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SESAME RESEARCH REPORT 1994-95 WET SEASON KATHERINE

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1994-95 WET SEASON

KATHERINE

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SUSTAINABLE AGRICULTURE

THE DEPARTMENT OF PRIMARY INDUSTRY AND FISHERIES IS COMMITTED TO THE PRINCIPLES AND PRACTICES OF SUSTAINABLE AGRICULTURE

Definition:

Sustainable agriculture is the use of practices and systems which maintain or enhance:

- the economic viability of agricultural production:
- the natural resource base: and
- other ecosystems which are influenced by agricultural activities.

Principles:

1. Agricultural productivity is sustained or enhanced over the long term.
2. Adverse impacts on the natural resource base of agricultural and associated ecosystems are ameliorated, minimised or avoided.
3. Harmful residues resulting from the use of chemicals for agriculture are minimised.
4. The nett social benefit (in both dollar and non-dollar terms) derived from agriculture is maximised.
5. Agricultural systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

SUSTAINABLE AGRICULTURE IN THE NORTHERN TERRITORY

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1. Introduction

There has been substantial research in identifying crops which are possible alternatives to maize, soybean, mungbeans and sorghum for the Northern Territory.

One crop that has shown potential for the Katherine region is sesame. Intensive research with sesame was initiated in the 1987-88 wet season. Research since then has included cultivar, sowing date, population, crop establishment, nutrition, weed control, disease monitoring, harvesting and seed maintenance experiments. Development of pure cv. Yori 77 seed and an improved cultivar for northern Australia has been given the highest priority. This research was jointly funded by Grains Research and Development Corporation and Rural Industries Research and Development Corporation.

A superior sesame genotype (Y1:44) was selected in 1992-93 (Bennett and Martin, 1993). Seed multiplication and demonstration areas of the new genotype were sown in January 1995. Significant differences in plant morphology and farmer adoption of zero tillage technology has highlighted the need to re-assess some agronomic practices, eg. row spacing by population interactions for sesame.

In March, the First Australian Sesame Workshop was convened in Darwin - Katherine. Twenty five papers were presented during formal sessions and have been reproduced in the 'Proceedings of the First Australian Sesame Workshop'. During group discussions, strategies for a coordinated approach to the expansion of the Australian sesame industry were developed. Critical issues identified were:

1. Improving sesame cultivars under a national breeding program.
2. Establishing an Australian Sesame Association which would liaise with the Australian Oilseeds Federation.
3. Defining standards for unhulled seed for both confectionery and industrial use.
4. Assembling a national data base to be used to develop a 'Growers Manual" and a sesame crop growth model.
5. Establishing a nationally coordinated research program.

These issues have been extensively covered in a strategic plan document for the Australian Sesame Industry.

This year research investigated various agronomic aspects of the new sesame cultivar 'Edith'.

2. General Methods

2.1 *Sites and Soils*

This year's experiments were undertaken at Katherine Research Station (14^0 28'S, 132^0 18'E) and Douglas Daly Research Farm (13^0 51'S, 132^0 12'E). The soil type used at Katherine was a Fenton clay loam, (Lucas *et al.* 1985) while a virgin Venn sandy loam was used at Douglas Daly. Soil fertility analysis is presented in Table 2.1.

2.2 *Seasonal Conditions*

At Douglas Daly and Katherine, the 1994-95 wet season was characterised by good land preparation rains in November and December. Suitable sowing rains and above average follow-up rains occurred in January. Rainfall during February and March was below average however the distribution was reasonable.

Total rainfall for November '94 to May '95 at Douglas Daly and Katherine was 1168 mm and 988 mm respectively (Table 2.2).

2.3 *Land Preparation and Weed Control*

Row spacing * population and genotype evaluation.

Land preparation for the row spacing * population and genotype evaluation experiments was by zero-tillage techniques. No pre or post emerge chemicals were applied to control weeds. Manual weed control occurred as required in the genotype evaluation experiment.

Demonstration area.
Paddocks H3 + H4 were conventionally prepared while paddock H5 was prepared using zero tillage techniques. Test strips of Metolachlor (Dual®) @ 1.5 L/ha and Trifluralin CR (Treflan CR ®) @ 1.5 L/ha were established in both the conventional and zero tillage areas.

Crop sequence.
Land preparation in paddock 10A (DDRF) was by zero tillage techniques. No pre or post emergence chemicals were applied to control weeds.

2.4 *Fertiliser Application*
Basal fertiliser applications are detailed in Table 2.3.

2.5 *Insect Control*
Antigastra catalaunalis caterpillars were sprayed at Katherine on 23 January with Endosulphan @ 1.0 L/ha. No insect control was required at Douglas Daly.

2.6 *Irrigation*
Supplementary irrigation (approx. 12 mm per application) was applied to the genotype evaluation on the 19, 21, 28 and 31 December '94 and 2 and 4 January '95.

Table 2.1 Soil nutrient status at Katherine and Douglas Daly Research Farm

Soil analysis[1]	Paddocks			
	10A[2]	H3 & H4[3]	H5[3]	H6[3]
Cond (ms/cm)	0.05	0.12	0.13	0.14
pH	6.2	6.5	6.5	6.7
Avail. P (ppm)	13	13	7	6
Avail. K (ppm)	82	260	210	390
Avail Ca (%)	0.04	0.11	0.17	0.15
Avail. S (ppm)	2	2	2	6
Avail Mg (ppm)	26	265	350	340
Avail. Cu (ppm)	0.6	2.7	1.8	2.7
Avail. Zn (ppm)	1.0	0.5	0.4	0.5

1 Soil depth, 0 - 15cm
2 Douglas Daly Research Farm
3 Katherine Research Farm

Table 2.2 Rainfall, pan evaporation, radiation and mean temperatures at Katherine and Douglas Daly

	Nov	Dec	Jan	Feb	Mar	Apr	May	
Monthly rainfall (mm)								**Total**
Douglas Daly	58.0	224.0	451.3	207.5	159.0	69.0	0.0	1167.8
Katherine	140.5	141.4	388.8	139.9	135.0	42.2	0.0	987.8
Mean (1)	108.5	142.9	269.2	303.2	253.6	46.6	7.5	1131.5
Mean (2)	83.3	191.6	228.6	210.2	162.7	32.8	5.1	914.3
Mean maximum daily temperature (°C)								
Douglas Daly	37.4	34.4	32.1	33.5	32.7	33.5	32.6	
Katherine	38.6	35.3	34.0	34.2	33.5	34.5	32.3	
Mean (1)	36.6	35.3	33.6	32.9	33.2	33.4	32.0	
Mean (2)	37.8	36.2	34.6	34.1	34.3	33.9	32.0	
Mean minimum daily temperature (°C)								
Douglas Daly	23.9	24.0	24.6	25.2	24.3	20.7	17.8	
Katherine	24.4	23.9	23.9	23.9	22.7	18.7	17.0	
Mean (1)	24.2	24.0	23.7	23.7	23.0	20.6	17.1	
Mean (2)	24.3	23.9	23.7	23.4	22.3	19.5	16.2	
Mean daily radiation (MJ/m²)								
Douglas Daly	N.A	N.A	N.A	N.A	N.A	N.A	N.A	
Katherine	24.1	23.7	20.7	19.7	18.7	N.A.	N.A.	
Mean (1)	24.5	24.2	22.4	21.4	21.7	22.6	21.1	
Mean (2)	24.6	24.2	21.9	22.5	21.7	21.7	22.0	
Mean monthly evaporation (mm)								
Douglas Daly	N.A	N.A	N.A	N.A	N.A	N.A	N.A	
Katherine*	246	205	183	148	174	162	170	
Mean (1)	252	226	168	146	N.A.	231	208	
Mean (2)	275	242	194	156	173	186	180	

* estimate as some values were missing N.A. Not available
(1) Douglas Daly (2) Katherine

