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APPROACHES TO MAINTAIN SWEET POTATO YIELDS IN MIXTURES WITH CORN

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ABSTRACT

Four field trials were conducted to examine the effect of various management practices on sweet potato yield in the sweet potato x corn mixture. The results showed that sweet potato marketable yields were significantly lowered when intercropped with simultaneously planted corn. Sweet potato planted before corn, however, was able to attain yields similar to those of the pure stand. Significant cultivar differences in the ability to tolerate intercropping with corn were demonstrated also, but this ability varied with corn planting data and with season. Cultivar responses reflected differing degrees to tolerance for limited availability of growth factors such as light and water to tolerate intercropping with simultaneously planted corn.

INTRODUCTION

In terms of its level of production during the 1980's, sweet potato ranks as the second most important root corp, after yams, in the Caribbean (FAO, 1984). In 1984, an estimated 33,000 t were produced, of which 3,060 were exported, mainly from St. Vincent and Jamaica, to intra- and extra-regional markets (Ministry of Trade, St. Vincent, 1985; Statistical Institute of Jamaica, 1984).

The sweet potato is grown mainly by small farmers who, in an attempt to increase the output from their holdings, frequently intercrop it with a range of other species. Since this is an important cash crop, one of the most common objectives in sweet potato mixtures is to obtain tuber yields as close as possible to those of the pure stand while obtaining satisfactory yields from the other mixture components.

Corn is one of the most common intercrops in sweet potato mixtures, possibly because of its early maturity. Reports from the Caribbean (Ferguson, 1974) and elsewhere in the tropics (Anon., 1960; Escobar-Carranza, 1975), however, indicate that sweet potato yields are negatively affected in this cropping system. It is necessary, therefore, to develop management practices for the sweet potato-corn mixture which will allow farmers to attain the stated goals. This study was undertaken to examine the effect of the following factors on sweet potato yields in mixtures with corn:

- level of competition
- choice of sweet potato cultivar

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- choice of corn planting date
- season

MATERIALS AND METHODS

Four experiments were conducted at the University Field Station, University of the West Indies, St. Augustine Campus, Trinidad. The soil type was River Estate loam. The land was ploughed. harrowed, rotavated, and ridged. Sweet potato slips 30 cm long were planted on the crest of the ridges, and corn was planted on the sides about 15 cm above the bottom of the furrow. During the first 2 months of growth 25 cm of water were supplied once per week in Trial 1, once every 3 weeks in Trial 2, and once every 2 weeks in Trial 3. Weeds were controlled manually and by paraquat applications, while Chlordane, Perfekthion, Dipterex and Dicrotophos were used for pest control. Corn was harvested as green ears at 11-13 weeks, and sweet potato tubers at 16-20 weeks after planting.

In Experiments 1 and 2, which were conducted between January and July 1980, cultivar differences in response to three cropping systems were examined. The sweet potato cultivars used were 049, a commercially recommended cultivar (Haynes and Wholey, 1971), C9, 02/62, A28/7, and C26/7, all of West Indian origin, and TIS 2328/6 from the collection of the International Institute of Tropical Agriculture (IITA). The Pioneer Hybrid corn cultivar X304B was intercropped with sweet potato. Each experiment consisted of three randomized complete blocks with the following treatments:

1. Pure stands of each sweet potato cultivar with plants spaced at 91 cm x 30 cm (36630 plants/ha).

2. Pure stands of corn with plants spaced at 91 cm x 60 cm (18315 plants/ha).

3. Pure stands of corn with plants spaced at 91 cm x 30 cm.

4. Mixtures of each sweet potato cultivar spaced at 91 cm x 30 cm and corn spaced at 91 cm x 60 cm (hereafter referred as Mixture 1).

5. Mixtures of each sweet potato cultivar spaced at 91 cm x 30 cm and corn spaced at 90 cm x 30 cm (hereafter referred to as Mixture 2).

The effect of staggered corn planting dates on yields of two sweet potato cultivars, 049 and TIS 2328/6, was examined in Experiments 3 and 4. Experiment 3 was conducted from February to August 1980, and consisted of the following cropping systesm:

1. Pure stand corn planted six weeks and three weeks before sweet potato, simultaneously with sweet potato, and three weeks after planting sweet potato.

