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SESAME RESEARCH

REPORT

1988 - 1989 WET SEASON

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SESAME RESEARCH REPORT

1988 - 1989 WET SEASON

KATHERINE

DEPARTMENT OF PRIMARY INDUSTRY

AND FISHERIES

NORTHERN TERRITORY

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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.

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INTRODUCTION

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

One crop that has shown potential for the drier Katherine region is sesame. Intensive sesame research was initiated in the 1987/88 wet season. Research included genotype, herbicide and population trials. Preliminary conclusions from this work, plus those from monitoring of commercial crops, and suggestions by various sesame farmers provided the directions for further research. These directions include restoration of pure seed lines, entomological studies, and research to improve fertiliser, herbicide, time of sowing and harvesting management.

Five projects were implemented to provide answers to the farmers most pressing problems.

1. GENERAL METHODS

All research plots, except for the 'dark' sesame seed evaluation, were sown on C8 paddock at CSIRO, Katherine. The 'dark' seed sesame evaluation was sown in paddock H11.

Seasonal Conditions

The 1988/89 season was characterised by a high rainfall for December, then a dry January and February. March and April were very high rainfall periods (Table 2.1.1).

Soil type was Fenton clay loam, which had grown signal grass pasture for the previous 2 years (Table 2.1.2).

Fertiliser Application

The area was fertilised with single-superphosphate plus zinc and copper at 250 kg/ha (approx. 22 kg/ha P, 1.6 kg/ha Cu and 1.6 kg/ha Zn), on 21 December, 1988. Urea was incorporated at 130 kg/ha (approx. 60 kg/ha N) on the same day.

Weed Control

Dual at 1.1 L/ha was applied by boom spray on the evening of 27 December, 1988. Soil conditions were moist.

Insect Control

There was no requirement for insect control this season.

TABLE 1.1: Monthly rainfall (November - May) for 1988/89 wet season at CSIRO

MONTH	SEASON	LONG TERM AVERAGE[1]
November	104.0	83.3
December	349.1	191.6
January	196.0 (2)	228.6
February	70.6	210.2
March	373.5	162.7
April	78.0	32.8
May	0.0	5.1
TOTAL	1171.2	914.3

1 Long term average for Katherine
2 Includes 59 mm of irrigation

TABLE 1.2: Soil nutrient analysis (0-15cm depth)

	Paddock C8	Paddock H11
Soil analysis		
Cond. (ms/cm)	0.04	0.06
pH	5.7	6.5
Avail. P ppm	9.0	11.0
Avail. K ppm	180.0	195.0
Avail. Ca ppm	550.0	725.0
Avail. Mg ppm	120.0	165.0
Avail. S ppm	4.9	14.0
Avail. Cu ppm	1.1	1.6
Avail. Zn ppm	0.4	0.4
Avail. Mn ppm	14.0	7.8
Avail. Fe ppm	9.5	-

2 SESAME GENOTYPE EVALUATION IN THE 1988/89 WET SEASON

ABSTRACT

A range of sesame genotypes were evaluated at CSIRO, Katherine in 1988/89 wet season. All genotypes were flowering 36 DAS and harvested by 112 DAS.

Pachequino (NT) and Instituto 15 produced the highest seed yields of 1727 and 1603 kg/ha respectively. Seed yield was not directly related to capsule number as indicated in literature. As for disease resistance Instituto 15, was not tolerant to Corynespora cassiicola, while Hnan Dun however was tolerant to it.

INTRODUCTION

Sesame is considered a potential crop in the semi-arid tropics of North West Australia. Extensive genotype evaluations were undertaken in Ord River Irrigation Area (ORIA) during the 1981-83 wet seasons. Nine, white-seeded genotypes best suited for the culinary trade market, were selected from the Department of Agriculture (ORIA) work for research in the Northern Territory in the 1986/87 season.

Three genotypes indicated potential suitability for the Northern Territory. These were Hnan Dun, Yori 77 and Pachequino. Pachequino and Yori 77 being readily commercially acceptable. Further lines were obtained from the University of Western Australian in 1988 for evaluation.

Characteristics of a sesame ideotype suitable for the Northern Territory include:

a) Maturity by late April for crops planted in early January.
b) Rapid height and minimal branch development, (eg 4-5 branches).
c) Tolerance to Sesame Leaf Roller, (Antigastra catalaunalis).
d) Rapid, compact capsule maturation.
e) Semi-dehiscent capsules.
f) White seeds with high oil content.
g) High yielding.
h) Lodging resistance.
i) Tolerance to Corynespora cassiicola (blight).
j) Tolerance to Cereospora sesamicola (large leafspot).

MATERIALS AND METHODS

Design, Treatments and Management

Experimental design was a randomised complete block with 3 replicates of ten genotypes. Genotypes were Pachequino (W.A.), Hnan Dun (W.A.), Yori 77 (W.A.), Pachequino (N.T.), Hnan Dun (N.T.), Yori 77 (N.T.), Ciano 27, Tehuan Tepec 111, Cola de Borrego, and Instituto 15. Plot size was 8 rows by 3.2 m long. Row spacing was 36 cm.
The experiment was sown on 12 January, 1989, with a cone-seeder at 15mm depth. Genotype germination was variable and seeding rate was adjusted in order to obtain a plant population of 300,000 plants/ha.

The experiment was irrigated 1, 3, 7 and 8 days after sowing (DAS), each of approximately 15 mm, to ensure establishment.

Recordings and Data Collection

During the season phenological data was recorded. These included date of first flower, date of 50% of plants flowering, date of physiological maturity (95% of capsules yellow) and date of harvest maturity (95% capsules brown).

Floral characteristics recorded were the presence or absence of floral nectaries, and the presence or absence of purple spots on the inner lower surface of the flower, 'speckled throat'.

Sesame genotypes were rated for susceptibility to Corynespora cassiicola on 18 April. Stem and capsules were scored; ranging from 0 (very mild infection), to 4 (severely infected). Leaves were not rated due to confounding influence of Cercospora sesamicola.