Table 2.3 Basal fertiliser applications

Experiment	Fertiliser	Rate	Application date
Row Spacing * Population [1]	19:13	348 kg/ha (66kg N/ha, 45 kg P/ha)	30 December
	Sulphate of ammonia	293 kg/ha (60 kg N/ha)	4 January
Genotype [2]	Single superphosphate	110 kg/ha (10 kg P/ha)	15 December
	Sulphate of ammonia	293 kg/ha	15 December
Demonstration [3]	Single superphosphate	110 kg/ha	21 December
	Sulphate of ammonia	293 kg/ha	2 January
Crop sequence [4]	Muriate of potash	80kg/ha (40kg K/ha)	6 January
	Single superphosphate	138kg/ha (12kg P/ha)	6 January
	Ammonium nitrate	0, 30, 60kg N/ha	11 January

[1] Location : Paddock H6, KRS
[2] Location : Paddock H9, KRS
[3] Location : Paddocks H3, H4 and H5, KRS
[4] Location : Paddock 10A, DDRF

3. Evaluation of sesame genotypes in the 1994-95 wet season

Introduction

A range of sesame genotypes were evaluated at Katherine Research Station in the 1994-95 wet season. This information is to be the basis for a Plant Breeders Rights (PBR) application for 'Edith' (Y1:44). Provionsal PBR protection was granted for one year, 1995-96.

Major differences in phenology, node of lowest flower scar, branching habit, and seed weight could be used to identify the various genotypes. This evaluation will be repeated to insure all sesame genotypes are distinct, uniform and stable.

Materials and Methods

Design, treatments and management
Experimental design was a randomised complete block with 3 replications of 4 genotypes. Genotypes were Pachequino, PA:45, Y1:44 and Yori 77. Plot size was a single row x 18.4 m long. Plots were sown 50 cm apart.

The experiment was sown by a 4 row cone-seeder under zero-till conditions on the 19 December 1994. Site preparation included mulching on the 11 November and spraying with Round-up CT® @ 2.0 L/ha on the 16 December. All seed was treated with Lorsban 25WC® @ 160 g/100 kg seed to prevent false wire worm damage.

Plants were thinned to an intra-row spacing of 10 cm (equivalent to 300 000 plants/ha) 14 DAS.

Recordings and data collection
During the season various plant characteristics were measured. These characteristics are listed in Table 3.1. At 35 DAS and 62 DAS, 5 plants were selected from the end of each plot and the following measured;

a. Plant height
b. Number of branches
c. Number of capsules
d. Leaf area
e. Leaf weight (oven dry)
f. Stem weight (oven dry)
g. Capsule weight (oven dry)

At physiological maturity, seed yield was recorded by harvesting 10.0 m from each row. Samples were threshed, cleaned and set aside for those measurements as required in Table 3.1.

Results and Discussion

Points of interest are as follows:

A. *Plant characteristics for sesame genotypes evaluated are presented in Table 3.2.*

1. Yori developed a hairy stem with a basal branching habit. The other 3 genotypes were non- branching and sparse stem hairiness.

2. Pachequino was late to flower and early to reach physiological maturity. Y1:44 was the last genotype to reach physiological maturity.

3. Y1:44 developed a long, wide capsule compared to the other genotypes.

4. Y1:44 produced the largest seed.

B. *Measurements of plant morphology at 35 DAS and 62 DAS are presented in Tables 3.3 and 3.4.*

1. Y1:44 rapidly developed in plant stature and crop canopy by 35 DAS.

2. Pachequino was the slowest genotype to develop capsules.

Table 3.1 Plant characteristics measured for sesame genotypes at Katherine.

Characteristic	Comment
Cotyledon colour	1 week after emergence
Cotyledon form	1 week after emergence
Cotyledon insertion	1 week after emergence
Plant pigmentation	At flowering
Stem hairiness	At flowering
Stem cross section	At harvest
Branching habit	At harvest
Number of branches	At harvest
Leaf phyllotaxy	At flowering
Basal leaf margin	At flowering
Basal leaf form	At flowering
Angle between petiole and stem	5 or 6th leaf position
Leaf shape	At flowering, 5 or 6th node
Leaf length	At flowering, 5 or 6th node
Leaf width	At flowering, 5 or 6th node
Petiole length	At flowering, 5 or 6th node
Leaf venation	5 or 6th leaf node
Corolla colour	At flowering
Corolla hairiness	At flowering
Style length	At flowering
Extra - floral nectaries	At flowering
Flowers per leaf axil	At flowering
Days to flower	At flowering
Days to maturity	98% capsules changed colour
Plant height at maturity	At harvest
Capsule shape	After harvest
Capsule hairiness	After harvest
Dry capsule colour	After harvest
Carpels per capsule	After harvest
Capsule dehiscence	After harvest
Capsule length	After harvest
Capsule width	After harvest
Node of lowest flower scar	After harvest
Testa colour	After threshing
Testa texture	After threshing
Seed length	After threshing
Seed width	After threshing
1000 seed weight	After threshing
Oil content of seed	After threshing
Protein content of seed	After threshing

Table 3.2 Plant characteristics for sesame genotypes at Katherine

	Genotype			
Characteristic	Y1:44	Yori 77	PA:45	Pachequino
Cotyledon colour	green	green	green	green
Cotyledon form	flat	flat	flat	flat
Cotyledon insertion	pedicellate	pedicellate	pedicellate	pedicellate
Plant pigmentation	normal green	light green	normal green	normal green
Stem hairiness	sparse	hairy	sparse	sparse
Stem cross section	square	square	square	square
Branching habit	non branching	basal branching	non branching	non branching
Number of branches				
Mean	0.4	1.9	0.0	0.2
Range	7	6	2	7
Std. dev.	0.91	1.16	0.26	1.04
No. measured	300	300	300	300
Leaf phyllotaxy	opposite	opposite	opposite	opposite
Basal leaf margin	lobed	lobed or entire	entire	lobed or entire
Basal leaf form	flat	flat	flat	flat
Angle between petiole and stem	acute	acute	acute	acute
Leaf length (mm)				
Mean	149.7	138.1	139.3	126.0
Range	158	161	201	131
Std. dev.	28.67	25.25	24.80	19.11
No. measured	300	300	300	300
Leaf width (mm)				
Mean	116.7	107.8	106.5	116.3
Range	234	224	187	160
Std. dev.	40.77	42.15	28.97	24.86
No.leaves measured	300	300	300	300
Petiole length (mm)				
Mean	66.5	58.5	58.0	51.3
Range	130	116	109	77
Std. dev.	23.45	20.48	18.76	16.14
No. measured	300	300	300	300
Leaf veneration	recessed	recessed	recessed	recessed
Corolla colour	All white with a violet tinge			
Style length	enclosed	enclosed	enclosed	enclosed
Extra-floral nectaries	rudimentary	rudimentary	rudimentary	rudimentary
Flowers per leaf axil	3	3	3	3
Days to flower (DAS)				
Mean	40.6	42.1	38.8	44.9
Range	19	14	17	18
Std. dev.	4.34	3.24	3.43	2.91
No. measured	300	300	300	300

