Sweet Potatoes in Queensland – Something Old, Something New

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Abstract

Though sweet potatoes are considered as one of the earliest domesticated plants, as historical evidence shows that they were cultivated as a crop in southern Peru and Mexico about 2,000 to 2,500 BC, their history of cultivation in Queensland is naturally much more recent. However, in the context of Queensland agriculture, the cultivation of sweet potatoes has had a relatively long history. Initially the crop was cultivated for stock feed where it played an integral part as a source of sustenance, particularly on dairy farms which were instrumental in the early development of Queensland agriculture. A sweet potato patch commonly in the size range of 2 - 5 hectares provided supplementary grazing for both the dairy cattle and pigs, the latter being an important component of these early enterprises. Both the shoots and the roots were utilised and no doubt the roots were also used as a part of the settlers' diet during these pioneering times.

From these early beginnings, the sweet potato industry has changed substantially, particularly from the early 1970s. The crop is now grown primarily for human consumption. This paper briefly traces the history of the crop in Queensland and outlines the research inputs by the Queensland Department of Primary Industries (QDPI) to service this industry with new varieties, a source of virus tested germplasm, improved agronomic practices, and more recently, joint research by QDPI and the University of Queensland, Gatton College to provide an understanding of the importance of feathery mottle virus on yield and quality of sweet potatoes. The size and distribution of the Queensland industry, and production trends, are also discussed.

Introduction

Historical research indicates that the sweet potato is possibly one of the earliest domesticated plants (Yen 1976). Carbon dating suggests sweet potatoes found in Peru were produced between 8,000 and 10,000 BC. Linguistic and historical evidence exists to believe that cultivation of the crop was widespread in southern Peru and Mexico about 2,000 to 2,500 BC (Bohac *et al.* 1995). While Austin (1988) proposes that the origin of the sweet potato occurred between the Yucatan and the mouth of the Orinoco river in South America, Yen (1982) describes related species in the tropical north of Australia including Arnhem Land and Cape York as well as the desert region of Central Australia that were used as a food source by aboriginal hunters and gatherers.

In the very first issue of the Queensland Agricultural Journal which chronicles the progress of agricultural development in Queensland, Tardent (1897), champions the cause of the sweet potato as a cultivated crop in the pioneering of Queensland Agriculture Records indicate that the crop was at least grown in Queensland as early as 1888 on St Helena Island at the mouth of the Brisbane River (Anon. 1897). Through the ensuing volumes of the Queensland Agricultural Journal some indication of the importance of this crop in the development of agriculture, particularly in coastal districts, can

be appreciated. The crop was often an integral part of the pioneering dairying industry where it was used as a fodder reserve for both cattle and pigs. Brooks (1923) observed that, though the crop was not grown on a large scale for sale, practically every farmer had his own sweet potato patch. At this time, Brooks classified 50 existing varieties into those suitable for stock feeding, culinary use and starch production.

Kerr (1943) concluded the varieties available at that time were not particularly suitable to culinary use because of the contorted shapes of storage roots and their high fibre content. In reality, demand for sweet potatoes in the market place at this time depended on a shortfall in the supply of English potatoes. As recently as 1955, Hassell described techniques for the grazing of sweet potatoes by pigs and cattle indicating this was still the major use of sweet potatoes in Queensland at this time (Hassell 1955).

A significant change occurred within the Queensland industry in the 1960s partly due to the decline of the dairying industry and also the introduction of new orange fleshed varieties, particularly Centennial, from the United States by Mr Ian Wood of QDPI. During this transition period the area sown to sweet potatoes declined from 250 ha in 1952-53 to 160 ha in 1972-73 (Wood 1976).

This paper outlines the growth and location of this new industry and the research input that has serviced its development.

Production

Australia's production in 1992/93 was 7,654 t of which Queensland produced 5,726 t from 437 ha (Australian Bureau of Statistics 1995). Production trends (Figure 1) indicate a steady increase with production doubling over the 10 year period 1982/83 - 1992/93. Current estimates of the size and value of the Queensland industry is 8,000 t worth $8 million (L. Loader, pers. comm. 1996). To put this into perspective, China with an annual harvest of approximately 100 million tonnes is responsible for 80% of all production. Only about 2% is grown in industrialised countries, mainly in the United States and Japan (Horton *et al.* 1989).