At physiological maturity, 10 plants were selected for yield component analysis: with plant height, height of lowest capsule, number of branches with capsules, node of lowest branch, node of lowest capsule, number of potential whorls of capsules, number of capsules on central stem and number of capsules on branches being recorded.

From this data, length of stem used for capsule development, number of capsules/cm of stem used for capsule development and number of capsules/whorl was calculated.

Plant population and seed yield were recorded by harvesting one metre from the central four rows of each plot.

Samples were threshed, cleaned and seed weighed to determine seed yield. Sub-samples set aside for 100 seed weight, seed colour and germination determinations.

Note

Ciano 27 and Tehuan Tepec 111 were extremely variable in physical and floral characteristics. Plots were rogued to improve uniformity of the major plant type. However, these plant types may not be the correct form, hence Ciano 27 and Tehuan Tepec 111 have been identified as Selection C and Selection T respectively later in this paper.

RESULTS

Phenology

All genotypes produced their first flower between 28 and 36 DAS, 50% of plants flowering between 32 and 41 DAS, and harvested between 98 and 112 DAS (Table 2.1). The Pachequino (W.A.) exhibited phenology similar to Yori 77.

Floral Characteristics

Floral characteristics of the sesame genotypes are presented in Table 2.2.

All genotypes except Yori 77 (NT), Pachequino (NT), Instituto 15, and Selection T to exhibited nectaries. The presence of nectaries reduces the number of potential sites for capsule set, hence is not a desirable characteristic.

Only Yori 77 (NT) and Selection T did not exhibit the presence of purple spots on the inner lower surface of the flower, eg 'speckled throat'.

Plant Population

The average genotype population was 288 x 10^3 plants/ha (Table 2.3). All genotype populations, except Pachequino (W.A.), were between 200 and 400 x 10^3 plants/ha. No seed yield advantage to plant stand is found between these populations.

Seed Yield

All genotypes produced seed yields greater than 1000 kg/ha (Table 2.4). Pachequino (N.T.) was significantly higher yielding than Yori 77 (N.T.) and Yori 77 (W.A.), 1727, 1303 and 1216 kg/ha respectively. The lower seed yield recorded by Pachequino (W.A.) as compared to Pachequino (N.T.) is a result of the lower Pachequino (N.T.) population.

Plant Height

Instituto 15 was significantly taller than all other genotypes(Table 2.5). Average genotype height was 105 cm. Some plants of Selection C exhibited apical curl, i.e. the growing point was forming a hook in relation to the ground. Such plants would lose a larger percentage of seed as the plant matures/ dehisces. No genotypes were greater than 1.5m tall, which is difficult to harvest.

Height of Lowest Capsule

Hnan Dun (W.A.) and Selection T were significantly lower in height of lowest capsule than the other genotypes (Table 2.5). Yori 77 (N.T.) was the highest in capsule set. None of the genotypes set their capsule less than 50cm above the ground. Minimum lowest capsule height would be 30cm; sufficiently high for insertion of the harvester cutter bar.

Number of Branches

Yori 77, Pachequino (W.A.) and Hnan Dun (W.A.) exhibited a branching habit (Table 2.5). Pachequino (N.T.) and Hnan Dun (N.T.) produced significantly less branches than their (W.A.) counterparts. Hnan Dun (N.T.) with low number of branches is very different to the 2.4 branches/ plant recorded for research 1987/88. Two branches with capsules is considered to be a more desirable plant characteristic than a single stem plant type.

Number of Capsules on Central Stem

Average number of capsules on central stem ranged from 20 to 42 (Table 2.5). Hnan Dun, Selection C and Cola de Borrego produced significantly less capsules than the other genotypes. This was due to the presence of nectaries instead of capsules.

Number of Capsules on Branches

Hnan Dun (W.A.), Yori 77 (W.A.) and Pachequino exhibited a branching habit. They produced between 12 and 19 capsules on their branches (Table 2.5).

Total Number of Capsules/Plant

Average total number of capsules produced was 38. Capsule number ranged between 25 and 53 for Cola de Borrego and Yori 77 (N.T.) respectively (Table 2.5).

As literature has indicated the higher the number of capsules the greater the seed yield potential. Hence genotypes with a low number of capsules are quickly discarded. Genotypes discarded were Hnan Dun (N.T.) and Selection C.

Node of Lowest Capsule

Average node of lowest capsule was 7 (Table 2.6).

Same argument as height of lowest capsule. The selection of genotypes with capsules set at a lower node number (as long as capsule height is greater than 30cm) a more efficient sesame plant structure will be identified. The lower the node number for initial capsule set, the greater the possibility for more nodes/whorls of capsules.

Number of Potential Whorls of Capsules

The range in number of potential whorls of capsules was from 9 to 14 for Yori 77 and Selection T respectively (Table 2.6). The greater the number of whorls of capsules the greater the seed yield potential.

Length of Stem for Capsule Development

Instituto 15 produced a significantly longer stem region for capsule development than the other genotypes (Table 2.6). Yori 77 and Pachequino (W.A.) produced the shorter capsule set stem regions. Average capsule set stem length was 45 cm.

The greater the length of stem available for capsule set combined with more whorls of capsules provides greater potential for higher seed yield. Instituto 15 exhibited both long stem length for capsule set and more whorls of capsules/stem than the other genotypes.

Average Number of Capsules per Whorl

Yori 77 recorded the highest number of capsules per whorl at 4 (Table 2.6). The average capsules per whorl was 3. Selection T indicated poor capsule orientation within the whorl. Some capsules were not acute to the stem, hence when they dehisce these capsules would 'shatter' a larger percentage of seed. The maximum number of capsules per whorl that can be expected is 6. (Weiss, E.A. 1983)

Tolerance to Corynespora cassiicola

Hnan Dun (N.T.),Hnan Dun (W.A.), Pachequino (N.T.) and Selection T were more tolerant than Yori 77 (N.T.) to stem infection of Corynespora (Table 2.7). Hnan Dun and Selection T were more tolerant than Yori 77 (N.T.) to capsule infection to Corynespora (Table 2.7).