Days to maturity (DAS)				
Mean	105.5	100.3	98.1	98.3
Range	20	11	17	20
Std. dev.	4.88	2.32	3.45	3.35
No. measured	300	300	300	300
Plant height at maturity (cm)				
Mean	157.8	148.2	161.4	157.1
Range	92	58	75	63
Std. dev.	16.94	9.64	11.22	10.22
No. measured	300	300	300	300
Node of lowest flower scar				
Mean	6.9	8.1	6.2	7.1
Range	5	5	4	4
Std. dev.	0.79	0.85	0.75	0.77
No. measured	300	300	300	300
Capsule shape	narrow oblong	narrow oblong	narrow oblong	narrow oblong
Capsule hairiness	very profuse	profuse	profuse	profuse
Dry capsule colour	brown	brown	brown	brown
RHS code	177C	165B	165B	165B
Carpels per capsule	2	2	2	2
Capsule length (mm)				
Mean	26.5	21.6	24.1	24.4
Range	14	11	11	12
Std. dev	2.73	1.99	1.91	1.98
No. measured	300	300	300	300
Capsule width (mm)				
Mean	6.8	6.0	6.5	6.3
Range	4	4	4	4
Std. dev.	0.78	0.68	0.82	0.70
No. measured	300	300	300	300
Testa colour	cream	white	cream	yellowish cream
RHS code	159B	159C	159B	158A
Testa texture	smooth	smooth	smooth	smooth
Seed length (mm)				
Mean	3.2	3.1	3.2	3.2
Range	1.09	0.96	1.00	1.05
Std. dev.	0.18	0.16	0.18	0.17
No. measured	300	300	300	300
Seed width (mm)				
Mean	2.0	2.1	2.0	2.0
Range	0.78	0.67	0.78	0.72
Std. dev.	0.13	0.11	0.13	0.13
No. measured	300	300	300	300
Weight 1000 seeds (g)	3.42	2.98	3.21	2.98
Oil content of seed (%)	52.2	57.3	51.3	53.8
Protein content of seed (%)	20.6	16.9	19.4	18.1

Table 3.3 Plant morphology at 35 DAS for sesame genotypes at Katherine

	Genotype[1]			
Characteristic	Y1:44	Yori 77	PA:45	Pachequino
Plant height (cm)	54.8	45.4	38.6	41.3
Branch number	0.4	0.6	0.0	0.0
Capsule number	0.2	0.0	0.0	0.0
Leaf number	30.6	20.2	15.4	14.6
Leaf area (cm^2)	98	54	38	48
Leaf weight (g)	5.0	2.7	2.0	2.4
Stem weight (g)	3.9	2.2	1.5	1.7
Capsule weight (g)	0.0	0.0	0.0	0.0
Total weight (g)	8.9	4.9	3.5	4.1

1 Mean for 5 plants, oven dry weights.

Table 3.4 Plant morphology at 62 DAS for sesame genotypes at Katherine

	Genotype			
Characteristic	Y1:44	Yori 77	PA:45	Pachequino
Plant height (cm)	62.6	55.0	58.2	64.3
Branch number	0.0	1.2	0.0	0.0
Capsule number	54.0	56.8	54.4	42.4
Leaf number	50.0	60.0	47.2	44.2
Leaf area (cm^2)	198	149	149	127
Leaf weight (g)	10.8	7.2	6.6	6.6
Stem weight (g)	19.8	12.3	13.4	14.2
Capsule weight (g)	7.9	5.9	7.3	5.1
Total weight (g)	38.5	25.4	27.3	25.9

1 Mean for 5 plants, oven dry weights.

4. Observations on the three naturalised sesame landraces in the Northern Territory

Introduction

The introduction of sesame (*Sesamum indicum*) in to NT probably coincided with the arrival of Chinese immigrants from Singapore and Hong Kong in the 1870s following the discovery of gold at Yam Creek and Pine Creek. However, the rapid depletion of the alluvial gold deposits resulted in some Chinese immigrants establishing local market gardens (W.M. Curteis, unpublished report). These market gardens flourished and extended following the development of the Darwin to Birdum Railway (1887-1929) with its extensive use of Chinese labour for construction (Bauer 1964).

Sesame introduced by the Chinese gardeners quickly naturalised in the surrounding areas. Today, 3 landraces (black seeded types) are known to exist between Darwin and Larrimah (500 km south of Darwin). According to the Weeds Branch, of the Northern Territory Department of Primary Industry and Fisheries a few pastoralists and land holders in the Katherine region consider this naturalised sesame a weed (J. Pitt, pers. comm.).

Though two of these landraces are very common there is a paucity of information on their growth and development. This experiment documents 3 sesame landraces found in the NT.

Materials and Methods

Design, treatments and management
Single rows of each genotype, Katherine Local 1 (KT:1), Katherine Local 2 (KT:2) and Darwin Local 1 (DWN:1) were sown adjacent to the genotype evaluation. Rows were 18.4 m long and 50 cm apart. Site preparation and management was similar to the genotype evaluation.

Recordings and data collection
During the season various plant characteristics were measured. These characteristics are listed in Table 4.1. At 35 DAS and 62 DAS, 5 plants were selected from the end of each plot and the following measured;

a. Plant height
b. Number of branches
c. Number of capsules
d. Leaf area
e. Leaf weight (oven dry)
f. Stem weight (oven dry)
g. Capsule weight (oven dry)

At physiological maturity, seed yield was recorded by harvesting 10.0 m from each row. Samples were threshed, cleaned and set aside for those measurements as required in Table 4.1.

Results and Discussion

Points of interest are as follows:

A. *Plant characteristics for sesame landraces evaluated are presented in Table 4.2*

1. All 3 genotypes have a branching habit, though KT:2 is basal branching as opposed to top branching for KT:1 and DWN:1.

2. All 3 genotypes have nectaries, though KT:2 nectaries are dark purple in colour as opposed to the yellow nectaries found on KT:1 and DWN:1.

3. KT:2 is very late to flower and to capsule maturation. KT:2 develops tapered capsules compared to the long oblong capsules found on KT:1 and DWN:1

4. KT:1 and DWN:1 have similar growth habits when sown at Katherine. Investigation of seed coat (testa) texture highlights a major difference in surface pitting. DWN:1 has more surface pitting than KT:1. See Figures 4.1 and 4.2.

B. *Measurements of plant morphology at 35 DAS and 62 DAS are presented in Tables 4.3 and 4.4.*

1. KT:2 was shorter in stature and smaller in canopy development. (However individual KT:2 plants growing under minimal population pressures develop extensive canopies).

2. KT:2 was perennial in its growth habit with new plant growth at the start of 1995 - 96 wet season.

Table 4. Plant characteristics measured for sesame landraces at Katherine

Characteristic	Comment
Cotyledon colour	1 week after emergence
Cotyledon form	1 week after emergence
Cotyledon insertion	1 week after emergence
Plant pigmentation	At flowering
Stem hairiness	At flowering
Stem cross section	At harvest
Branching habit	At harvest
Number of branches	At harvest
Leaf phyllotaxy	At flowering
Basal leaf margin	At flowering
Basal leaf form	At flowering
Leaf length	At flowering, 5 or 6th node
Leaf width	At flowering, 5 or 6th node
Petiole length	At flowering, 5 or 6th node
Corolla colour	At flowering
Extra - floral nectaries	At flowering
Flowers per leaf axil	At flowering
Days to flower	At flowering
Days to maturity	98% capsules changed colour
Plant height at maturity	At harvest
Capsule shape	After harvest
Capsule hairiness	After harvest
Dry capsule colour	After harvest
Carpels per capsule	After harvest
Capsule length	After harvest
Capsule width	After harvest
Testa colour	After threshing
Testa texture	After threshing
Seed length	After threshing
Seed width	After threshing
1000 seed weight	After threshing
Oil content of seed	After threshing
Protein content of seed	After threshing

