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Pasture seed as a crop for small farmers

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The advisability of promoting forage seed production as a crop for small farmers was examined in the Caribbean context. If used in rotation with crops, a minimum 3-year pasture break is capable of reducing disease and weed problems, improving soil structure and chemical fertility, and the foliage left after seed harvesting provides a valuable source of either animal feed or mulch for sale or use in other farm enterprises. The sale of seed would provide a useful cash income. Problems include the loss of flexibility imposed by a perennial crop, the weed potential of pasture species, competition for available labour and the present lack of an established local market for the seed. Government policies to stimulate the use of pastures would increase the demand for seed, while a potential export market already exists in South America. It is concluded that if central cleaning and quality control facilities are established by a regional organization such as CARDI, pasture seed production could be an attractive alternative for careful farmers.

Keywords: Grasses; Forage legumes; Seed production; Small farmers

Introduction

The production of seed of tropical pasture species is a capital-intensive, specialist operation in Australia (e.g. Humphreys, 1975) and parts of Brazil, but other countries have chosen less costly ways to provide farmers with the seed required for pasture development. Ferguson (1979) describes several levels of intensity of operations in South America, but notes that most seed is produced as an opportunist by-product of commercial grazing enterprises. In contrast, Hare (1985) refers to a successful project in Thailand, where in 1981, 200 tonnes of pasture seed was produced by village farmers using manual harvesting and cleaning methods. Where the availability and cost of labour permits, collection by hand produces higher yields and better quality seed than mechanical harvesting.

In the Caribbean, a range of pasture seed has been produced in Antigua and Trinidad by CARDI as a specialist enterprise, using a combination of mechanical and manual operations, while volunteer Guinea Grass (*Panicum maximum*) is collected manually for either home use or local sale in Jamaica. No systematic attempt has been made to promote pasture seed as a crop for small farmers. This paper attempts to examine the technical feasibility of such an exercise.

The market

The level of present demand for pasture seed in the Eastern Caribbean was discussed by Paterson (1987). It was concluded that current production levels only satisfy about half of the requirement for the drier, calcareous soils in the region, although present demand is distorted by the fact that CARDI provides seed free-of-charge to Government and Development agencies throughout the CARICOM area.

Almost certainly, the demand would fall if current world market prices were charged for the seed. Indications are, however, that commercial livestock farmers in Barbados, where about half of the production from Antigua is presently used, are sufficiently convinced of the value of improved pastures to begin to pay for the seed that they require.

Attempts to assess the demand for seed suitable for acid, infertile soils in the Caribbean have met with little success. While there is undoubtedly an enormous potential for pasture improvement in countries such as Jamaica, Guyana and Trinidad, the lack of clear species recommendations inhibits the establishment of large scale regional seed production projects. The purchase of seed on the world market is not an attractive proposition, given the present currency values and shortages of foreign exchange in these countries. The answer to these problems could lie in the production of a range of species by small-scale farmers for sale on the local market.

Climatic and edaphic requirements

A detailed description of the climatic and edaphic requirements for tropical seed production is given by Humphreys (1975), while a more recent summary is provided by Hare (1985).

Best yields of most species are obtained within the range of 10 to 23° of latitude. Below 10°, day length variation from season to season during the year is insufficient to induce prolific flowering in plants which are sensitive to daylength. Most commercial pasture species require short days for flowering while others require long days. Very few are day neutral. Above 23° of latitude, the risk of cold weather, or even frosts at the time of flowering is too great in most countries, although in small islands the danger is lessened by the maritime influence.

An annual rainfall of between 800 and 2,000 mm is generally considered to be adequate for most species. Below about 800 mm, the wet season is unreliable, while above 2,000 mm, the lack of a well-defined dry season favours plant diseases and creates problems during harvesting.

Tropical pastures can be grown on a range of soils, but best seed yields are obtained on good agricultural soils. Very acid, saline or waterlogged areas are generally unsuitable, while shallow soils reduce seed yields, since they limit root growth.

With the exception of Guyana, which lies too close to the equator to produce high yields of most pasture species, the CARICOM countries in general provide a combination of physical characteristics which render them suitable for the production of seed of tropical pastures. Pasture seed could constitute a potentially lucrative alternative crop for those farmers who are prepared to develop the skills necessary for efficient production.

