# Adoption of Soybeans as a Rotation Crop in Far North Queensland

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## Introduction

Fallow cropping with green-manure legumes has traditionally been a practice in the Australian sugar industry. At the end of the crushing season, the final ratoon of cane is removed and this land is not replanted to cane until the following autumn/winter. Fallow land is either planted to legumes or left as a bare or weedy fallow. The main legumes used in the past include Dolichos (lablab) and cowpeas but their use diminished in the wetter areas as they frequently died with the onset of the heavy rainfall.

Until 1975 fallow planting was enforced on growers who were not allowed to harvest their full assigned area in any one year. With the lifting of these restrictions many growers moved towards 100% cane production using a plough-out/replant system of cane and discontinued fallow cropping. The resulting long-term monoculture system has led to a decline in soil health resulting in poor productivity.

Research done by the Sugar Yield Decline Joint Venture (SJDJV) identified that yield decline was in large part due to the sugarcane monoculture. By breaking this monoculture through the introduction of suitable fallow crops has increased cane yields by 15-20% in trials. Fallow crops that were used in research trials consisted of pastures, peanuts, maize and soybeans. The best results in terms of yield increases with short season crops were achieved with the soybean variety Leichardt.

Legumes such as soybeans are grown for 2 basic reasons; firstly to provide a diverse break from sugarcane and so relieve build up of diseases and secondly to provide a source of nitrogen for the following cane crop. Leichardt soybean has a number of useful attributes that make it ideally suited to cultivation in the wet tropics. Leichardt is very tolerant of waterlogging, produces a lot of organic matter, has excellent nitrogen fixation and reduces soil borne diseases and nematodes.

One of the roles of the DPI Sugar Solutions project was to extend the SYDJV research findings to the general farming public and help growers to implement soybean fallows. Maximum benefits of the legume fallows can only be realised if good agronomy practices are applied. For soybeans this involves planting with a row-crop planter, planting onto raised beds (especially on the wet coast) and applying a pre-emergent herbicide.

## Extension methods

The first extension exercise consisted of a soybean field day. This was held to create an awareness of the crop as well get an interest from growers who would then form the basis of grower groups in selected mill areas. The field day also served to clarify a wide range of pre-conceived ideas that cane growers had about the role of soybeans in farming systems.

Extension of soybean agronomy was carried out in groups using principles of adult learning. Ten grower groups, with a total of 180 farmers, were formed from Ingham to Mossman in early 2000. This region is known as the Wet Tropics due to the high rainfall of between 2,000-5,000

mm/annum. The wettest region lies between Babinda and Tully and this is known as the super wet tropics.

Growers in the 10 groups actively participated in meetings with a number of growers planting soybeans in their fallows. Many of the soybean paddocks were used as demonstration sites and field days, farm walks and bus tours were scheduled around these sites.

**Growing Soybeans in the Wet Tropics**

With sugar cane farmers having little knowledge of crops other than cane and the unique climatic conditions in the North; every aspect of soybean production was re-examined. Initially seed supply was limiting but a company on the Atherton Tablelands saw a market opportunity and have increased supply of Leichhardt seed to meet the demand in the north and some in the more southern cane growing areas. In the last year a central Queensland company has also entered the market, which has created healthy competition.

One of the major constraints to implementing good soybean fallows was the availability of planters. While soybeans can be broadcast, this method usually results in poor stands that quickly become infested with weeds. To enable growers to access a row crop planter, the sugar solutions project obtained a planter that was hired out to growers at a nominal fee of $50 (regardless of area planted). To improve timeliness of growing fallows and avoid waiting for the DPI planter, a number of growers bought or made up their own planters. This has led to a number of different methods used by growers namely:

a. Conventional planting on mounds.
b. Strategic (strip) till and planting on the old cane stool with undisturbed wheel tracks.
c. Zero-till and planting into the cane trash blanket.
d. Broadcasting.

Conventional planting on mounds involves cultivation of the whole paddock, which includes the relatively friable stool area and the heavily compacted inter-row area. This requires a considerable number of passes and the compacted area contributes to numerous hard clods, which take further tillage to break up. This system does allow the application and incorporation of lime and pre-emergent herbicides but unreliable weather can delay seedbed preparation and planting.

