient example, is capable of producing enough spikelets (if all survived to produce seed and new plants) to plant about 15 000 times its own area. In fact, 50 times is a realistic figure. We are, therefore, dealing with an efficiency of production of the order of about one third of one per cent, a figure that suggests there is room for improvement.

As a result of failure to set seed, poor synchronization of spikelet development, and ready abscission of ripe seeds, a maximum of only about one third of the original spikelet population is present as set seed at harvest ripeness. Of this usually about 40% is too immature ever to be useful seed.

Header harvesting is a wasteful operation, and though variable in efficiency, can generally be expected to lose at least one half of the seed presented to it. Deterioration during handling, through over-heating in transit to the drier and during drying itself, further reduces the quantity of useful seed. Normal commercial drying is almost always too rapid, and will commonly halve the germinable seed content.

More seed is lost during cleaning, varying from trivial amounts from weed-free crops to total loss when an excess of certain weed seeds prevails. Loss through aging then proceeds during storage, its extent depending on the quality of the seed, its moisture content, storage temperature, the presence of pests and the duration of storage.

Further losses occur at planting through failure of seed to germinate successfully, seedling desiccation, damage by pests, etc. These are highly variable, but it is seldom reasonable to expect more than about a third of viable seeds to produce established plants.

Which points in this catalogue of loss are most sensitive to manipulation? Attention to established methods of husbandry will ensure the presentation of the maximum amount of seed at harvest ripeness, and with the free-seeding grasses this is perhaps the best we can expect to do. If we could prolong retention of ripe seed, potential yield and quality would improve greatly, but in general we cannot. Harvest efficiency is improving all the time, primarily with the steady increase in horse power of headers used in seed crops, and secondarily with the growing use of more efficient threshing mechanisms. Handling could be enormously improved, with a consequent massive improvement in seed quality; but only with substantial extra expense or reduced through-put. The technology exists, and it is up to the industry to decide if it wants smaller amounts of better quality and dearer seed. Storage could also be greatly improved, though again at a cost, and again with simple established technology. Efficient use at planting depends on circumstances, and it is often cheaper to use and sacrifice luxury amounts of seed than to provide conditions that ensure maximum survival.

As is so often the case, we can already point to many options for improvement. Whether or not these are justifiable in terms of consumer demand or economics is quite another matter.

Approximate losses sustained by a green or Gatton panic seed crop between spikelet formation and establishment of the next generation in a pasture

Figures are highly variable and values chosen are therefore mostly arbitrary.

	Fraction of previous	Fraction of original
Total spikelets produced	1	1
Set as seed	2/3	2/3
Presented for harvest	1/2	1/3
Recovered by header	1/2	1/6
Mature enough to be viable	3/5	1/10
Surviving handling	1/2	1/20
Surviving cleaning	4/5	1/25
Surviving storage	3/4	1/35
Emerging after planting	1/3	1/100
Surviving to establish	7/8	1/114

COMMERCIAL SEED PRODUCTION

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Without adequate supplies of seed, newly selected plant lines will not become established as regularly used species in pastures. To ensure supplies, production of seed should be carried out in a number of areas to avoid losses due to droughts, floods, cyclones, frost, insect pests and disease. Fortunately, in Queensland we can produce seed from the south eastern areas to the Atherton Tablelands and in the Cairns and Cooktown areas thus reducing the risk of total failure of seed supplies due to the vagaries of the weather or insect and disease problems.

The soil type needs to suit the particular plant and isolation from contaminants is required especially for certification.

Weed Control

Crop hygiene is important as contaminants once present are difficult to remove. Even if they can be removed the process is time consuming, expensive and wasteful of good seed.

Weeds are best kept out of the crop in the first place or contaminated areas avoided at harvest time. Light scattered infestations can be spot sprayed during growth of the crop or heavy infestation broad-acre sprayed. Grass seed crops are normally broad-acre sprayed with 2,4–D as soon as the weeds appear whereas residual patches are spot sprayed with Roundup®. If the bad weeds are known and kept out of the crop right from the start it is much cheaper.