Table 4.2 Plant characteristics for sesame landraces at Katherine

Characteristic	Landrace KT:1	 KT:2	 DWN:1
Cotyledon colour	green	green	green
Cotyledon form	flat	flat	flat
Cotyledon insertion	pedicellate	pedicellate	pedicellate
Plant pigmentation	normal green	dark green	normal green
Stem hairiness	sparse	hairy	sparse
Stem cross section	square	square	square
Branching habit	top branching	basal branching	top branching
Number of branches			
Mean	3.5	2.6	2.9
Range	6	7	6
Std. dev.	1.70	2.03	1.66
No. plants measured	30	30	30
Leaf phyllotaxy	opposite	opposite	opposite
Basal leaf margin	lobed	entire	lobed
Basal leaf form	flat	flat	flat
Leaf length (mm)			
Mean	141.7	68.9	160.6
Range	63	58	99
Std. dev.	18.80	15.24	27.33
No. leaves measured	30	30	30
Leaf width (mm)			
Mean	107.8	28.03	85.9
Range	123	32	127
Std. dev.	38.32	7.49	35.13
No. leaves measured	30	30	30
Petiole length (mm)			
Mean	63.9	13.7	51.5
Range	124	21	69
Std. dev.	25.58	5.25	17.36
No. measure	30	30	30
Corolla colour	white, violet tinge	violet	white, violet tinge
Extra-floral nectaries	developed	developed	developed
Flowers per leaf axil	1	1	1
Days to flower (DAS)			
Mean	56.2	80.7	58.7
Range	8	30	6
Std. dev.	1.69	6.78	2.02
No measured	30	30	30

Characteristic	Landrace KT:1	KT:2	DWN:1
Days to maturity (DAS)			
Mean	109.8	133.6	110.4
Range	9	9	2
Std. dev.	1.51	2.63	0.67
No. measured	30	30	30
Plant height at maturity (cm)			
Mean	177.8	133.2	181.7
Range	71	61	68
Std. dev.	18.53	15.81	20.22
No. measured	30	30	30
Capsule shape	narrow oblong	tapered	narrow oblong
Capsule hairiness	glabrous	very profuse	glabrous
Dry capsule colour	brown	light brown	brown
RHS code	165C	165D	165C
Carpels per capsule	2	2	2
Capsule length (mm)			
Mean	24.2	25.5	22.6
Range	6	7	7
Std. dev	1.68	1.41	1.59
No. measured	30	30	30
Capsule width (mm)			
Mean	5.7	6.9	6.0
Range	2	3	2
Std. dev.	0.61	0.69	0.53
No. measured	30	30	30
Testa colour	dark black	black	dark black
RHS code	202A	202A	202A
Testa texture	rough	rough	rough

	Landrace		
Characteristic	KT:1	KT:2	DWN:1
Seed length (mm)			
Mean	2.7	3.0	2.7
Range	0.48	0.52	0.56
Std. dev.	0.12	0.12	0.12
No. measured	30	30	30
Seed width (mm)			
Mean	1.7	2.1	1.9
Range	1.07	0.59	0.74
Std. dev.	0.26	0.17	0.15
No. measured	30	30	30
Weight of 1000 seeds (g)	2.13	1.90	2.25
Oil content of seed (%)	34.2	31.0	33.1
Protein content of seed (%)	15.6	18.1	15.0

Table 4.3 Plant morphology at 35 DAS for sesame landraces at Katherine

	Landrace[1]		
Characteristic	KT:1	KT:2	DWN:1
Plant height (cm)	27.4	12.4	28.2
Branch number	0.0	0.0	0.0
Capsule number	0.0	0.0	0.0
Leaf number	16.0	19.0	17.6
Leaf area (cm^2)	47	27	37
Leaf weight (g)	2.3	1.3	1.9
Stem weight (g)	1.0	0.5	1.0
Capsule weight (g)	0.0	0.0	0.0
Total weight (g)	3.4	1.8	2.9

[1] Mean for 5 plants, oven dry weights.

Table 4.4 Plant morphology at 62 DAS for sesame landraces at Katherine

	Landraces		
Characteristic	KT:1	KT:2	DWN:1
Plant height (cm)	64.9	37.4	64.0
Branch number	3.8	0.4	4.6
Capsule number	2.8	0.0	0.0
Leaf number	62.6	33.0	90.4
Leaf area (cm^2)	123	86	221
Leaf weight (g)	9.3	3.6	11.6
Stem weight (g)	16.7	4.4	19.8
Capsule weight (g)	0.2	0.0	0.0
Total weight (g)	26.2	8.0	31.4

[1] Mean for 5 plants, oven dry weights.

Figure 4.1 Seed testa of the sesame landrace KT:1

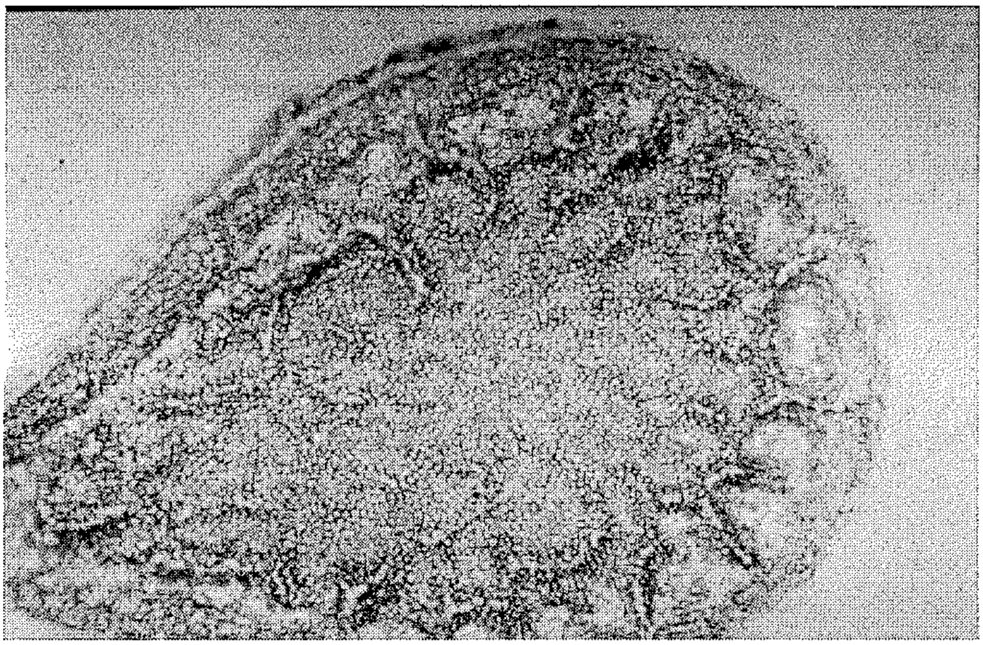
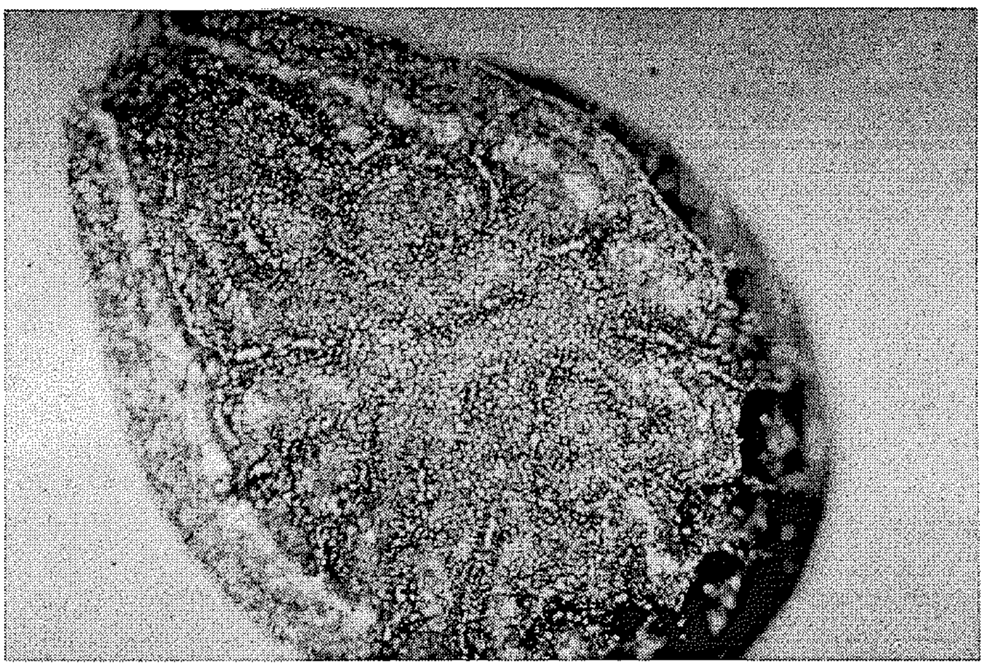


Figure 4.2 Seed testa of the sesame landrace DWN:1



5. Effect of sesame plant population and row spacing on seed yield

Introduction

The effect of sesame plant population and row spacing on seed yield has been investigated by various Australian authors over the last ten years. Most authors have conducted the experiments under conventional tillage practices with a branching genotype.