Location of Industry

Sweet potato production is predominantly in Shires located along the eastern coastal and sub coastal regions (Table 1). The major soil types utilised in these areas are coastal sandy loams with low inherent fertility, red volcanic soils on the Atherton Tablelands, Redland Bay and the Bundaberg District and red and brown loams in Central Queensland. Annual rainfall in the main growing areas exceeds 1000 mm, the majority of which falls in the growing period. However, supplementary irrigation is necessary to maintain sufficient soil moisture and is practised by successful growers (Wood 1976).

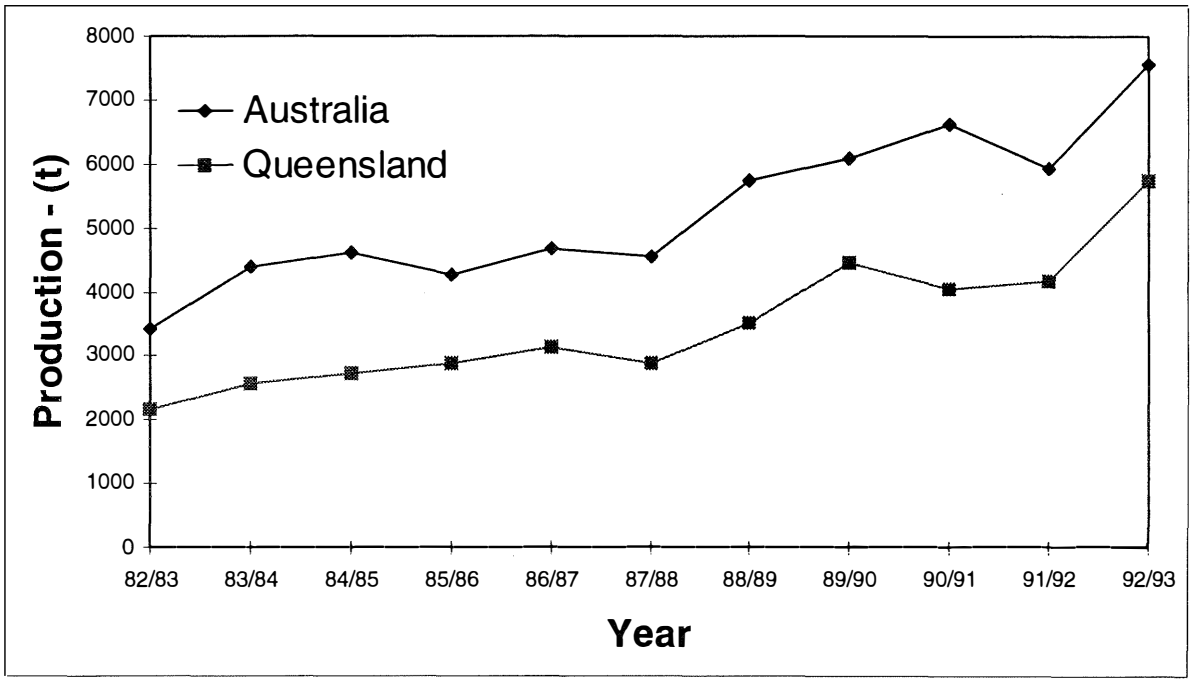

Figure 1. Production trends in Australia and Queensland over the period 1982/83 to 1992/93. Source: Australian Bureau of Statistics

Table 1. Area description, number of producers, growing areas (hectare), production (tonne), average yield (t/ha), and percentage (%) of total production for the major sweet potato growing areas in Queensland (1992-93)*

Area description (Shires)	No. of producers	Area (ha)	Production (t)	Yield (t/ha)	% of total production
Albert	13	29	452	15.8	7.89
Bowen	1	6	126	21.0	2.2
Caboolture	7	33	509	15.4	8.89
Gooburrum	13	47	736	15.8	12.85
Isis	3	29	258	8.9	4.51
Laidley	7	39	282	7.2	4.92
Landsborough	7	47	253	5.4	4.42
Livingstone	3	34	304	5.31	8.8
Mareeba	6	47	895	19.04	15.63
Redcliffe city	2	12	164	13.67	2.86
Redland	10	18	588	32.47	10.27
Woocoo	2	11	132	12.57	2.31
Woongarra	7	47	724	15.33	12.64
Others	20	38	303	7.97	5.29
Total	101	437	5726	13.10	100

* Source: Australian Bureau of Statistics (Hampton, N. personal communication).