Pastures in the small farm system

There are numerous small farm systems to be found in the Caribbean region. A full discussion of the existing variation is beyond the scope of this paper; suffice to say that on most small farms in the drier areas, a combination of vegetables and annual field crops are produced. In higher rainfall areas, permanent tree crops (coconuts, fruits) or semi permanent crops such as bananas tend to assume greater importance. Many small farmers also keep livestock. Cattle are frequently tethered along road sides or on common land, while sheep

and goats are often allowed to roam free during the day, being confined at night to reduce animal losses. Pasture seed production within such a system offers several potential benefits, but could also compete with existing activities. The main advantages and disadvantages are discussed below:

Advantages

Most of the tropical pastures recommended for commercial use in the region are perennial, producing good seed yields for a minimum of three years. In a commercial environment, first year yields are usually sufficient to show a profit after paying all establishment costs. Maintenance costs in the second and subsequent years are low, and profits are then considerably higher.

A three year pasture break is usually sufficient to control soil-borne diseases or persistent weeds in a problem area. Grass weeds can be smothered by the use of a legume, while broad - leaved weeds can be economically controlled in a grass stand by the use of selective herbicides.

Three years under pasture is usually sufficient to produce noticeable improvements in both soil fertility and structure, particularly if the species chosen is a legume. As well as being able to fix atmospheric nitrogen, the deep root systems of most legumes are capable of recycling plant nutrients from the deeper horizons of the soil profile. The undisturbed root mass will increase the organic matter content of the soil and improve the structure for subsequent crops.

While the harvesting of pasture seed on a small scale is carried out by hand, it is not heavy work. In many parts of the world, women and children are given the task of collecting and cleaning the seed.

The pasture foliage which is left behind after the harvesting or cleaning operations represents a valuable resource. It can be used as a mulching material in the cropping enterprise. The excellent results obtained in many tropical countries by the use of fertilizer/mulch from legumes such as *Leucaena leucocephala* are well known. Herbaceous pasture legumes are equally suitable for this purpose. While grasses have a lower nitrogen content than legumes, and consequently are less effective as fertilizer material, they decompose more slowly when placed on the soil, and therefore have a longer lasting effect on water conservation. The relative merits of grasses and legumes as mulching material will depend upon the fertility and soil moisture relations prevailing in a particular field. Mulching with guineagrass is an established practice in Jamaica and the technique has improved crop yields in Antigua (L. Daisley, pers. comm.)

The foliage can also be used as animal feed. If the home farm has no livestock, leguminous leaf and pod material can be dried and bagged for storage, while grass can be cut and made into hay. These commodities can be sold to livestock owners, particularly during the worst part of the dry season.

Several of the advantages outlined above are difficult to quantify, but it is clear that the cash payment received from the sale of seed is only a part of the economic return to be derived from pasture seed production. The reduction in soil borne diseases and the improvement in soil fertility, together with the ready availability of mulching material should lead to increased yields from the cropping enterprise, although these benefits will not become fully apparent

until the area of land used for the pastures is ploughed up and returned to a cropping phase. Improvements in the animal enterprise would arise in the first year, although these will be small if attempts are made to feed too many animals with the available material. Above all, pasture seed production provides an opportunity to solve particularly difficult disease or weed problems while still generating a cash income from the affected plot.

Disadvantages

The production of pasture seed is a relatively inflexible operation, since an area should be kept under the crop for at least three years to derive the maximum benefit from the enterprise. It therefore reduces the ability of the farmer to rapidly respond to changing market opportunities.

Most pasture species have to be harvested quickly once the crop is mature, since the seed falls or the pods shatter within a few days of seed maturity. Judgement must be exercised to choose the correct time of harvesting, since a week either way from the optimum date can make a large difference to the yield of clean seed. Best yields are obtained from repeated harvesting, but this increases the labour requirement.

Careless choice of pasture species can lead to severe competition for labour between the seed crop and the other farming enterprises.

An area of green pasture during the dry season will be particularly attractive to livestock. Fences must be maintained in good condition, since the unplanned entry of livestock may ruin not only the seed crop but also other crops in adjacent areas.

There is no formal market established for pasture seed in the Caribbean region, although demand is starting to grow as farmers become aware of the benefit to be derived from the use of improved pastures. The major disadvantage is obviously the lack of a ready market within the region. There presently exists a large demand in the northern part of South America for seed of species suitable for use on acid soils. If the efficient Caribbean producer could compete in the international market, he would enjoy the advantage of being much closer to the consumer than the traditional suppliers in Australia and South-East Asia.

Species considerations

There are some aspects of pasture plants that must be taken into account by the farmer who is considering seed production.

Grasses: In general, perennial grasses are potential weeds on a cropping farm. Pasture grasses are frequently stoloniferous, and can therefore spread both by seed and by creeping along the surface of the ground. The sward can be hard to kill out at the end of the pasture phase, unless a mouldboard plough is available to completely invert the sod, or unless use is made of expensive herbicides such as glyphosate. Seed is produced during the wet season when the labour requirement for crop production is at its peak. To counteract these disadvantages, grazing (or cut grass) is available throughout the dry season. Most pasture grasses will produce at least two crops per year if they are cut back or heavily grazed after the first harvest. If harvesting is carried out at the optimum time, Guinea (*Panicum maximum*) or Signal grasses (*Brachiaria spp.*) can yield up to about 100

kg/ha of commercial seed at each harvest, although the production will depend upon soil fertility and moisture availability. After taking the seed, the forage available for grazing, mulching etc. is usually in excess of 8 tons of dry matter per hectare per year.