2. Pure stands of each sweet potato cultivar.

3. Mixtures of sweet potato with six-week old corn (Mixture 1).

4. Mixtures of sweet potato with three-week old corn (Mixture 2).

5. Mixtures of sweet potato and corn planted simultaneously (Mixture 3).

6. Mixtures of corn planted with three-week old sweet potato (Mixture 4).

In Experiment 4, which also consisted of three complete randomized blocks, there were only three corn planting dates four weeks before, simultaneously with sweet potato and four weeks after planting sweet potato. Thus, the mixtures in this trial (Mixtures 5, 6, and 7) had corn planted four weeks before, simultaneously with sweet potato and four weeks after sweet potato, respectively. In Experiments 3 and 4 sweet potato and corn were both spaced at 91 cm x 30 cm.

RESULTS AND DISCUSSION

Level of Composition

Sweet potato marketable yields in mixtures with corn were generally lower than in the pure stands in all experiments, thereby confirming the earlier findings (Anon. 1960; Ferguson, 1974; Escobar-Carranza, 1975), that sweet potato yields were adversely affected in this cropping system. Significantly lower yields were obtained in Mixture 2 than in pure stands and in Mixture 1 in Experiment 1, and there were significantly lower yields in both mixtures than in the pure stands in Experiment 2 (Tables 1 and 2). Thus, both experiments showed that higher corn populations in the mixtures led to greater competition for growth factors,i.e., light, water, nutrients, thereby lowering sweet potato yields, than in mixtures with lower corn populations.

Table 1. Sweet potato marketable yields (T ha^{-1}) in pure stands and in mixtures with corn in Experiment 1

Cultivars	Pure Stand	Mixture 1	Mixture 2	Cultivars Means
		± 3.1*		± 1.8*
049	24.6	30.0	23.1	25.9
02/62	31.0	30.6	23.9	28.5
C9	28.3	23.7	23.7	25.2
C26/7	29.4	27.4	20.4	25.7
TIS2328/6	36.3	27.9	18.7	27.6
A28/7	43.1	37.8	39.1	40.0
		± 1.3*		
Cropping systems Means	32.10	29.6	24.8	

* (±) Standard Error of Means.

Table 2. Sweet potato marketable yields (T ha^{-1}) in pure stands and in mixtures with corn in Experiment 2

Cultivars	Pure Stand	Mixture 1	Mixture 2	Cultivar Means
		± 2.2*		± 0.8*
049	8.2	7.2	8.6	8.0
02/62	6.0	4.8	3.9	4.9
C9	9.2	8.1	5.1	7.4
C26/2	18.4	8.3	9.2	12.0
TIS2328/6	16.2	10.6	10.3	12.4
A28/7	16.0	15.2	13.3	14.8
		± 0.9*		
Cropping systems Means	12.3	9.0	8.4	

*(±) Standard Error of Means.

Choice of Cultivar

There were differences in sweet potato cultivar in response to intercropping with corn (Tables 1 and 2). In Experiment 1, TIS 2328/6 produced significantly lower marketable yields in Mixture 2 than in the pure stand and in Mixture 1 while in Experiment 2, yields in both mixtures were lower than those of the pure stand. Cv. C26/7 also produced significantly lower marketable yields in Mixture 2 than in pure stand in Experiment 1, and its yields in both mixtures were lower than those in the pure stand in Experiment 2. Among the other cultivars no significant differences in response to the cropping systems were detected. Cv. 049 and the high-yielding A28/7 appeared particularly tolerant to intercropping.

Corn Planting Date

Mateo (1976) and Chang et al., cited by Wan (1982), found that there were greater reductions in sweet potato yields the earlier corn was planted in the mixture. in Experiments 3 and 4, the magnitude of the sweet potato response to intercropping with corn also varied according to the date of planting corn relative to that of sweet potato. Yields tended to be lowest when corn was planted three weeks before or simultaneously with sweet potato (Tables 3 and 4): 46 per cent lower yields in Mixture 2 and 37 per cent lower yields in Mixture 6 than in the pure stands were obtained in Experiments 3 and 4, respectively. However, where corn was planted after sweet potato tuber yields approached those of the pure stands.

Cultivar differences in response to corn planting date were also observed In Experiment 3, TIS 2328/6 was more adversely affected by corn planted six weeks before sweet potato than by later corn planting dates: yields improved from 64 per cent of the pure stand yields in Mixture 1 to 71, 80 and 85 per cent in Mixtures 2, 3 and 4, respectively. On the other hand, 049 tuber yields in Mixture 1 were 77 per cent of the pure stand yield, 22 per cent in Mixture 2, 5 per cent in Mixture 3, and 102 per cent in Mixture 4. However, in Experiment 4 this cultivar was more adversely affected by the later planting dates but yields of TIS 2328/6 were only slightly reduced in the mixtures.