Overall Cola de Borrego, Instituto 15 and Selection C were not tolerant to Corynespora cassiicola. However this did not prevent Selection C and Instituto 15 producing the 2nd and 3rd highest seed yields for the experiment.

Hnan Dun was the most tolerant genotype to Corynespora cassiicola.

Germination Percentage

Hnan Dun, Cola de Borrego and Pachequino (N.T.) contained a high proportion of fresh ungerminated/ dormant seed. Pachequino (W.A.) did not display this characteristic (Table 2.8).

The percentage of fresh ungerminated seed decreases (and normal germination increases) as the seed age during storage between seasons. Generally by the start of the next cropping season there is little or no fresh ungerminated seed.

100 Seed Weight

Hnan Dun (N.T.) and Pachequino (W.A.) produced the lightest seed, 0.28g/100 seed (Table 2.8). While Cola de Borrego and Instituto 15 produced the heavier seed, 0.38g/100 seed. Generally the larger, heavier sesame seed more acceptable to the market requirements.

DISCUSSION

Five genotypes were selected for further review in the following season. Genotypes include Pachequino (N.T.), Yori 77 (N.T.), Hnan Dun (W.A.), Instituto 15, and Cola de Borrego. The reasons for discarding the rest were as follows:

Selection C was discarded due to apical curl while Selection T was due to poor capsule orientation. Both selections could easily lose an amount of seed due to shattering.

Pachequino (W.A.) exhibited all the characteristics of Yori 77. Phenology, Pachequino (W.A.) reached harvested maturity at 102 DAS versus 112 DAS for Pachequino (N.T.). Branching habit, Yori 77 and Pachequino (W.A.) were multiple branching while Pachequino (N.T.) was single stem. Finally seed germination characteristics, Pachequino (N.T.) exhibits a percentage of dormant (ungerminated), while seed, Yori 77 does not. Pachequino (W.A.) exhibited no characteristics. Hence Pachequino (W.A.) was discarded as being similar to yori.

Hnan Dun (N.T.) was discarded in favour of Hnan Dun (W.A.) due to the W.A. plants had a more compact maturation of capsules.

Yori 77 (W.A.) was discarded due to the presence of nectaries in some of the plants.

The remaining 5 genotypes will be further reduced to 3 after the 1989/90 wet season research.

TABLE 2.1: Phenology of sesame genotypes

GENOTYPE	DAYS AFTER SOWING FOR THE FOLLOWING EVENTS			
	FIRST FLOWERS	50% PLANTS FLOWERING	P.M.	HARVEST MATURITY
Hnan Dun N.T.	28	34	*	101
Hnan Dun W.A.	28	32	*	99
Yori 77 N.T.	36	41	96	102
Yori 77 W.A.	31	40	96	100
Pachequino N.T.	30	37	101	112
Pachequino W.A.	31	38	96	102
Cola de Borrego	29	36	99	108
Instituto 15	30	38	102	107
Selection C	29	37	103	110
Selection T	28	36	*	98
LSD (5%)=	2	1	-	3
CV (5%)=	4.4	2.1	-	1.7

* Difficult to distinguish PM
PM = Physiological Maturity

TABLE 2.2: Floral characteristics of sesame genotypes

GENOTYPE	PRESENCE OF NECTARIES	PRESENCE OF 'SPECKLED THROAT'
Hnan Dun N.T.	Yes	Yes
Hnan Dun W.A.	Yes	Yes
Yori 77 N.T.	No	No
Yori 77 W.A.	Yes (some plants)	Yes
Pachequino N.T.	No	Yes
Pachequino W.A.	Yes (some plants)	Yes
Cola de Borrego	Yes (some plants)	Yes
Instituto 15	No	Yes
Selection C	Yes	Yes
Selection T	No	No

TABLE 2.3: Sesame genotype plant populations

GENOTYPE	PLANT POPULATION ($x10^3$/ha)
Hnan Dun N.T.	333
Hnan Dun W.A.	313
Yori 77 N.T.	289
Yori 77 W.A.	285
Pachequino N.T.	350
Pachequino W.A.	197
Cola de Borrego	322
Instituto 15	286
Selection C	299
Selection T	208
AVERAGE	288
LSD (5%) =	39
CV(%) =	8.0

TABLE 2.4: Sesame cultivar seed yields

GENOTYPE	SEED YIELD (kg/ha)
Hnan Dun N.T.	1431
Hnan Dun W.A.	1414
Yori 77 N.T.	1303
Yori 77 W.A.	1216
Pachequino N.T.	1727
Pachequino W.A.	1576
Cola de Borrego	1442
Instituto 15	1603
Selection C	1634
Selection T	1088
LSD (5%) =	314
CV (%) =	12.6

TABLE 2.5: Yield components for sesame genotypes.

GENOTYPE	PLANT HEIGHT (cm)	HEIGHT OF CAPSULE (cm)	NO. OF BRANCHES	TOTAL NO. OF CAPSULES/ PLANT	NO. OF CAPSULES ON: CENTRAL STEM	BRANCHES
Hnan Dun N.T.	105	57	0.4	25	20	5
Hnan Dun W.A.	95	51	1.4	36	22	14
Yori 77 N.T.	105	67	1.1	53	34	19
Yori 77 W.T.	95	63	1.3	47	34	13
Pachequino N.T.	104	60	0.1	36	34	2
Pachequino W.A.	99	63	1.1	46	34	12
Cola de Borrego	109	64	0.2	25	24	1
Instituto 15	135	63	0.5	40	37	3
Selection C	112	63	0.2	26	24	2
Selection T	103	50	0.4	46	42	4
LSD (5%) =	11	6	0.4	13	8	9
CV (%) =	6.0	5.7	34.3	19.9	15.8	67.5

TABLE 2.6: Yield components for sesame genotypes

GENOTYPE	NODE OF LOWEST CAPSULE	NUMBER OF POTENTIAL WHORLS OF CAPSULES	LENGTH OF STEM SET TO CAPSULES (cm)	CAPSULE PER WHORL
Hnan Dun N.T.	6	10	48	2
Hnan Dun W.A.	6	10	44	2
Yori 77 N.T.	8	9	38	4
Yori 77 W.A.	8	9	33	4
Pachequino N.T.	7	12	44	3
Pachequino W.A.	7	10	35	3
Cola de Borrego	7	11	46	2
Instituto 15	7	14	63	3
Selection C	7	12	48	2
Selection T	7	14	53	3
LSD (5%) =	1	2	9	1
CV (%) =	5.5	11.8	11.2	7.9