Legumes: Legumes are easier to eliminate than grasses. Cutting at, or close to ground level with a cutlass will kill most mature plants, while the seedlings which emerge later are susceptible to cheaper herbicides such as gramoxone or 2, 4-D, particularly in the early stages. Seed is usually produced only once during the dry season (April - May in Antigua), so inability to harvest at that time can lead to the loss of the whole crop. Grazing, cut forage and mulch are usually only available after the harvest of the seed, although a light topping or grazing is sometimes possible in December or January to reduce the bulk of foliage, well before the time of flower initiation. With frequent hand harvesting, most species are capable of producing in excess of 400 kg/ha of clean seed, particularly if the scrambling species are allowed to climb on a fence. This not only improves yield, but also makes collection a less tiring operation. The forage available after seed harvest is usually some 5 t/ha per year, but its high nitrogen content makes it suitable, either as a protein-rich animal feed or as a fertilizer.

Some seed sown pasture grasses and legumes recommended for the Caribbean region are shown in Table 1. The recommendations are taken from several sources (e.g. Keoghan, 1980; Cumberbatch, 1986) modified in the light of observations. They are intended to give an indication of the species for which there is a current demand, or for which one is expected to develop in the near future. They are the species which should be considered for potential small-scale seed production.

Table 1 Seed sown pasture grasses and legumes for the Caribbean Region

Soil Group	Grasses	Legumes
Neutral to Alkaline (pH 6.5 and above)	*Cenchrus ciliaris* *Chrysopogon sp.* *Panicum coloratum* *Panicum maximum*	*Macroptilium atropurpureum* *Neonotonia wightii* *Stylosanthes hamata* *Teramnus labialis*
Moderately acid (pH.5.0 to 6.5)	*Brachiaria decumbens* *Brachiaria humidicola* *Panicum maximum*	*Centrosema pubescens* *Desmodium spp.* *Macroptilium atropurpureum* *Pueraria phaseoloides* *Stylosanthes guianensis* *Stylosanthes hamata*
Highly acid (pH below 5.0)	*Andropogon gayanus* *Brachiaria decumbens* *Brachiaria humidicola* *Panicum maximum*	*Centrosema spp.* *Desmodium spp.* *Pueraria phaseoloides* *Stylosanthes capitata* *Stylosanthes guianensis* *Zornia spp.*

Policy considerations

Any government policy decisions designed to increase the use of improved pastures in the region will affect the local demand for pasture seed. Clearly, an investment in perennial pastures is a long-term decision. The livestock farmer will only be prepared to improve

his pastures if he is confident about his land tenure and the future of the market. The price structure for local animal products must provide for a reasonable profit and the producer must be protected from the dumping practices of extra-regional countries. Any subsidies for the ruminant livestock industry should be aimed at increasing the use of high-quality, legume-based pasture while decreasing the reliance on imported fertilizers and animal feeds. Policies such as these could lead to a rapid increase in the regional demand for pasture seed.

Most of the legumes listed in Table 1 produce pods which each contain several seeds. The pods shatter when dry, and it is easy to hand separate the seed from the inert material. Other legume species (e.g. *Desmodium spp., Stylosanthes spp.*) and most grasses are more difficult to clean to acceptable international standards without the use of sophisticated machinery, which is too expensive for an individual farmer. It may not be necessary to clean seed to these levels for sale on a local market, since the price and the sowing rate can be adjusted to compensate for the inert material in the seed lot, but for export, cleaning assumes greater importance, since freight charges can constitute a considerable proportion of the final cost to the consumer. Seed for export must also be accompanied by a recent certificate of purity and germination, so that the purchaser can estimate the true value of the seed lot. For these reasons, seed destined for the export market should be produced under contract to a central organization which would be responsible for cleaning, testing, packaging and distribution. In view of its regional representation, it is thought that CARDI is in an ideal situation to fill this role.

Conclusions

The production of pasture seed offers a potential source of both cash income and soil improvement benefits to those small farmers who are prepared to master the technically simple, but logistically demanding processes involved. Grasses and legumes each have their own advantages within the small farm system, but the latter group of species are probably more compatible with annual field crop production, since the peak labour demand occurs in the dry season. CARDI has plans to encourage small farmers to produce seed under contract, although these plans will not come to fruition until a commercial market for seed of improved pastures is established in the region.

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