Variety Introduction

By the 1970s the only two varieties that had survived to any extent the transition of sweet potatoes from the production for stockfeed to an almost exclusive human food were White Maltese and Porto Rico. Much of the recent success of the Queensland sweet potato industry has resulted from the introduction of orange fleshed varieties from breeding programs in North Carolina and Louisiana in the United States.

The orange fleshed varieties belong to the dessert type and are characterised by their sweet orange flesh in contrast to the staple type which generally has a white to cream coloured flesh and a higher dry matter content. Current market demand in Queensland is mainly for the dessert type, however substantial amounts of the staple type are grown to meet demand mainly from interstate markets in Sydney and Melbourne.

Mr Ian Wood and Mr Terry Harper of QDPI were particularly responsible for the introduction and development of varieties from the United States. The most successful of these introductions were Centennial, Beerwah Gold, Jewel, LO-323 and NC-3 (Harper 1982). All these varieties other than Jewel are still grown today. In the 1980s a group of Taiwanese breeding lines developed by the Asian Vegetable Research and Development Center (AVRDC) as well as two endemic staple varieties (One Moon and Coleambally) plus the US variety, Resisto, were evaluated. None of the AVRDC lines was released mainly due to their poor shape and uneven flesh colour (Loader 1987). The three named varieties were released. Further introductions were made from AVRDC and the US in the early 1990s. A white fleshed, AVRDC line (CN1489-89) and the US variety, Rojo Blanco, are undergoing small commercial trials.

In 1994, Mr Lester Loader (QDPI) and a grower, Mr Phil Buchanan, having visited the United States, made further introductions which included the orange fleshed varieties, Hernandez, Beauregard, Garnet, Ureka and Travis. Additionally, they introduced seed of a number of crossbreds from North Carolina. This material, as well as approximately 100 lines from Oceania countries procured from the National Germplasm Collection (held at the Institute for Horticultural Development, Knoxfield, Victoria) by North Queensland grower, Mr George Bolland, are being screened for potential commercial use by Mr Lester Loader at the QDPI Southedge Research Station in North Queensland.

Germplasm Maintenance

An essential component of the success of the sweet potato industry in recent years has been the development of a germplasm maintenance system for introduced varieties. Since 1981, virus tested planting material of successful new introductions has been made available to producers. Procedures involved in managing this system are reported by Harper *et al.* (1990). Growers frequently purchase virus-tested material from QDPI research stations at Redlands in Southern Queensland and Walkamin in North Queensland to establish their own nurseries. Part of the germplasm maintenance program involves the regular testing for the presence of sweet potato feathery mottle virus by graft indexing onto the host species *Ipomoea setosa*. Any variety giving a positive reaction is withdrawn from the commercial nurseries and the virus is eliminated using tissue culture techniques. The regenerated plantlets are again tested to ensure the virus has been eliminated before the variety is re-introduced into the program.

Importance of Sweet Potato Feathery Mottle Virus (SPFMV)