TABLE 2.7: Observations of genotype tolerance to Corynespora cassiicola

Rating: 0 = Very tolerant 4 = No tolerance

GENOTYPE	SITE OF INFECTION		
	Stem	Capsules	Average
Hnan Dun N.T.	1.0	1.7	1.4
Hnan Dun W.A.	1.7	1.3	1.5
Yori 77 N.T.	3.0	2.0	2.0
Yori 77 W.A.	2.0	2.0	2.5
Pachequino N.T.	1.3	2.7	2.0
Pachequino W.A.	2.3	2.3	2.3
Cola de Borrego	3.0	3.0	3.0
Instituto 15	3.0	3.3	3.2
Selection C	3.0	3.0	3.0
Selection T	1.3	1.3	1.3
LSD (5%) =	1.3	1.3	-
CV (%) =	35.7	33.7	-

TABLE 2.8: Germination and 100 seed weight sesame genotype.

GENOTYPE	GERMINATION (%)		100 SEED WEIGHT
	Normal	Ungerm.	(g)
Hnan Dun N.T.	77	20	0.29
Hnan Dun W.A.	35	59	0.34
Yori 77 N.T.	95	0	0.31
Yori 77 W.A.	94	0	0.32
Pachequino N.T.	72	24	0.36
Pachequino W.A.	98	0	0.29
Cola de Borrego	70	15	0.38
Instituto 15	95	0	0.38
Selection C	92	0	0.32
Selection T	93	1	0.30

3. SESAME SELECTION EVALUATION IN THE 1988/89 WET SEASON

INTRODUCTION

A wide range of sesame plant types are presently found in commercial crops in the Northern Territory. This diversity provides scope for selection of new genotypes.
In the 1988/89 wet season, "reference" seed and seed from individual plant selections of *Yori 77* and *Pachequino* were planted. Measurements of various plant characteristics have enabled the identification of potentially improved lines for inclusion into future genotype evaluations.

MATERIALS AND METHOD

Design and Management

The sesame selections of *Pachequino* and *Yori 77*, plus the reference material of both cultivars were sown in unreplicated plots on December 31, 1988.

There was 5 selections of both *Yori 77* and *Pachequino*, *Pachequino* selections 1, 2, 3, 4 and 5, *Yori 77* selections 1, 2, 3, 4, 5 and S. The reference material was *Pachequino A, B* and *C*, and *Yori 77* was *A* and *B*.

All plots consisted of 2 rows, 13m long with 36cm between rows.

Plants were thinned to an intra-row spacing of 7cm (equivalent to 400,000 plants/ha), within 2 weeks of sowing.

Recordings and Data Collection

During the season, phenological data were recorded. These included date of first flower, date of 50% of plant flowering and date of harvest.

Floral characteristics recorded were the presence or absence of floral nectaries, and the presence or absence of purple spots on the inner lower surface of the flower ('speckled throat').

Sesame selections were visually rated for susceptibility to Corynespora cassiicola and Cercospora sesamicola.

At physiological maturity, 100 plants were selected for recording of morphological characteristics, including plant height, height of lowest capsule, number of branches with capsules, node of lowest branch, node of lowest capsules, potential number of whorls of capsules, number of capsules on central stem and number of capsules on branches.

From this data, length of stem used for capsules development, number of capsules/cm of stem used for capsules development and number of capsules/whorl was calculated.

Harvested material was air-dried, threshed and seed set aside for 100 seed weight determinations.

All material was then scored for the following characteristics; total number of capsules, length of stem used for capsules development, 100 seed weight and node of lowest capsules. If the measured value was greater than the mean for that characteristic/selection, a score of one (1) was recorded. Less than the mean, zero (0) was applied. Total capsules score was weighted by times 2. The presence of apical curl (central stem curls over so capsules are facing the ground) was scored as zero.

Plants scoring the highest possible rating were kept. This material was divided into 'superior lines' and 'reserve superior' lines, according to the level of score.
All other material was discarded.

The following lines were discarded either because of poor growth, segregating plant population or susceptibility to leaf diseases: *Pachequino C, Pachequino 1, Yori 77 3,* and *Yori 77 4.*

RESULTS

Phenology

All selections produced their first flower by 45 days, 50% of plants flowering by 58 days and harvested by 119 days (Table 3.1). There was not a large range in the phenology of the material, and none of the selections could be discarded for being too late to harvest maturity.

Floral Characteristics

Floral characteristics are presented in Table 3.2. Most selections exhibited an absence of nectaries and a presence of purple speckling within the flower. The presence of nectaries reduces the number of potential sites for capsules development, hence is not or desirable characteristic.

Morphology

The top scoring 11 plants were titled 'superior' lines and the next 16 highest scoring plants were titled 'reserve superior' lines.
Morphological characteristic of 'superior' lines are presented in Table 3.3. 'Reserve superior' lines are presented in Table 3.4.

DISCUSSION

Basically the sesame ideotype suitable for the N.T.is a plant that has to be disease and insect tolerant. Has a long stem length available for capsules development, the lowest capsules set approximately 30cm above the ground, with the maximum number of capsules/whorl and whorls/plant possible (hence no nectaries). Also the plants should have 4 to 5 branches with capsules.

The seed produced should be bold, white and heavy, greater than 0.35g/100 seed, plus have a high oil content.

The 'superior' lines, and 'reserve superior' lines all exhibited these characteristics.

The top third of the 'superior' lines in the 1989/90 wet season experiments will be included in future genotype evaluation.