The development of a new superior non-branching cultivar 'Edith' for northern Australia and the adoption of zero till technology has highlighted the need for a review of current agronomic recommendations.

Observation experiments during the 1994-95 wet season indicated that sowing sesame on row spacing greater than 70 cm resulted in intra-row plant competition which significantly depressed harvest population and seed yields. Plant populations between 150 000 and 250 000 plants/ha produced the highest seed yields.

This paper investigates the effect of row spacing and plant population on seed yield for a non-branching cultivar grown under zero till conditions.

Materials and Methods

Design, Treatments and Management

Experimental design was a split plot with 4 replications. Main plots were row spacing ; 32 cm (5 rows), 50 cm (5 rows), and 72 cm (4 rows). Sub-plots were plant population ; 150 000, 250 000, 300 000 and 400 000 plants/ha. Plots were 14 m long.

Sesame genotype Y1:44, (cv. Edith), was sown with a cone seeder under zero till conditions on the 9 January. Site preparation included mulching on the 8 and 28 December and spraying Round-up CT® @ 3.0 L/ha on the 9 January. All seed was treated with Lorsban 25 WC® @ 160g/100 kg seed to prevent the false wire worm damage. Plants were thinned to appropriate populations at 10 and 11 DAS.

Recordings and Data Collection

At 35 DAS and 63 DAS, 3 plants were sampled from the end of each plot and the following measured:

a. Plant height
b. Number of branches
c. Leaf area

Plant population, sesame biomass and weed biomass were determined by harvesting a 2.0 m^2 quadrant at 35 DAS, 63 DAS and 91 DAS. At physiological maturity (91 DAS), sesame seed yield was measured by collecting the seed from the sesame biomass sample.

Results

Sesame morphology at 35 DAS
Row spacing and plant population did not significantly effect plant height and branch development at 35 DAS (Tables 5.1 and 5.2). Mean plant height and number of branches was 71 cm and 0.3 branches/plant respectively.

Leaf area development was significantly larger at narrow rowspacings and lower plant populations (Table 5.3). Leaf area ranged from 169 cm^2 at 32 cm row spacing and 150 000 plants/hectare to 80 cm^2 at 72 cm row spacing and 450 000 plants/hectare.

Mean plant population at 35 DAS was 296 000 plants/ha (Table 5.4).

Sesame biomass significantly increased with narrow row spacing and higher plant populations (Table 5.5). Sesame biomass at 32 cm and 50 cm were not significantly different, similarly, sesame biomass for plant populations of 300 000 and 450 000 were not significantly different. Mean sesame biomass was 1618 kg/ha.

There was no significant difference in weed biomass for any combination of row spacing and sesame population, however the trend was for the development of a larger weed biomass in plots with wide row spacing and low sesame populations (Table 5.6). Mean weed biomass at 35 DAS was 435 kg/ha.

Sesame morphology at 63 DAS
Row spacing and plant population did not significantly effect plant height at 63 DAS (Table 5.7). Number of branches was significantly higher for the lowest plant population (150 000 plants/ha) though still less than 1.0 branch/plant (Table 5.8). Mean plant height and number of branches was 167 cm and 0.2 branches/plant.

There was no significant effect of row spacing on leaf area production, however leaf area significantly increased at lower plant populations (Table 5.9).

Mean plant population at 63 DAS was 311 000 plants/ha (Table 5.10).

Row spacing or plant population did not significantly effect sesame biomass development at 63 DAS. Mean sesame biomass was 6411 kg/ha.

Weed biomass in plots with narrow row spacing (32 cm) was significantly less than that of plots with wider row spacing. Similarly a trend for a smaller weed biomass to develop in plots with a higher sesame population (Table 5.12).

Sesame morphology at 91 DAS
Mean plant population at 91 DAS was 294 000 plants/ha (Table 5.13).

Sesame biomass was not significantly effected by plant population while sesame biomass for plants sown on 50 cm row spacing was significantly higher than those for the 32 cm and 72 cm row spacings (Table 5.14). Mean sesame biomass at 91 DAS was 6130 kg/ha.

Weed biomass at 91 DAS was significantly effected by the row spacing of the sesame crop. A larger weed biomass developed in plots with a wider row spacing (Table 5.15).

Sesame seed yield
Sesame seed yield was not significantly effected by either row spacing or plant population though the following trend was observed. The highest seed yield was produced in plots with populations of 150 000 plants/ha and sown on 50 cm row spacing (Table 5.16). Mean seed yield was 1725 kg/ha.

Discussion

The adoption of zero tillage and the new sesame genotype (Y1:44) has resulted in a re-assessment of recommended agronomic practices for the growing sesame in the NT. Zero tillage has seen the modification of the tyne configuration on planters change from 32 cm to 50 cm to assist in trash flow.

The new sesame genotype has a non branching habit and therefore is unable to compensate by branching for areas of low plant population. Successful establishment of the optimum plant population is critical if the sesame crop is smoother the weeds. The optimum plant population for a 32 cm row crop is 300 000 plants/ha (range 200 000 - 400 000 plants/ha).

Crops sown at a wider row spacing may require a higher plant population to smoother weeds. This experiment suggests that higher populations were not required to produce high seed yields. Populations as low as 150 000 plants/ha produced high seed yields. Results also indicated that the genotype Y1:44 was unable to compensate by branching when sown on wide row spacing or at low plant populations. Weed biomass was greater at low sesame plant populations or wide row spacings.

Sesame seed yields were higher for low plant populations and the 50 cm row spacing. It is fortuitous that a 50 cm row spacing under zero till conditions is not detrimental to potential seed yield, while the use of high plant populations was not necessary to compensate increased weed competition. Seed yield was not significantly different for the range of plant populations tested, though the trend was for higher yields at plant stands of 150,000 plants/ha.

Table 5.1 Effect of row spacing and sesame plant height at 35 DAS

Plant height(cm)	Plant population ($x10^3$)				
Row spacing (cm)	150	250	300	450	*Mean*
32	65	73	74	76	*72*
50	71	72	69	69	*70*
72	70	71	72	76	*72*
Mean	*69*	*72*	*72*	*74*	*71*

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

Table 5.2 Effect of row spacing and plant population on number of branches on sesame plants at 35 DAS

Number of branches	Plant population ($x10^3$)				
Row spacing (cm)	150	250	300	450	*Mean*
32	0.3	0.4	0.0	0.0	*0.2*
50	0.8	0.3	0.0	0.0	*0.3*
72	0.5	0.6	0.0	0.5	*0.5*
Mean	*0.5*	*0.4*	*0.0*	*0.2*	0.3

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

Table 5.3 Effect of row spacing and plant population on leaf area at 35 DAS

Leaf area (cm^2)	Plant population ($x10^3$)				
Row spacing (cm)	150	250	300	450	*Mean*
32	169.0	95.0	107.5	73.3	*111.2*
50	119.8	124.5	58.3	79.5	*95.5*
72	94.5	58.3	65.5	79.8	*74.5*
Mean	*127.8*	*92.6*	*77.1*	*77.5*	*93.7*