Strategic (strip) till planting involves the use of a rotary hoe and ripper tines to prepare only the strip where the cane crop grew. The advantages are that the soil is easy to work and requires less cultivation as fewer clods are formed. The inter-row is left hard with a trash cover, which prevents weed growth and creates permanent traffic zones. Lime and pre-emergent herbicides is applied to the strip only. Sugar cane can also be subsequently planted into the same strip after the soybeans.

Zero-till planting was carried out with existing fertiliser applicators that apply fertiliser either side of the cane stool. To avoid possible seed damage by the fertiliser feed mechanism a seed box was attached to the back of the fertiliser box to meter seed down the fertiliser chutes. The ratooning cane is either sprayed out with glyphosate prior to planting or Fusilade® after planting.

**Crop Nutrition**

In the past, fallow legumes were grown without fertiliser and this practice is be difficult to change. Fortunately, heavy use of phosphatic fertilisers in the past has left high residual levels often above 100ppm. Soybeans, being good fixers of nitrogen need no additional nitrogen and the only potential problem is potassium with exchangeable levels often being at the low end of optimal.

Many cane growers are aware of the benefit of lime to legumes and if lime is required for the subsequent cane crop it is applied before planting the soybeans.

Mill mud / ash mix is often available to growers close to the mills and is applied to fallow paddocks. The chemical analysis varies from mill to mill but it is commonly high in phosphorus, potassium and lime as well as containing a range of trace elements. Excellent soybean crops are consistently grown where mill mud is applied prior to planting.

**Weed Control**

With the warm wet conditions in the north weeds are a major problem and the fallow period provides a good opportunity to reduce weed levels. With a soybean fallow grass weed control is relatively cheap and easy with pre-emergent herbicides such as trifluralin, pendimethalin or metalachlor.

Broadleaf weeds, particularly vines, are a greater problem and chemicals such as imazethapyr, bentazone and aciflurofen are expensive, not effective on all the weeds and can be phytotoxic to the crop. To achieve good broadleaf weed control growers have used inter-row cultivation and shielded sprayers with some success.

**Post-soybean Management**

Once the soybeans mature and start to drop their leaves the canopy opens and weeds become established. Traditionally growers have used cultivation at this stage but one or more sprays with a cheap herbicide mix such as a glyphosate / 2,4-D amine has given good weed control until such time that the ground is prepared for cane planting. Trials have been done with zero-till cane planters planting into the standing soybeans trash with good results.

**Constraints to adoption**

As with the adoption of any new practice there were a number of obstacles with the implementation of good soybean fallows. Traditional green manure legumes such as cowpeas and lablab were usually broadcasted, incorporated and left to grow until the wet season killed these crops. Weed control was rare and when the fallow crop died from waterlogging, it resulted in a paddock that is generally termed a 'weedy fallow' that had little positive impact on subsequent cane crop. Many of the weedy fallows also included ratoon cane, which did not contribute to the breaking of disease or pest cycles.

Growing soybean was considered to be a lot more effort in having to prepare a finer seedbed, gain access to a planter and having to spend money on weed control. The fallow crop was always considered in isolation and not as part of the whole system. Many growers are now realising that investing money in the fallow can pay dividends; with no nitrogen topdressing required in the plant cane, less expensive weed control in the cane crop as well as soil health benefits and the opportunity to reduce tillage in the cane crop.

With the sugar industry being depressed in recent times a number of farmers have stated that the lack of money is the reason for the reluctance to embrace new technology. Despite this the area planted to soybeans and the number of growers participating has steadily increased up to 2002 as shown in Table 1.