TABLE 3.1 Phenology of sesame selections

SELECTION	DAYS AFTER SOWING FOR THE FOLLOWING EVENTS		
	FIRST FLOWERS	50% PLANTS FLOWERING	HARVEST
Pachequino reference A	37	47	116
Pachequino reference B	37	51	118
Pachequino selection 2	40	47	119
Pachequino selection 3	36	47	118
Pachequino selection 4	37	47	118
Pachequino selection 5	41	49	117
Yori 77 reference A	45	58	110
Yori 77 reference B	37	54	107
Yori 77 selection 1	37	47	118
Yori 77 selection 2	41	53	118
Yori 77 selection 5	40	47	118
Yori 77 selection S	39	53	113

TABLE 3.2: Floral characteristics of sesame selections.

SELECTION	PRESENCE OF NECTARIES	PRESENCE OF "SPECKLED THROAT"
Pachequino A	Yes (some plants)	Yes
Pachequino B	No	Yes
Pachequino 2	No	Yes
Pachequino 3	Yes (some plants)	Yes
Pachequino 4	No	Yes
Pachequino 5	No	Yes
Yori 77 A	No	No
Yori 77 B	No	Yes (some plants)
Yori 77 1	No	Yes
Yori 77 2	No	Yes
Yori 77 5	No	Yes
Yori 77 S	No	Yes

TABLE 3.3: Morphological characteristics of 'superior' sesame lines for research.

Selection	no.	A	B	C	D	E	F	G	H	I
Pachequino A	45:	106	35	0	0	6	25	99	0	0.45
Pachequino B	64:	102	28	0	0	5	20	69	0	0.39
Pachequino 2	31:	109	30	0	0	5	22	93	0	0.41
Pachequino 2	39:	103	39	2	3	6	24	73	38	0.43
Pachequino 3	63:	103	34	1	4	7	19	92	10	0.37
Pachequino 4	13:	93	27	2	4	6	20	71	15	0.37
Yori 77 A	69:	101	49	3	6	8	17	69	56	0.32
Yori 77 S	18:	112	43	1	6	9	22	85	1	0.38
Yori 77 1	44:	97	35	0	0	6	19	52	0	0.46
Yori 77 2	57:	94	35	0	0	6	17	50	0	0.39
Yori 77 5	83:	102	37	0	0	6	17	49	0	0.40

A: Height of plant (cm)
B: Height of lowest capsule on mainstem (cm)
C: Number of branches
D: Node of lowest branch
E: Node of lowest capsule on mainstem
F: Potential number of whorls of capsules
G: Number of capsules on mainstem
H: Number of capsules on branches
I: Mass of 100 seeds (g)

TABLE 3.4: Morphological characteristics of 'reserve superior' sesame lines for research.

SELECTION	NO	A	B	C	D	E	F	G	H	I
Pachequino A	40:	94	31	2	3	6	17	63	18	0.36
Pachequino A	69:	105	46	0	0	6	18	52	0	0.38
Pachequino B	46:	98	33	0	0	5	18	53	0	0.38
Pachequino B	53:	93	29	2	3	6	18	38	28	0.36
Pachequino B	54:	94	30	0	0	4	22	64	0	0.37
Pachequino B	56:	95	36	1	3	5	16	54	3	0.37
Pachequino 2	54:	89	50	0	0	6	12	22	0	0.38
Pachequino 3	47:	110	48	0	0	6	13	54	0	0.37
Pachequino 4	43:	120	45	0	0	6	20	63	0	0.37
Yori 77 A	35:	92	44	2	6	7	13	51	6	0.32
Yori 77 A	67:	98	52	2	7	9	14	56	14	0.33
Yori 77 1	91:	104	50	0	0	5	16	45	0	0.39
Yori 77 1	96:	100	46	0	0	6	13	54	0	0.39
Yori 77 2	33:	108	47	0	0	6	16	48	0	0.40
Yori 77 2	34:	104	47	0	0	6	19	41	0	0.39
Yori 77 5	82:	105	43	1	5	6	18	45	4	0.39

A: Height of plant (cm)
B: Height of lowest capsule on mainstem (cm)
C: Number of branches
D: Node of lowest branch
E: Node of lowest capsule on mainstem
F: Potential number of whorls of capsules
G: Number of capsules on mainstem
H: Number of capsules on branches
I: Mass of 100 seeds (g)

4. EVALUATION OF DARK SEEDED SESAME GENOTYPES IN THE 1988/89 WET SEASON

INTRODUCTION

In the 1988/89 wet season, observations on naturalised sesame (Katherine Local), Kye ma shaung and Black Seeded were recorded during renewal of seed stocks. All the genotypes were late in maturity. Seed yields were 1253 kg/ha for Kye ma shaung, 929 kg/ha for Black Seeded and 847 kg/ha for Katherine Local sesame. Seeds were light in weight.

MATERIALS AND METHODS

Design and Management

The sesame genotypes, Katherine Local, Black Seeded and Kye ma shaung were sown in unreplicated observation plots on 31 December, 1988.

All plots consisted of 8 rows, 13 m long with 36 cm between rows.

Seed germination was variable and seeding rate was adjusted in order to obtain a plant population of 300,000 plants/ha.

Herbicide, Dual, at 1.0 L/ha was applied by boom spray on the evening of 28 December, 1988.

Recordings and Data Collection

Date of various phenological stages were recorded. These included date of first flower, date of 50% plants flowering, date of physiological maturity (95% of capsules yellow) and date of harvest maturity (95% of capsules brown).

The dark seed genotypes were rated for susceptibility to Corynespora cassicola and Cercopora sesamicola.

At physiological maturity, 10 plants were selected for yield component analysis: plant height, height of lowest capsule, number of branches with capsules, node of lowest branch, node of lowest capsule, number of potential whorls of capsules, number of capsules on central stem and number of capsules on branches were recorded.

From this data, length of stem used for capsule development, number of capsules/cm of stem used for capsule development and number of capsules/whorl on the central stem was calculated.

Plant population and seed yield were recorded by harvesting the centre four rows by 1 m from each plot. Samples were threshed, cleaned and recorded. Sub-samples set aside for 100 seed weight, seed colour and germination determinations.