Row spacing LSD (5%) = 17.47
Population LSD (5%) = 20.18

Table 5.4 Plant population as measured at 35 DAS

Row spacing (cm)	Mean plant population (x10^3 p/ha)
32	317
50	282
72	289
LSD (5%) = 27.4	
Plant population (x10^3 p/ha)	
150	158
250	243
300	324
450	460
LSD (5%) = 31.7	
Overall mean	*296*

Table 5.5 Effect of row spacing and plant population on sesame biomass at 35 DAS

Sesame biomass (kg/ha)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	1389	1910	1794	2136	*1807*
50	1675	1619	1686	1797	*1694*
72	1086	1061	1633	1628	*1352*
Mean	*1383*	*1530*	*1704*	*1854*	*1618*

Row spacing LSD (5%) = 205.3
Population LSD (5%) = 237.1

Table 5.6 Effect of plant population on total weed biomass at 35 DAS

Weed biomass (kg/ha)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	544	156	274	258	*308*
50	285	247	459	369	*340*
72	828	990	595	215	*657*
Mean	*552*	*464*	*443*	*280*	*435*

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

Table 5.7 Effect of row spacing and plant population on plant height at 63 DAS

Plant height (cm)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	168	159	168	165	*165*
50	177	175	162	166	*170*
72	172	165	160	168	*166*
Mean	*172*	*166*	*163*	*166*	*167*

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

Table 5.8 Effect of row spacing and plant population on number of branches at 63 DAS

Number of branches					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	0.4	0.0	0.0	0.0	*0.1*
50	0.5	0.0	0.0	0.0	*0.1*
72	0.5	0.3	0.3	0.0	*0.3*
Mean	*0.5*	*0.1*	*0.1*	*0.0*	*0.2*

Row spacing LSD (5%) = not significant
Population LSD (5%) = 0.26

Table 5.9 Effect of row spacing and plant population on leaf area at 63 DAS

Leaf area (cm^2)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	227	140	147	99	*153*
50	286	180	103	175	*186*
72	227	150	146	130	*163*
Mean	*247*	*157*	*132*	*134*	*168*

Row spacing LSD (5%) = not significant
Population LSD (5%) = 35.6

Table 5.10 Plant population as measured at 63 DAS

Row spacing (cm)	Mean plant population (x10^3 p/ha)
32	308
50	313
72	311
LSD (5%) = not significant	
Plant population (x10^3 p/ha)	
150	198
250	240
300	340
450	464
LSD (5%) = 41.9	
Overall mean	*311*

Table 5.11 Effect of row spacing and plant population on sesame biomass at 63 DAS

Sesame biomass (kg/ha)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	6352	6290	6587	6419	*6412*
50	6472	6565	6368	6608	*6503*
72	5897	5855	6802	6716	*6317*
Mean	*6240*	*6237*	*6586*	*6581*	*6411*

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

Table 5.12 Effect of row spacing and plant population on weed biomass at 63 DAS

Weed biomass (kg/ha)					
		Plant population (x10^3 p/ha)			
Row spacing (cm)	150	250	300	450	*Mean*
32	263	121	52	123	*140*
50	398	82	327	116	*231*
72	800	819	544	270	*608*
Mean	*487*	*340*	*308*	*170*	*326*

Row spacing LSD (5%) = 272.3
Population LSD (5%) = not significant

Table 5.13 Plant population as measured at 91 DAS

Row spacing (cm)	Mean plant population ($x10^3$ p/ha)
32	304
50	293
72	283
LSD (5%) = not significant	
Population ($x10^3$)	
150	161
250	245
300	335
450	433
LSD (5%) = 49.0	
Overall mean	*294*

Table 5.14 Effect of row spacing and plant population on sesame biomass at 91 DAS

Sesame biomass (kg/ha)					
	Plant population ($x10^3$ p/ha)				
Row spacing (cm)	150	250	300	450	*Mean*
32	6184	5909	6384	5945	*6105*
50	6284	6547	6667	6217	*6429*
72	6014	5717	5958	5740	*5857*
Mean	*6161*	*6057*	*6336*	*5967*	*6130*

Row spacing LSD (5%) = 429.0
Population LSD (5%) = not significant

Table 5.15 Effect of row spacing and plant population on weed biomass at 91 DAS

Weed biomass (kg/ha)					
	Plant population ($x10^3$ p/ha)				
Row spacing (cm)	150	250	300	450	*Mean*
32	481	523	36	239	*320*
50	561	468	412	208	*412*
72	843	720	570	665	*699*
Mean	*628*	*570*	*339*	*371*	*477*

Row spacing LSD (5%) = 452.0
Population LSD (5%) = not significant

Table 5.16 Effect of row spacing and plant population on sesame seed yield

Seed yield (kg/ha)					
	Plant population (x10^3 p/ha)				
Row spacing (cm)	150	250	300	450	*Mean*
32	1768	1736	1746	1548	*1699*
50	2043	1759	1871	1574	*1812*
72	1804	1806	1505	1541	*1664*
Mean	*1871*	*1767*	*1707*	*1554*	*1725*

Row spacing LSD (5%) = not significant
Population LSD (5%) = not significant

6. Monitoring demonstration areas of conventional and zero till sesame

Introduction

Farmers in the Northern Territory are readily adopting zero till crop management practices. All sesame farmers in the 1995 wet season sowed their crops into a mulch. The advantages of zero till farming practices in producing sorghum, maize and soybeans have been demonstrated; successful crop establishment, higher grain yields and reduced soil erosion have been measured. These advantages need to be demonstrated with sesame.

The current difficulties with zero tillage experienced by local farmers are mulch management, the need to modify the planter to handle trash flow, seed placement, weed control and fertiliser requirements. It was decided to sow a commercial area of sesame under the best conventional and zero tillage practices commercially available. Three herbicide treatments were imposed;

- No herbicide
- Pre-plant application of Dual® at 1.5 L/ha
- Pre-plant application of Treflan CR ®at 1.5 L/ha.

This paper reports on the success of this demonstration.

Materials and Methods

Design, Treatments and Management
Demonstration areas of conventional and zero till sesame with 3 herbicide treatments superimposed were sown at Katherine Research Station.

Agronomic practices are detailed in Tables 2.3, 6.1 and 6.2

Crop establishment was measured 11 DAS with 2 x 1.0 m^2 quadrats per treatment. Sesame biomass and weed biomass were measured at 28 DAS, 49 DAS, 59 DAS and 98 DAS with 3 x 1.0 m^2 quadrats per treatment. Samples were partitioned into sesame, grass and other weeds, and then oven dried at 80°C for 7 days.

At 57 DAS, 30 youngest fully expanded leaves were collected from each treatment. Leaves were combined into conventional and zero till samples then oven dried at 40°C for 7 days. The leaf material was analysed for nitrogen content.

At physiological maturity (98 DAS), potential seed yield was determined by collecting the seed from the biomass sample. This seed was subsampled for 1000 seed weight and nitrogen content determination.

Results

Sesame establishment at 11 DAS

Sesame establishment was more successful under zero tillage conditions than conventional till (Table 6.2). Mean plant population was 613 000 and 533 000 plants/hectare for zero till plots and conventional till plots respectively.

The application of a pre-emerge herbicide under conventional tillage conditions, and Treflan® under zero till conditions depressed sesame establishment. Treflan® depressed sesame populations more than Dual.®

Sesame biomass development

Sesame biomass was slightly higher in the conventional tillage plots than the zero tillage plots through out the life of the crop (Table 6.3). Within tillage treatments there was no herbicide effect on sesame biomass development after 28 DAS. During the first 28 days of crop growth, plant population influenced sesame biomass.