SPFMV is found throughout the world sweet potato production areas. The effect of this virus on yield and quality of sweet potatoes however is poorly understood. In a joint research project between QDPI and the University of Queensland, Gatton College, the importance of this virus in the Queensland sweet potato industry was undertaken as a Master's study by Mr George Pan. An isolate of the virus from SE Queensland reduced yields of Beerwah Gold, LO-323 and Coleambally by 12.3%, 18.2% and 15.5% respectively compared with healthy material. In the variety NC-3 where an additional treatment of older infected material was also included, yield reduction of the older infected material was 17.7% less than the uninfected control compared to 9.2% in the recently infected material (Pan *et al.* 1995). Infection by the virus did not have a significant effect on dry matter content, sugar content, flesh or skin colour or shape of storage roots in any of the varieties evaluated. Further studies by Pan *et al.* (1996) examined the effect of three isolates of SPFMV, one each from North Queensland (NQ), S.E. Queensland (SEQ) and Northern New South Wales (NSW) on LO-323 and Beerwah Gold. LO-323 was more susceptible to the three viruses. Yield reductions in LO-323 were 86% (NSW strain), 26.8% (SEQ strain) and 25.2% (NQ strain). The corresponding reductions in yield in Beerwah Gold were 71.3%, 18.2% and 11.0%. Later investigations determined that the NSW strain co-existed with the phytoplasma Sweet Potato Little Leaf. All three isolates caused significant reductions in the number of marketable roots. None of the isolates had any significant effect on the dry matter content though the NSW strain significantly increased the sugar content of both varieties. These studies have established the importance of using virus tested material for commercial plantings.

Agronomy

With the introduction of the new US varieties commencing in the early 1970s, there was a need to develop a detailed agronomic package to provide producers with guidelines to supply markets with acceptable grades of the new varieties.

Population and Growth Cycle Studies

Studies by Harper (1984) determined that a 26.6 cm intra-row spacing was optimal for Jewel, Beerwah Gold, NC-3 and Centennial while a 20 cm spacing, or harvesting before 20 weeks, would minimise the production of very large storage roots in LO-323 and White Maltese. Since LO-323 showed greatest potential as a commercial variety, Harper and Walker (1984) studied this variety over a range of planting and harvesting dates to ascertain the year-round production of this variety for the fresh market as well as for starch production. Highest storage root dry matter yield was recorded in the May planting (15.16 t/ha). Plantings in November and January produced 13.9 and 10.5 t/ha respectively. Maximum yields were achieved generally at the last or second last harvest of each planting.

Nutrition

Nutritional studies were also undertaken by Harper and Walker (1985) to establish the effect of nitrogen (N) and potassium (K) application on the yield and shape of storage roots when applied to the infertile coastal sands and volcanic soils in SE Queensland. They found that the addition of 30 kg N/ha gave significant yield responses in both the sandy and volcanic soils while significant yield responses to the addition of 60 kg K/ha on the sandy soil types were obtained. No response to additional K was measured on the volcanic soil.

Irrigation and Weed Control Studies

Irrigation studies by Harper (1985) compared production when irrigation replenishment to field capacity to a depth of 30 cm was scheduled at 75%, 50% and 25% of available soil moisture (ASM). It was concluded that replenishment at 25% ASM was sufficient to maximise yields.

Harper and Walker (1987) completed extensive herbicide screening to find a replacement for the discontinued herbicide Lasso. This work resulted in the recommendation of Dual as a replacement, but unfortunately this chemical has not as yet been registered for use in sweet potatoes.

Plastic Mulch and Storage Studies

Harper and Walker (1987) determined that black plastic mulch had potential for sweet potato plantings between March and May, but was not recommended for August plantings because of the risk of soil rots developing in the hot, wet summer growing conditions encountered following this planting time.

Shed versus in-ground storage studies were conducted by Harper and Walker (1980). They concluded that neither White Maltese nor Centennial were suitable for over-winter storage in either the field or a shed. The varieties Jewel and NC-3 were stored successfully in the field and produced higher saleable yields than shed stored material from the same varieties. Under the conditions of the trial, storage for future fresh market sales could not be recommended. These studies were undertaken primarily to supply markets in late winter and spring from SE Queensland production areas to take advantage of the higher prices at this time.

Conclusion

The sweet potato has served Queensland agriculture both as an old crop to provide a source of reserve fodder on the pioneering dairy farms and more recently as a new crop to supply an estimated 8000 t for human consumption. While this industry is steadily growing, it is still a minor horticultural crop in Queensland. Per capita consumption of sweet potato in Australia is approximately 0.5 kg compared to 35 kg for the English potato. There is a need to promote the nutritional value and the versatility of this crop both as a fresh and a processed vegetable. For example Mason (1976) determined the suitability of Queensland sweet potatoes for canning, but this product has never been commercialised.

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