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Evaluation of varieties, planting date and polyethylene mulch for spring and summer sweet potato production in south-east Queensland

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Abstract

Three sweet potato (*Ipomoea batatas* (L) Lam.) varieties LO-323, Beerwah Gold and Red Abundance were tested for spring and summer harvests in coastal south-east Queensland. Experiments were established in March (Experiment 1), May (Experiment 2) and August (Experiment 3) of 1984. Three harvests per experiment at monthly intervals commencing in October, November and December, respectively, monitored rate of maturity with and without black polyethylene mulch.

Polyethylene mulch significantly increased total yield in all experiments and saleable yield in Experiments 1 and 2 ($P<0.05$).

Total and saleable yields increased significantly from sequential harvests in all experiments ($P<0.05$). There were significant differences between varieties for total and saleable yields and percentage saleable in all experiments ($P<0.05$). LO-323 was superior for total yield in all experiments and for saleable yield in Experiments 2 and 3. Red Abundance produced the highest saleable yield in Experiment 1. Beerwah Gold was superior for percentage saleable in Experiments 1 and 2, and exhibited much less cracking and malformation than LO-323.

Interaction of variety×polyethylene mulch×time of harvest occurred in Experiment 3. Beerwah Gold produced a significantly higher saleable yield under mulch than with no mulch at second time of harvest in January ($P<0.05$). LO-323 produced a significantly lower marketable yield with mulch than without mulch at the final harvest in February as a result of losses from soil rot (*Streptomyces ipomoea*).

INTRODUCTION

Considerable over-winter production of sweet potatoes (*Ipomoea batatas* (L) Lam.) takes place in south-east Queensland to take advantage of high market prices which prevail between October and January. Our observations of commercial plantings showed great variation in yield and quality of crops harvested over this period.

Autumn plantings need sufficient time for vine growth before winter to achieve reasonable ground cover and shading of weeds. If planted too early, storage root development commences and is then arrested by low soil temperatures (Harper and Walker 1984). Subsequent growth of these roots in spring can result in malformation and splitting. The extent of this problem varies greatly among varieties.

During 1978–81 a number of introduced sweet potato varieties were assessed from spring, summer and early autumn plantings. The most consistent varieties were released for commercial use (Harper 1982). Suitability of these varieties for over-winter cropping for harvesting from October to January has not been assessed.

The varieties in this study were the three most commonly grown and provide most of Queensland's production. LO-323 and Beerwah Gold are orange fleshed varieties released in 1982 and Red Abundance is the only white fleshed variety in major commercial use. Although orange and white fleshed cultivars were included, neither could entirely substitute for the other. There is a steady market demand for both types and most producers grow both types.

Hockmuth and Howell (1983) reported increases in marketable yields of up to 80% from using black polyethylene mulch on raised beds in cool short season locations in the USA. Yield response was assumed to be due to increased temperature, moisture and nutrient retention of the soil.

The objective of this project was to evaluate sweet potatoes for improved yield and quality from October to January. This required autumn–winter plantings.

MATERIALS AND METHODS

A series of experiments was planted in March (Experiment 1), May (Experiment 2) and August (Experiment 3) 1984 at Beerwah Field Station (27°S, 153°E; altitude 34 m).

Each experiment was a factorial arrangement of 3 varieties×3 sequential harvests×2 mulch treatments (Table 1) in a completely randomised design with three replications.

Table 1. Planting and harvest times for the three experiments

Experiment	Planting date	Time to 1st harvest	Harvest dates		
			1st	2nd	3rd
1	27 Mar 84	6.9 months	24 Oct 84	21 Nov 84	19 Dec 84
2	8 May 84	6.5 months	21 Nov 84	19 Dec 84	16 Jan 85
3	17 Aug 84	4.1 months	19 Dec 84	19 Jan 85	13 Feb 85

All experiments were conducted on Beerwah sand (Dy 5.21, Northcote 1974). The soil type is typical of the soils being used for commercial sweet potato production in coastal south-east Queensland.

Plots comprised two hilled rows 820 mm apart each containing eight plants 266 mm apart. The centre six plants in each row were harvested. Fertiliser at the rate of 400 kg/ha of Q7K (44 N: 8 P: 88 K) plus 120 kg/ha of the nematicide–insecticide ethoprophos were mixed and incorporated into the soil prior to hilling up the experimental sites. Polyethylene mulch was laid on the hills by hand and holes cut at planting sites with a sharpened soil sampling tube. Following the planting of vine cuttings, each experiment was treated with 4.5 L/ha of the herbicide alachlor which was incorporated with 12 mm of overhead irrigation.

All experiments were overhead irrigated on a regular basis to maintain adequate soil moisture in the unmulched treatments. Mulched treatment guard rows were examined periodically and remained consistently moist within the covered hills.

Soil thermometers were placed in the hills between plants in mulched and unmulched plots immediately following planting in Experiment 2. Soil temperature at 100 mm depth was measured daily at 1400 hours and periodically at 0700 hours.

Digging forks were used to harvest roots. Total yield comprised all storage roots greater than 150 g weight. Saleable yield comprised total yield less all storage roots that were badly split, severely malformed or breaking down due to soil rot.

RESULTS

There was no significant interaction among the main effects in Experiments 1 and 2.

In Experiments 1 and 2 black polyethylene mulch significantly increased total and saleable yields of sweet potato storage roots ($P<0.05$) (Table 2). Mean soil temperatures in Experiment 2 were 23.4°C without mulch and 22.5°C with mulch. In the same experiment periodic observations at 0700 hours indicated soil temperatures under polyethylene mulch were approximately 2°C higher at this time each day. Temperatures in unmulched hills following heavy falls of rain or irrigation consistently registered 1° to 2°C lower than mulched hills for periods up to 48 hours. This was presumed to be due to heat loss during rapid evaporation of moisture from the exposed soil surface.