Total weed biomass development

Total weed biomass was higher in the conventional tillage plots than the zero till plots (Table 6.4). Dual® was the most effective herbicide in the conventional plots in minimising weed development whereas Dual® and Treflan® in the zero till plots were only effective for the first 29 DAS. Weed biomass reached a peak at approximately 49 DAS.

The grass component of the total weed biomass was higher in the zero till plots than the conventional till plots (Table 6.5).

Grain yield, 1000 seed weight and nitrogen content of seed

All conventional tillage plots developed higher seed yields than their corresponding zero till plots (Table 6.6). Mean seed yield for the conventional till and zero till treatments was 1871 kg/ha and 1325 kg/ha respectively.

Sesame seeds were slightly larger in the zero till plots than the conventional till plots while nitrogen content of the seed was the reverse.

Discussion

The herbicide by tillage demonstration highlighted 3 important points. Firstly, farmers can generally expect more successful establishment of sesame under zero tillage conditions. Secondly, weed development will be smaller in the zero till areas though grass weeds will be a bigger component of those weeds that are present. Thirdly, seed yields would be limited by nutrition (nitrogen) if the recommended level of 60 kg N/ha used for conventional till practices is maintained for zero till conditions. The amount of nitrogen removed in the additional 500 kgs of seed harvested from the conventional till crop is equivalent to 15 kg N/ha. Nutrient requirements under zero tillage conditions requires investigation.

Table 6.1 Location, site preparation and area of cv. Edith sown at Katherine Research Station

Location (area)	Site preparation	Date
H_3 & H_4 (2.4 ha)	*Conventional tillage*	
	• chisel plough	21 Nov '94
	• sweeps	6-7 Dec '94
	• disc	20 Dec '94
Eastern third	Treflan CR (1.5 L/ha)	7 Jan '95
Middle third	No herbicide	
Western third	Dual® (1.5 L/ha)	7 Jan '95
H_5 (2.2 ha)	*Zero tillage*	
	• mulched	8-9 Dec '94
Eastern third	Treflan® (1.5 L/ha)	7 Jan '95
Middle third	No herbicide	
Western third	Dual® (1.5 L/ha)	7 Jan '95
H_3,H_4 & H_5	• Round-up CT ®(3.0 L/ha)	9 Jan '95
	• sown (3.8 kg/ha)	9 Jan '95

Germination for cv.Edith was 75% normal and 13% fresh ungerminated.

Table 6.2 Establishment sesame populations at 11 DAS

Treatment	Established populations (p/ha)
Conventional tillage	
• Treflan®	440 000
• No herbicide	610 000
• Dual®	550 000
Mean	*533 000*
Zero tillage	
• Treflan®	575 000
• No herbicide	620 000
• Dual®	645 000
Mean	*613 000*

Table 6.3 Effect of herbicide and tillage practices on sesame biomass development

Sesame biomass (kg/ha)				
	Date (DAS)			
Treatment	28	49	59	98
Conventional tillage				
• Treflan®	743	3210	5848	6638
• No herbicide	679	4213	5635	6648
• Dual®	558	3205	5285	6741
Mean	*660*	*3543*	*5589*	*6676*
Zero tillage				
• Treflan®	579	3581	5104	6387
• No herbicide	594	3616	4913	6097
• Dual®	657	3711	5105	5882
Mean	*610*	*3636*	*5041*	*6122*

Table 6.4 Effect of herbicide and tillage practices on total weed development in sesame

Total weed biomass (kg/ha)				
	Date (DAS)			
Treatment	28	49	59	98
Conventional tillage				
• Treflan®	93	286	242	122
• No herbicide	97	213	138	119
• Dual®	52	170	151	79
Mean	*81*	*223*	*177*	*107*
Zero tillage				
• Treflan®	17	150	94	84
• No herbicide	124	165	97	144
• Dual®	57	150	93	17
Mean	*66*	*155*	*95*	*82*

Table 6.5 Effect of herbicide and tillage practices on grass development in sesame

Grass biomass (kg/ha)				
	Date (DAS)			
Treatment	28	49	59	98
Conventional tillage				
• Treflan®	1	21	0	62
• No herbicide	2	7	11	11
• Dual®	0	0	8	7
Mean	*1(1)*[1]	*9(4)*	6(3)	*27(25)*
Zero tillage				
• Treflan®	6	7	19	30
• No herbicide	15	30	21	99
• Dual®	12	19	30	2
Mean	*11(17)*	*19(12)*	*70(78)*	*44(54)*

[1] grass biomass as a percentage of total weed biomass

Table 6.6 Effect of herbicide and tillage practices on seed yield, 1000 seed weight nitrogen content of seed

Treatment	Yield (kg/ha)	1000 seed weight (g)	Seed nitrogen content (%)
Conventional tillage			
• Treflan®	1899	3.33	3.2
• No herbicide	1845	3.23	3.3
• Dual®	1869	3.23	3.1
Mean	*1871*	*3.26*	*3.2*
Zero tillage			
• Treflan®	1317	3.50	2.9
• No herbicide	1393	3.33	2.9
• Dual®	1266	3.20	3.3
Mean	*1325*	*3.34*	*3.0*

7. Effect of crop sequence on sesame development and seed yield

Introduction

The adoption of crop rotations, undersowing of cereals with pasture legumes and zero tillage has reduced farming risk levels for NT farmers. Many farmers are establishing improved pastures (legume based) for agistment of steers for the live export trade to Asia. Some farmers are considering utilising the residual soil nitrogen provided by these legumes by sowing either sorghum or sesame into the mulch after a one or two year pasture ley. During the 91-93 cropping seasons various legume pastures *(Centrosema pascuorum cvs Cavalcade, Bundey, Stylosanthes hamata cv Verano, Macroptilium longipedunculatum cv Maldonado)* were established as part of an extensive experiment to determine the nitrogen contribution of these leys to the following sorghum crop (Thiagalingam 1995). The availability of 2nd year residual soil nitrogen was investigated by sowing sesame into the sorghum stubble.

This paper reports on the availability of soil nitrogen in the 2nd year of grain cropping.

Materials and Methods

Design, Treatments and Management
Initial experimental design, treatments and trial management have been extensively documented by Thiagalingam in Pasture legume leys and their N contribution to no-till, dryland grain sorghum in the semi-arid tropics (1995). In 1994-95, the research site was sown zero till to sesame. Test strips on nitrogen (applied as ammonium nitrate) were randomly allocated to the sorghum, verano and cavalcade plots. *The plots selected had received no additional nitrogen in the 1993-94 season.* The levels of nitrogen applied were 0, 30 and 60 kg /ha. There were 4 replications.

Agronomic practices are detailed in Tables 2.3, 7.1 and 7.2.

Sesame population and biomass were measured at 35 DAS and 71 DAS with a 1.0 m^2 quadrat per treatment. At physiological maturity (97 DAS) potential seed yield and harvest population were determined by harvesting a 1.0 m^2 quadrat per treatment.

Results

Sesame development at 35 DAS
Mean sesame plant population at 35 DAS was 329 000 plants/ha. Sesame biomass measured at 35 DAS are presented in Tables 7.3a, 7.3b and 7.3c.

Mean biomass at 35 DAS was 379 kg/ha. Sesame sown on the sorghum leys responded to nitrogen application. Biomass increased from 296 kg/ha to 413 kg/ha for an application of 60 kg N/ha. Sesame biomass for plants stands sown on verano leys increased from 293 kg/ha to 364 kg/ha for the application of 60 kg N/ha, and from 417 kg/ha to 460 kg/ha for cavalcade leys.

Cavalcade leys produced the largest sesame biomass.

Sesame development at 71 DAS
Mean sesame plant population at 71 DAS was 298 000 plants/ha. Sesame biomass measured at 71 DAS are presented in Tables 7.4a, 7.4b and 7.4c.