RESULTS

Phenology and floral characteristics are in Table 4.1 and Table 3.2 respectively. Morphological characteristics of sesame genotypes Black Seeded, Katherine Local and Kye ma shaung are in Table 4.3

DISCUSSION

The dark seed genotypes tended to be tall in stature, produce many branches with capsules set high above the ground. A distinguishing characteristic of Black Seeded was the anthocyanin in the petioles. Seed weight for all genotypes was light.

The Katherine Local sesame was very susceptible to leaf diseases while Kye ma shaung was not. Katherine Local sesame seed can also be identified by its rough seed coat and 'hard seed/ dormancy' characteristic. This feature is an advantage to the Katherine Local sesame as this prevents the sesame from germinating on "false" initial wet season rainfall.

The rejuvenate seed stock was returned to the long term store.

TABLE 4.1: **Phenology of Black seeded, Kye ma shaung and Katherine Local sesame.**

GENOTYPES	DAYS AFTER PLANTING FOR THE FOLLOWING EVENTS			
	FIRST FLOWERS	50% PLANTS FLOWERING	P.M.	HARVEST
Katherine Local	43	58	*	111
Black Seeded	42	57	122	132
Kye ma shaung	57	68	120	135

* Difficult to distinguish PM
PM = Physiological Maturity

TABLE 4.2: Floral characteristics of Black Seeded, Kye ma shaung and Katherine Local Sesame.

CHARACTERISTIC	BLACK SEEDED	KYE MA SHAUNG	KATHERINE LOCAL
a) Flower			
. Nectaries	Yes	Yes	Yes
. "Speckled throat"	Yes	Yes	Yes
b) Petiole Colour	Red	Green	Green

TABLE 4.3: Morphology of sesame genotypes, Black Seeded, Kye ma shaung and Katherine Local sesame.

CHARACTERISTICS	BLACK SEEDED	KYE MA SHAUNG	KATHERINE LOCAL
a) Plant Structure			
. Plant height (cm)	153	199	120
. Height of lowest capsule (cm)	119	139	82
. Length of stem for capsule set	34	60	38
. Number of branches	6.7	4.6	2.5
. Node of lowest branch	7	11	7
. Node of lowest capsule/flower scar	12	13	9
. Number of capsules on central stem	18	26	17
. Number of capsules on branches	67	36	25
. Capsules/cm of stem for capsule set	0.5	0.4	0.4
. Number of whorls of possible capsules	10	14	10
. Capsules/whorl on central stem	2	2	2
. Capsules/branch	10	8	10
b) Seed			
. Colour	blackish brown	brownish black	black
. Texture	smooth/round	smooth/round	rough/flat
. 100 seed weight (g)	0.31	0.24	0.21
. Germination, normal%	93.7	96.7	24.3
. % fresh ungerminated	0.0	0.0	70.3
c) Resistance to			
. <u>Cercospora sesamicola</u> (Leaf Spot)	Susceptible	Tolerant	Very Susceptible
. <u>Corynespora cassiicola</u> (Blight)	Very Tolerant	Tolerant	Susceptible

TABLE 4.4: Plant population and seed yield for Black Seeded, Kye ma shaung and Katherine Local sesame.

GENOTYPE	Plant Population (thousands/ha)	Seed Yield (kg/ha)
Black Seeded	306	929
Kye man shaung	257	1253
Katherine Local	300 *	847

* approximately

5. EFFECT OF SPLIT APPLICATION OF NITROGEN ON YIELD AND NUTRIENT UPTAKE OF SESAME

ABSTRACT

The effect of split application of nitrogen on the growth, capsule development and nutrient uptake of sesame was studied in an experiment on virgin Venn sandy clay loam.

Sesame seed, cv Yori 77 was sown with an application of either 0, 30, 60 or 120kg/ha nitrogen plus an additional application 30kg/ha nitrogen applied pre or post flowering to the 30 and 60kg/ha nitrogen treatments.

There was a significant increase in capsule number to applications of nitrogen up to 120kg/ha. The additional application of nitrogen pre-flowering produced a 59% increase in capsule number, while the additional nitrogen post-flowering decreased capsule numbers.

The tallest sesame plants were produced with an initial application of 30kg N/ha plus an additional 30kg N/ha at 40 days after sowing.

Leaf material at node 9 proved to be the most suitable to assess nitrogen status.

Regression analysis for percentage nitrogen in leaves at node 9 versus capsule number and plant weight indicated a percentage variation accounted for of 85% and 88% respectively. Node 9 for Yori 77 sesame planted 24 November, is in relation to phenology, the first node in which the flower is borne in the leaf axil. Critical nitrogen concentration to achieve 90 percent of maximum capsule number and plant biomass for leaf tissue at node 9, 8 or 7 was 3.8 percent.

INTRODUCTION

High sesame seed yields require substantial inputs of plant nutrients. Due to the high cost of nitrogen fertiliser and potential for loss of nitrogen from the cropping system, efficient use of nitrogen is important. One potential way to increase efficiency is by split applications. This offers the option of adjusting the final application rate according to seasonal conditions and supplying nitrogen when crop requirements are high. However, the split application of nitrogen may enhance vegetative growth in sesame at the expense of yield and increase application costs.

The use of plant analysis as a diagnostic tool is a common practice in many other crops. It is the relationship between nutrient concentration and seed yield that form the basis of assessing nutrient status. The most important point is to determine the critical nutrient concentration - to predict levels to produce 90% maximum seed yield.

Some of the factors influencing nutrient concentration are the physiological age of the tissue and the location of the tissue. Information currently available for sesame (Barscones and Lopez Ritas, 1961) has stated deficiency symptoms may be expected below 2%N, 0.2%P, 0.88%K, 0.6%Ca and 0.15%mg. There is no information as the position to sample tissue.

MATERIALS AND METHOD

Design, Treatments and Management

The experiment was a pot trial, with 4 replications. Experimental design was randomised complete block.

Virgin Venn (sandy loam) was collected at CSIRO research farm, Katherine. All soil was collected from the surface 15cm. The soil chemical composition is presented in Table 5.1.