**Table 1: Changes in area of soybean grown over the life of the project**

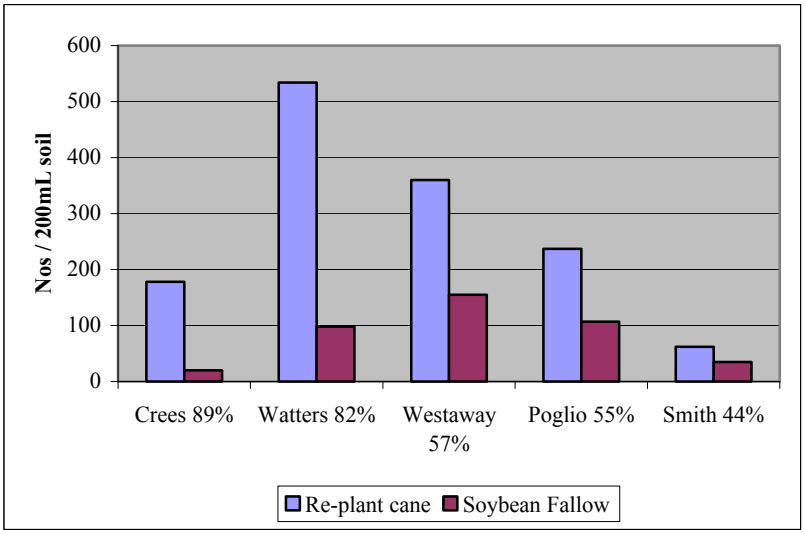
| Year | 1999/2000 | | 2000/2001 | | 2001/2002 | |
|---|---|---|---|---|---|---|
| Region | No. of growers | Area planted (ha) | No. of growers | Area planted (ha) | No. of growers | Area planted (ha) |
| Mossman | 0 | 0 | 4 | 52.5 | 9 | 103.5 |
| Cairns | 0 | 0 | 2 | 30 | 2 | 15 |
| Gordonvale | 2 | 11 | 9 | 45 | 17 | 111 |
| Babinda | 0 | 0 | 0 | 0 | 6 | 22 |
| Innisfail | 2 | 8 | 5 | 16 | 16 | 64 |
| Tully | 2 | 50 | 5 | 47 | 16 | 293 |
| Ingham | 1 | 6 | 3 | 11 | 16 | 230 |
| **Total** | **7** | **75** | **28** | **201.5** | **82** | **838.5** |

## Other Project Outputs

*a. Soybean fallow impact on nematodes*

Comparing cane following soybean fallows and a plough-out/re-plant has clearly demonstrated to farmers the impact of the fallow on cane parasitic nematodes. The primary parasitic nematode of cane is lesion nematode (*Pratylenchus zeae*) and Table 2 shows the effect of a soybean fallow on their numbers compared to a re-plant situation.

**Table 2. Comparison of lesion nematodes in plough-out/re-plant versus soybean fallow plant**




In addition to the reduction in parasitic nematodes after soybean fallows there was an increase in free-living nematodes (bacterivores and fungivores) which indicate an increased biological activity in the soil.

*b. Herbicide trials*

There are a number of registered herbicides available for use in soybeans but the weed species prevalent in north Queensland do not often appear on product labels. Field demonstrations and replicated trials were carried out to determine the most cost-effective methods of weed control. Stomp® applied post-planting, pre-emergent has become the standard for grass weed control but broadleaf weeds are more problematic. Blazer®, Basagran® and Spinnaker® are deemed too

expensive for weed control in a green manure crop and inter-row cultivation and shielded spraying are preferred. In the 2003 season we are looking at Gramoxone® (paraquat) through Irvin legs at the base of the plant and the use of glyphosate through a wick wiper for the control of volunteer cane in the soybeans.

*c. Economic Analysis*
An economist has used SJDJV trial yield data to model possible returns from farming systems with and without a soybean fallow. The results show that increased yields achieved after soybean fallows throughout the cane production cycle compensate for the missed crop and growers can produce as much cane and sugar from the reduced area. There are also reduced costs less tillage following the fallow and reduced nitrogen rates due to fixation.

**Conclusions**

The use of legume fallows in the cane industry is less frequent than in the past due to the economic pressure to grow more cane and the lack of tolerance of many legume species to waterlogging. The introduction of soybean enables farmers to gain all the benefits of a green-manure legume crop in wet areas where only failures have occurred in the past. Economic modelling shows that a system including soybean fallows can produce improved gross margins over 100% cane throughout the whole crop cycle as well as improving soil health. There are also environmental benefits through reduced use of nitrogenous fertiliser due to the slower release of nitrogen from soybean residues and the reduced tillage after a soybean crop avoiding erosion losses following excessive aggressive tillage.

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