Fertilizers

For high yields of any grain crop it is essential to feed the crop adequately. Pasture seeds are grain crops. The legume crops at Cooroy need phosphorus and potassium and the grasses nitrogen, phosphorus and potassium fertilizers. Legumes are usually planted with 300 kg ha^{-1} of Mo superphosphate and up to one bag of muriate of potash. The *Rhizobium* needs of legumes must also be known. Grasses require adequate phosphorous and potassium and sufficient nitrogen, the latter especially, to force tillering and produce viable seed heads. We usually use 300 kg ha^{-1} of superphosphate, 100 kg ha^{-1} of muriate of potash and for rhodes grass 100 kg ha^{-1} nitrogen or up to 180 kg ha^{-1} for Narok setaria.

Harvesting

The big question is when to start harvesting. The ideal conditions are rain or irrigation during growth of the crop and then perfectly fine weather for maturation and harvesting. We use direct heading rather than windrowing for harvesting, waiting until 10% of seed has fallen and then harvest quickly. The sample will contain ripe seed, immature seed and green seed with about 60% moisture content. This has to be dried slowly at about 40 °C.

If one crop is destroyed by a storm before it can be harvested another can be ready a week or so later, so the producer has to be alert to likely weather conditions.

Costs are skyrocketing and risks are high. Fertilizer prices have risen 400% in the last 10 years. Wages, fuel, irrigation costs and LP gas for the driers have all gone up similarly. Unless costs can be contained cheap seeds will be a thing of the past.

STANDARDS IN CERTIFICATION AND QUALITY CONTROL

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Seed Certification

The Queensland approach to seed certification is a little different to that in other countries and other States within the Commonwealth. We do not certify much seed in Queensland by comparison with other places, but what we do has a high guarantee of authenticity. Queensland criteria for deciding to certify pasture cultivars are:

(i) The cultivar must be a valuable component in pastures;
(ii) The seed must be indistinguishable from that of less desirable cultivars;
(iii) An authentic seed supply must be dependent on certification;
(iv) The Department's field staff must be able to handle the extra work involved in supervising additional certified seed production.

Certification nevertheless is increasing. Ten cultivars (Riversdale and Makueni guinea, Callide and Samford rhodes, Narok setaria, Graham and Oxley stylo and Fitzroy and Seca shrubby stylo and Cunningham leucaena) are now handled. Field standards are high but seed quality is no longer required to be higher than that of uncertified seed and certified seed is thus more economic to produce than it was in the past. The scheme will expand as the need arises, assuming the continued availability of Departmental staff.

Quality Control

Minimum standards of germination and purity are set under 'The Agricultural Standards (Seeds) Regulations of 1969' which seed lots must pass before they can be offered for sale. It is proposed to replace these standards by a labelling system which would require the actual pure seed content and germination level of the seed lot to be shown to buyers. The buyer and seller would then negotiate the sale on the basis of the guaranteed quality of the sample. This system will eventually be introduced in all Australian States and possibly during 1982, in Queensland.

A problem arises however, as to what germination figure to put on the seed label. Dormant seeds have two germination figures which may be quoted at any one time (a) the actual germination at the time of test, and (b) the germination potential which will be reached when dormancy is broken. The minimum standard system is largely based on testing in the laboratory following dormancy breaking procedures.

Whereas laboratory tests of crop plants bear a close relationship to field performance this is not the case with grasses, especially within the dormant phase of the seed. Initially it was intended to label with the analytically obtained germination test figure and the date of test. This was changed in favour of the seller's guarantee of the minimum germination to be expected from each lot. Which of the two will be mandatory on the label has yet to be decided, but among the States generally there is a tendency towards regarding the lower germination figure obtained without dormancy breaking, as the official result for labelling purposes.

The present standards will not be abandoned entirely. The sale of sub-standard seed will not be prevented, but seed above the present or future prescribed minimum standard may be saleable as high grade. For seed to be designated as high grade this may mean some upgrading of present standards.