Table 3. Marketable yields (T ha^{-1}) of 049 and TIS2328/6 in cropping systems with corn planted at staggered dates in Experiment 3

Cropping Systems	Cv. 049	Cv. TIS2328/6	Cropping Systems Means
		± 2.9*	
Pure Stands	12.5	23.3	17.9
Mixture 1	9.6	15.0	12.3
Mixture 2	2.7	16.6	9.7
Mixture 3	6.7	18.5	12.6
Mixture 4	12.7	19.9	16.3
Cultivar		± 1.3*	
Means	8.8	18.7	

*(±) Standard Error of Means

Table 4. Marketable yields (T ha^{-1}) of 049 TIS2328/6 in cropping systems with corn planted at staggered dates in Experiment 4

Cropping Systems	Cv. 049	Cvs. TIS2328/6	Cropping Systems Means
	± 2.0*		± 1.4*
Pure Stands	9.7	13.6	11.6
Mixture 5	10.4	11.2	10.8
Mixture 6	3.5	11.1	7.3
Mixture 7	5.7	13.1	9.4
Cultivar	± 1.0*		
Means	7.3	12.2	

*(±) Standard Error of Means

Planting Season

Seasonal effects on the yield performance of sweet potato were evident in the experiments and accounted for differences in yields between Experiments 3 and 4 (Tables 3 and 4) and Experiments 1 and 2 (Tables 1 and 2). Haynes et al. (1971) and Lowe (1971) reported that lower sweet potato tuber yields were obtained in the wet season than in the dry season mainly because fewer tubers were produced. High soil moisture content (Spence and Humphries, 1972) and shade (Wilson, 1967; Martin, 1985; Roberts-Nkrumah et al., in press) are known to retard tuberization. Thus, the relative lower yields obtained in Experiment 4 than in Experiment 3 may be attributed to the high soil moisture content and overcast conditions which prevailed during the first four months of Experiment 4. In mixtures, the presence of corn should have lowered soil moisture content to more favourable levels for tuberization

but higher tuber yields were not obtained in mixtures than in pure stands, thereby suggesting that some factor other than high soil moisture content limited tuberization. Cultivar 049 produced markedly lower yields in Mixtures 5 and 6 than in the pure stand and therefore showed that it was less tolerant in the wet season to intercropping with late planted corn than in the dry season. On the other hand, TIS 2328/6 performed better in the wet season. Roberts-Nkrumah et al. (in press) showed that TIS 2328/6 and C26/7 were more shade-tolerant than 049 and A28/7.

Both Experiments 1 and 2 were planted during the same dry season when rainfall averaged 27 mm per month. Differences in the level of supplemental irrigation supplied contributed to the yield differences between the two trials. Thus, in Experiment 2, moisture availability was a significantly limiting factor in sweet potato yield in pure stands, and consequently, even at the lower levels of competition in Mixture 1, yields were significantly reduced. In the dry season plantings TIS 2328/6 and C26/7 yields were always more affected than those of 049 and A28/7. Roberts (1983) observed that 049 and A28/7 exhibited drought-tolerant characteristics.

CONCLUSIONS

Sweet potato yields in mixtures could be maintained at pure stand levels by minimizing competition for growth factors. This was accomplished by:

- Limiting the population of the corn component in the mixture;
- Alleviating seasonal deficits in the availability of growth factors, e.g., application of adequate levels of irrigation during the dry season;
- Choosing sweet potato cultivars compatible with corn, e.g., with known tolerance to low levels of a major limiting factor. A28/7 and 049 are more drought-tolerant than TIS 2328/6 and C26/7, which are more shade-tolerant.
- Choosing corn planting dates appropriate to the sweet potato cultivar grown, and the season. In general, sweet potato performed better when planted before corn. Furthermore, when sweet potato was planted before corn the cropping system occupied the land for the same period as the pure stands, unlike those cropping systems in which corn was the earlier planted component.

Other approaches to minimizing competition in mixtures such as adjusting spatial arrangements of the intercrop components and the amendment of existing fertilizer application regimes need to be investigated and recommendations developed.

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