Mean sesame biomass for the 1 year and 2 year pasture leys was 4197 kg/ha and 3976 kg/ha respectively. The difference in biomass can be attributed to plant population.

Sesame grown on all pasture leys responded to nitrogen application. Sesame biomass was greatest on the cavalcade ley and smallest on the sorghum ley. The difference between the 0 kg N/ha plots for the cavalcade ley and sorghum ley was 1673 kg/ha. While the difference between the 60 kg N/ha plots for the cavalcade and sorghum leys was 1312 kg/ha. Lodging was observed in the calcavade plots top dressed with 60 kg N/ha.

Sesame seed yield
Mean sesame plant population at 97 DAS (physiological maturity) was 286 000 plants/ha. Seed yield results are presented in Tables 7.5a, 7.5b and 7.5c.

There was no significant difference in seed yield for sesame grown on 1 or 2 year pasture leys. Mean seed yield was 819 kg/ha across all treatments..

The application of 60 kg N/ha generally doubled seed yield for sesame grown on 0 kg N/ha sorghum and verano leys.

Seed yields for the 0 N kg/ha calcavade plots were twice that of the 0 N kg/ha sorghum plots. The application of nitrogen (30 or 60 kg N/ha) to the calcavade leys increase seed yield by 100 kg/ha. The plots receiving the additional 60 kg N/ha however were badly lodged.

Discussion

The advantage of rotating grain crops with pasture legumes in the semi-arid tropics of the NT is obvious. After a 1 or 2 year cavalcade ley and then a sorghum crop there was sufficient residual soil nitrogen to produce sesame seed yields twice that of sesame into a continuous (3 year) sorghum crop regime. The amount of residual nitrogen left after verano leys was less than that of cavalcade leys. Sesame seed yields only increased by 100 kg/ha in the verano plots and 500 kg/ha in the cavalcade plots for the 0 kg N/ha treatments.

At higher rates of nitrogen top-dressed there was no difference in sesame seed yields between sesame incorporated into a continuous sorghum program and sesame incorporated in a verano/crop rotation program. Visual observation indicated that the number of verano seedlings growing under the sesame crop was small compared to the number of cavalcade seedling after 2 years of grain crops.

Two year old cavalcade pastures (sufficient age to have established a seed bank) provide sufficient nitrogen to reduce the nitrogen fertiliser input for sesame crop by half. This is worth approximately $42/ha to the farmer.

Table 7.1 Treatments imposed throughout the crop sequence experiment

Wet season	91-93		93-94	94-95
Treatments selected		No of years		
1	sorghum	1	sorghum[1]	sesame[2]
2	sorghum	2	sorghum[1]	sesame[2]
3	verano	1	sorghum	sesame[2]
4	verano	2	sorghum[1]	sesame[2]
5	cavalcade	1	sorghum[1]	sesame[2]
6	cavalcade	2	sorghum[1]	sesame[2]

1 = *no additional nitrogen applied*
2 = three levels of nitrogen application: 0, 30, 60 kg/ha

Table 7.2 Site preparation for the crop sequence experiment in the 94-95 wet season

Site preparation	Date
Mulched	9 Nov '94
Slashed	5 Jan '95
Round-up CT® (3.0 L/ha)	12 Jan '95
Sown (3.8 kg/ha)	17 Jan '95
Re-sown (5.7 kg/ha)	26 Jan '95

Table 7.3a Sesame development in previously sorghum plots at 35 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame biomass (kg/ha)
sorghum	1	0	323	235
sorghum	2	0	315	357
sorghum	1	30	455	390
sorghum	2	30	268	289
sorghum	1	60	340	502
sorghum	2	60	305	324
Mean across treatments				
§ 1 year			373	376
§ 2 years			296	323
§ 0 N			319	296
§ 30 N			362	340
§ 60 N			323	413
§ Grand			*334*	*350*

Table 7.3b Sesame biomass and weed development in previously verano plots at 35 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop.	Sesame biomass
verano	1	0	403	345
verano	2	0	228	241
verano	1	30	373	389
verano	2	30	540	488
verano	1	60	343	422
verano	2	60	273	307
Mean across treatments				
§ 1 year			373	385
§ 2 years			347	345
§ 0 N			316	293
§ 30 N			459	439
§ 60 N			308	364
§ Grand			*360*	*365*

Table 7.3c Sesame and weed development in cavalcade plots at 35 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame biomass (kg/ha)
cavalcade	1	0	320	449
cavalcade	2	0	300	384
cavalcade	1	30	303	431
cavalcade	2	30	220	347
cavalcade	1	60	300	595
cavalcade	2	60	305	324
Mean across treatments				
§ 1 year			308	492
§ 2 years			275	453
§ 0 N			310	417
§ 30N			262	389
§ 60N			303	460
§ Grand			*292*	*422*

Table 7.4a Sesame development in previously sorghum plots at 71 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame biomass (kg/ha)
sorghum	1	0	330	2140
sorghum	2	0	310	2307
sorghum	1	30	305	3769
sorghum	2	30	233	2962
sorghum	1	60	340	4882
sorghum	2	60	213	4679
Mean across treatments				
§ 1 year			341	3598
§ 2 years			252	3316
§ 0 N			320	2224
§ 30 N			269	3366
§ 60 N			301	4782
§ Grand			*297*	*3457*

Table 7.4b Sesame development in previously verano plots at 71 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame biomass (kg/ha)
verano	1	0	343	3251
verano	2	0	228	2147
verano	1	30	288	3910
verano	2	30	300	4252
verano	1	60	290	4459
verano	2	60	265	5198
Mean across treatments				
§ 1 year			307	3873
§ 2 years			264	3866
§ 0 N			286	2699
§ 30 N			294	4081
§ 60 N			278	4829
§ Grand			*286*	*3870*

Table 7.4c Sesame development in previously cavalcade plots at 71 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame biomass (kg/ha)
cavalcade	1	0	355	3750
cavalcade	2	0	280	4044
cavalcade	1	30	345	4989
cavalcade	2	30	260	4633
cavalcade	1	60	318	6624
cavalcade	2	60	310	5563
Mean across treatments				
§ 1 year			339	5121
§ 2 years			283	4747
§ 0 N			318	3897
§ 30N			303	4811
§ 60N			314	6094
§ Grand			*311*	*4934*

Table 7.5a Sesame seed yield in previously sorghum plots at 97 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop.	Seed yield
sorghum	1	0	263	391
sorghum	2	0	288	451
sorghum	1	30	325	844
sorghum	2	30	265	875
sorghum	1	60	275	991
sorghum	2	60	345	858
Mean across treatments				
§ 1 year			288	742
§ 2 years			299	728
§ 0 N			276	421
§ 30 N			295	860
§ 60 N			310	925
§ Grand			*294*	*735*

Table 7.5b Sesame seed yield in previously verano plots at 97 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop.	Seed yield
verano	1	0	333	608
verano	2	0	210	414
verano	1	30	275	817
verano	2	30	325	684
verano	1	60	278	872
verano	2	60	280	989
Mean across treatments				
§ 1 year			295	766
§ 2 years			272	696
§ 0 N			272	511
§ 30 N			300	751
§ 60 N			279	931
§ Grand			*284*	*731*

Table 7.5c Sesame seed yield in previously calcavade plots at 97 DAS

Prev. crop	No. years	Fertiliser (kg N/ha)	Sesame pop. ($x10^3$ p/ha)	Sesame yield (kg/ha)
cavalcade	1	0	285	893
cavalcade	2	0	340	946
cavalcade	1	30	268	1096
cavalcade	2	30	208	960
cavalcade	1	60	273	985
cavalcade	2	60	305	1062
Mean across treatments				
§ 1 year			275	991
§ 2 years			284	989
§ 0 N			313	920
§ 30N			238	1028
§ 60N			289	1024
§ Grand			*280*	*990*