Treatment details are presented in Table 4.2 Phosphorus was applied as triple-superphosphate powder. Basal fertiliser application was equivalent to 2kg Zn/ha, 2kg Cu/ha, 30kg S/ha, 73kg K/ha and 30kg P/ha.

All chemicals were mixed prior to planting with 10kg of sieved soil and placed in 25cm diameter pots.

The experiment was sown with seed of cv Yori 77 on 24 November 1988 in the greenhouse at Katherine Rural College. Ten seeds were sown in each pot. Seven days after sowing plants were thinned to 2 plants/pot. Pots were watered each day with rain water to field capacity.

RECORDINGS AND DATA COLLECTION

Harvesting was carried out at 40, 60 and 81 days after sowing. Two pots from each treatment were harvested on the first date, and one on the other dates.

The following measurements were recorded on all plants; plant height and number of leaves per plant. Plants were divided into leaf at node 9, leaf at node 8, leaf at node 7 and remaining plant material. Plant material was dried at 60°C for 48 hours. Dry weights were recorded and samples were then milled to pass a 0.5mm screen and analysed for total N, P, K, S, Mg, Cu and Zn. At the last sampling date, capsule number was also recorded.

Regression analysis for sesame capsule number and plant weight versus percentage nitrogen in leaves at node 9, node 8 and node 7 at 40 d.a.s were investigated.

RESULTS AND DISCUSSION

FORTY DAYS AFTER SOWING.

Plant Height

Nitrogen applications of 30 and 60 kg/ha significantly increased plant height by 19% and 13% respectively (Table 4.3). However the highest level of nitrogen decreased plant height. Average plant height was 89cm.

Leaf Number

There was a significant increase (36%) in leaf number for an application of 30 kg N/ha (Table 4.3). There was no further increase in leaf number for higher levels of nitrogen application. Average leaf number was 19.

Dry matter tops

Dry matter tops significantly increased with nitrogen application up to 60kg/ha (Table 5.4). There was no further increase in dry matter tops to higher levels of nitrogen application.

Nitrogen uptake.

There was significant increase in nitrogen uptake for sesame leaves at the 7th, 8th and 9th nodes and sesame stover for higher levels of nitrogen application (Table 5.5). Older leaf material, i.e. leaves at node seven contained higher levels of nitrogen.

Phosphorus uptake.

A similar response to that for nitrogen uptake (Table 5.6). That is sesame plants responded to higher levels of nitrogen application by taking up higher levels of phosphorus.

Again older leaves (i.e. leaves at node 7), contained higher levels of phosphorus than younger leaves.

Sulphur uptake.

A similar response as for nitrogen, except there was no difference between leaf 8 and leaf 7 in sulphur uptake (Table 5.7).

Nutrient uptake, stover

There was a significant increase in Ca, Mg, K, S, Cu and Zn uptake in sesame plant material with increasing application of nitrogen (Table 5.8).

SIXTY DAYS AFTER SOWING.

Plant Height

A significant increase in sesame plant height was achieved with an application of 30 kg N/ha at 40 days after sowing (Table 5.9). There was no difference between the 30 kg N/ha and 60 kg N/ha in plant height, however the highest rate of nitrogen application suppressed plant height.

The additional application of 30 kg N/ha to the 30 kg N/ha treatment produced a further significant increase in plant height. However, the application of an additional 30kg/ha nitrogen to the 60 kg N/ha did not affect plant height.

Average plant height was 127 [illegible]n.

Number of Leaves

There was a significant increase in number of leaves for nitrogen application up to 60 kg N/ha (Table 5.9). There was no difference in leaf number between the 60 kg N/ha and 120 kg N/ha treatments.

An additional 30 kg N/ha to the 30 kg N/ha at sowing treatment produced a significant increase in leaf number. This did not occur with the additional nitrogen to the 60 kg N/ha at sowing.

This indicates that a total application of 60kg N/ha by 40 DAS is adequate for sesame leaf development.

Dry matter tops

Increasing levels of nitrogen fertiliser significantly increased sesame dry matter production (Table 5.10).

Maximum dry matter tops was achieved with an initial application of 120kg N/ha, (311% increase over the zero treatment). The application of an additional 30kg N/ha at 40 DAS applied to the 30kg N/ha and 60kg N/ha treatment further increased dry matter production. This indicates that the increase in dry matter production must be associated with larger leaves, because leaf number did not increase after a total application of 60kg N/ha. Note, visual observation also showed an increase in development of leaves at the leaf axil.

EIGHTY-ONE DAYS AFTER SOWING

Plant Height

Application of nitrogen resulted in an increase in plant height at all levels of treatment except for 120kg N/ha. The tallest plant was produced with an application of 30kg N/ha plus an additional 30kg N/ha at 40 DAS (Table 5.11). Average plant height was 123cm.

Leaf Number

Average leaf number for sesame plants at 81 DAS was 6. Generally the trend was for plants receiving the lowest level of nitrogen application not to abscise their leaves as they mature (Table 5.11), e.g. the 0kg N/ha and 120kg N/ha treatments had 9 and 4 leaves respectively at 81 DAS

Capsule Number

There was a significant increase in capsule number to applications of nitrogen up to 120kg N/ha. The additional application of nitrogen at 40 DAS (pre-flowering) produced a further increase in capsule number. The additional nitrogen at 60 DAS (post-flowering) did not affect capsule numbers (Table 5.11). Maximum dry matter tops was achieved with an initial application of 120 kg N/ha. Additional nitrogen applied pre or post flowering increased sesame biomass by similar amounts.

Dry Matter Tops

Increasing levels of nitrog. increased sesame dry matter production (Table 5.12). Maximum dry matter tops was achieved with an initial application of 120 kg N/ha. Additional nitrogen applied pre or post flowering increased sesame biomass by similar amounts.

Regression Analysis

Results of regression analysis between percentage nitrogen in leaf material at node 9, node 8 and node 7 versus sesame dry matter tops or sesame capsule number are presented in Table 5.12.

In all cases leaf sampling at node 9 accounted for a greater percentage variance when determining sesame dry matter tops or capsule number.

Generally the position of this leave relative to floral structures is the first leaf above the lowest flowering branches. This is the lowest node position for flowers to be present in the leaf axil.