There is a considerable problem too, in variation in grass seed quality from bag to bag in the one seed lot. Tests with setaria and *Paspalum plicatulum* have shown that such variation cannot be eliminated by better blending of seed, although more attention should be given to this by sellers of seed. The problem has remained even after thorough mixing and its full ramifications and implications must be further investigated, before a decision can be made on the labelling system.

MARKETING REQUIREMENTS AND PROBLEMS FOR THE LOCAL AND EXPORT TRADE FOR TROPICAL PASTURE SPECIES

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Marketing

The export of tropical seeds and their distribution for the local domestic trade are closely related. The historic system of marketing seed locally follows a fairly set pattern. After harvest, the seed passes through a processor where it is cleaned. Samples are then sent for testing by a government seed testing station. When the samples are found to comply with the standards of purity and germination, the bulk seed is packed in standard weight sacks, branded with the variety name, the mass content, the lot or line number and the packer's name. It is then ready for marketing, firstly, by the wholesale seedsman who in turn offers to resellers and storekeepers strategically placed throughout the rural seed consuming areas. These people who service our farmers and developers can best be referred to as seedsmen. They must keep themselves well educated in the latest advances in agriculture, so that they are in a position to pass these findings on to their consumers.

Developing Export Trade

Tropical grass and legume seed production became commercial here in the very early sixties and before we could become marketers of seed for tropical species for export, a demand had to be created throughout the world where these species had a place. There were several ways of creating this demand. Firstly, we have the Trades Departments and Offices whose staff investigate markets, make contacts, and supply information back to the Australian exporter. As well, organizations in the export business solicit trade by visiting different countries throughout the world. The establishment of a working arrangement may take years and includes the development of technology and some experimentation, because the majority of the importing countries lack expertise in these areas. It was necessary for trial areas to be initiated and assessed before a demand for our product was created. When all this had taken place and it could be seen that there was a demand in certain countries, our job as marketers was to advise our producers of the anticipated requirements of the market place.

Problems in the marketing of seed

Before seed can be exported, we face the same regulations and requirements for testing as on the local scene. Samples from the bulk of seed to be exported, must be found to be in keeping with the standards required. Moreover it must comply with the requirements of the importing state or country. Before seed can be shipped, a health certificate in compliance with the regulations laid down, and endorsed with the necessary requirements of the importing country, is essential. In Queensland, the procedure is that the seed is tested at our seed testing station to see that it does comply and when shipments are made, samples from that shipment are taken and inspected by the exporting officer.

For both local and export trade, our major problem is a reliable and continuing supply of the main export species. It is equally essential to build-up a reliable export market. Droughts, floods and other weather stresses have plagued this operation, but if we are to be reliable marketers of the tropical species, we must have the dedication and understanding of our producers. Reliable marketing cannot depend on irregular supplies. A lot of our production is grown on an *ad hoc* basis, the farmer's intention to close up fields for seed production being easily altered, particularly when dry conditions occur and fields are required for grazing. Too many times, we have the demand but not the commodity.

Other problems can of course, be minimized providing that all regulations, both local and overseas, are adhered to. If inferior seed is shipped overseas, there will be problems, the same as inferior seed being sold on the local market. However, we have problems in the export trade when it is necessary to test seed on arrival, or when the importing countries do not have the expertise to carry out testing on tropical species. In addition, there is a lack of information in some of the countries, as to how the species are to be sown. Most seed companies overcome this problem by providing expert advice to their consumers on how fields are to be treated prior to sowing. In recent years, many of these problems have disappeared.

One other problem for seed exported to tropical areas is storage in open warehouses, where seed deteriorates very quickly under humid conditions. A lot of work has been done in this area in recent years to illustrate the problem and to ensure that seed is stored in controlled temperature conditions.

No doubt in the future problems of the kind described will occur again. It is only by co-operation with our own state and commonwealth government departments, that we can achieve understanding with importing countries to make the flow of our exports workable.