Table 2. Effect of black plastic mulch, varieties and time to harvest on total yield and saleable yield (t/ha) and percentage saleable for Experiments 1 and 2

	Total yield	Saleable yield	Per cent saleable
Mulch treatment			
Experiment 1			
Without mulch	25.8	18.4	74.7
With mulch	35.4	26.7	80.5
LSD (P=0.05)	3.23	3.46	5.30
Experiment 2			
Without mulch	30.3	26.9	89.1
With mulch	37.5	33.5	90.7
LSD (P=0.05)	3.73	4.23	n.s.
Variety			
Experiment 1			
LO-323	41.5	21.8	50.6
Beerwah Gold	18.9	18.7	99.3
Red Abundance	31.4	27.1	83.1
LSD (P=0.05)	3.9	4.2	6.5
Experiment 2			
LO-323	44.7	37.1	85.8
Beerwah Gold	28.2	28.2	99.4
Red Abundance	28.8	25.3	84.6
LSD (P=0.05)	4.5	5.1	7.3
Time of harvest			
Experiment 1			
October	19.2	11.7	70.5
November	31.5	24.8	82.4
December	41.2	31.1	80.0
LSD (P=0.05)	3.9	4.2	6.5
Experiment 2			
November	17.6	17.1	92.6
December	33.4	28.3	86.3
January	50.7	45.2	90.9
LSD (P=0.05)	4.5	5.1	7.3

The unmulched treatments required hand hoeing to control broad leafed weeds six weeks after planting in Experiments 1 and 2. Subsequently many tall growing broad leafed weeds matured in these two experiments before harvest. In the mulched treatments these weeds were confined to the uncovered interrow spaces. In Experiment 3 no follow up weed control was required as the vines achieved effective ground cover within two months.

LO-323 produced the highest total yield in Experiments 1 and 2 and the highest saleable yield in Experiment 2 ($P<0.05$). LO-323 produced only 50% of saleable yield in Experiment 1 due to severe malformation and splitting of storage roots occurring in this variety. In Experiment 1 Red Abundance produced highest saleable yields ($P<0.05$). Beerwah Gold produced the highest proportion of saleable storage roots (99%) in both experiments ($P<0.05$) (Table 2). Total and saleable yield increased with later harvests, the final time of harvest in each experiment ($P<0.05$) (Table 2).

In Experiment 3 second order interactions occurred. Beerwah Gold produced higher marketable yield under polyethylene mulch than with no mulch at the second harvest in January ($P<0.05$). LO-323 produced lower marketable yield under polyethylene mulch than without mulch at the final harvest in February ($P<0.05$) because of a severe soil rot infestation (*Streptomyces ipomoea*) in this variety under mulch (Table 3).

Table 3. Effect on saleable yield (t/ha) of main effect combinations in Experiment 3*

Mulch treatment	Variety	Harvest 1 Dec	Harvest 2 Jan	Harvest 3 Feb	LSD (P=0.05)
No mulch	LO-323	21.4	39.4	72.7	
Mulched	LO-323	22.8	41.9	41.4	
No mulch	Beerwah Gold	8.8	22.2	48.2	11.6
Mulched	Beerwah Gold	11.5	34.0	48.1	
No mulch	Red Abundance	4.0	22.1	38.1	
Mulched	Red Abundance	3.8	23.4	41.4	

* Second order interaction variety×mulch×time of harvest occurred in this experiment only

DISCUSSION

In terms of the objective to produce improved yield and quality of sweet potatoes during the period from October to January in coastal south-east Queensland the following can be stated.

March plantings could not achieve sufficient yield or maturity to be profitably marketed in October, even with the added benefit from the use of a black ployethylene mulch. By November saleable yields of Beerwah Gold and Red Abundance established under mulch in March were acceptable. Without mulch they required an additional month to reach similar yields. The Brisbane Market price for sweet potatoes averaged over 5 years 1981 to 1985 fell from $15.10 per 20 kg carton for November to $13.27 for December.

LO-323 a quicker maturing and higher yielding variety produced a higher saleable yield of better quality roots, grown under mulch, in November from the May planting indicating no benefit from earlier planting of this variety as a over-winter crop.

For December to January harvests both LO-323 and Beerwah Gold produced much higher marketable yields from the May planting compared to the August planting. Red Abundance was mature in December from its March planting only and mature in January from its May planting. This was anticiapted as Red Abundance is normally very slow maturing outside of the hot midsummer growing period.

August plantings under polyethylene mulch are at risk from soil rot pathogens depending on varietal susceptibility and only one variety responded to mulching at this planting time. Comparisons with previous investigations (Harper 1982) indicates a mean 10 t/ha advantage in favour of August planting compared with a September planting 30 days later when harvested in February.

All varieties produced storage roots of inferior shape from all harvests from March and May plantings compared to their normal summer crop production (September–January plantings). The least affected, Beerwah Gold would have commanded a much higher market price than the other varieties particularly from the March planting.

Black polyethylene mulch appears to have commercial potential for use with plantings between March and May. Benefits of mulchings, in addition to yield increases, are improved weed control and reduced soil moisture fluctuation in the hills. A photodegradable mulch which breaks down as crop maturity approaches would eliminate costly removal and permit machine harvesting without the mulch material jamming equipment.

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