Critical nutrient concentration.

Seed yields are commonly expressed relative to maximum seed yield or biomass. Usually 90% of maximum yield and the nutrient concentration in the leaf tissue at this seed yield is accepted as the critical nutrient concentration. Capsule number and dry matter produced are expressed as a percentage of maximum level versus leaf nitrogen concentration in Figures 5.11 and 5.12.

Critical leaf nitrogen concentration for 90% maximum plant biomass or seed yield at 40 DAS is 3.7 - 3.8 percent.

However further field tests are necessary to substantiate this.

CONCLUSIONS

Nitrogen fertilisation must occur before sesame commences flowering. Applications of nitrogen after flowering do not increase sesame yield. A total of 60kg N/ha is adequate for plant growth, however, seed yield will increase up to 120kg N/ha.

Critical leaf nitrogen concentration at 40 DAS for 90% maximum seed yield is 3.8 percent. The location of leaf tissue suitable to determine nitrogen status is at node 9, i.e., the lowest node where the flower is borne in the leaf axil.

These conclusions have to be tested in extensive field trials.

TABLE 5.1 Soil analysis for Virgin Venn CSIRO, Katherine.

pH	7.0
Conductivity (ms/cm)	0.01
Avail. P (ppm)	5.6
Avail. K (ppm)	30.0
Avail. Ca (ppm)	750.0
Avail. Mg (ppm)	170.0
Avail. S (ppm)	7.6
Avail. Cu (ppm)	0.2
Avail. Zn (ppm)	0.9
Avail Mn (ppm)	6.4
Total Nitrogen (%)	0.02

TABLE 5.2 Time and rate of nitrogen application (kg N/ha as urea)

TREATMENT	TIME OF APPLICATION SOWING	40DAS	60DAS	TOTAL
1	0	0	0	0
2	30	0	0	30
3	30	30	0	60
4	30	0	30	60
5	60	0	0	60
6	60	30	0	90
7	60	0	30	90
8	120	0	0	120

TABLE 5.3 **Average plant height and leaf number for sesame 40 days after sowing.**

TREATMENT (Kg N/ha)	PLANT HEIGHT (cm)	% Increase Over Zero	LEAF NUMBER	% Increase Over Zero
00	79.2	-	14	-
30	94.6	19	19	36
60	89.5	13	21	50
120	77.5	-2	21	50
LSD (5%) =	6.1		3	
CV(%) =	4.7		8.9	

TABLE 5.4 **Average dry matter tops for sesame 40 days after sowing**

TREATMENT Kg N/ha	DRY MATTER TOPS (g)	% Increase Over Zero
00	3.4	-
30	8.5	150
60	10.0	194
120	10.6	212
LSD (5%) =	1.0	
CV(%) =	8.1	

TABLE 5.5 Nitrogen uptake and % nitrogen for sesame at 40days after sowing.

TREATMENT (Kg N/ha)	LEAF AT NODE 9	8 (mg/leaf)	7	REMAINING PLANT MATERIAL (mg/plant material)
00	0.4 (2.3)[1]	1.8 (2.0)	3.5 (1.9)	25.6 (0.8)
30	4.8 (2.3)	8.8 (2.1)	12.1 (1.9)	63.7 (0.9)
60	9.1 (3.1)	17.5 (3.0)	23.3 (2.9)	125.6 (1.5)
120	13.9 (4.1)	27.9 (3.9)	40.8 (4.1)	216.6 (2.5)
LSD (5%) =	1.1	4.1	3.5	28.0
CV (%) =	10.4	20.8	12.9	19.0

1. ( ) = % N content

TABLE 5.6 Phosphorus uptake for sesame at 40 days after sowing.

TREATMENT (Kg N/ha)	LEAFATNODE 9	8 (mg/leaf)	7	REMAINING PLANT MATERIAL (mg/plant material)	Total
00	0.07	0.30	0.59	12.33	13.29
30	0.65	1.27	1.95	18.96	22.83
60	1.02	3.05	3.05	22.41	29.53
120	1.29	2.72	3.81	22.02	29.82
LSD (5%) =	0.12	0.33	0.46	3.48	
CV (%) =	10.30	14.10	13.00	12.10	

TABLE 5.7 Sulphur uptake for sesame at 40 days after sowing.

TREATMENT (Kg N/ha)	LEAF AT NODE 9	8 (mg/leaf)	7	REMAINING PLANT MATERIAL (mg/plant material)	Total
00	0.5	0.2	0.2	9.4	10.3
30	0.3	0.7	0.7	12.5	14.2
60	0.5	1.1	1.1	14.0	16.7
120	0.9	1.9	1.9	18.8	23.5
LSD (5%) =	0.10	0.31	0.31	2.1	
CV (%) =	13.80	12.90	19.00	10.70	

TABLE 5.8 Nutrient uptake for sesame biomass at 40 days after sowing.

TREATMENT (Kg N/ha)		Ca	Mg	K	Cu	Zn
		(mg/plant material)				
00		32.3	8.4	77.1	31.8	138.8
30		70.4	19.3	170.6	40.7	305.3
60		106.0	30.5	163.4	44.0	388.2
120		104.8	45.0	181.1	57.9	498.2
LSD (5%)	=	30.2	4.0	48.9	10.4	54.9
CV(%)	=	24.9	11.0	21.3	16.7	11.1

TABLE 5.9 Plant height and number of leaves for sesame at 60 days after sowing.

TREATMENT (Kg N/ha)			PLANT HEIGHT (cm)	% Increase Over Zero	NUMBER OFLEAVES	% Increase Over Zero
00	00		109.1	-	25	-
30	00		128.8	18	32	28
30	30		141.6	30	39	56
60	00		130.9	20	39	56
60	30		126.9	16	41	64
120	00		115.6	6	42	68
LSD (5%)		=	8.4		4	
CV (%)		=	3.5		8.4	

TABLE 5.10 Sesame dry matter tops at 60 days after sowing.

TREATMENT (Kg N/ha)			DRY MATTER TOPS (g)	% Increase Over Zero
00	00		5.9	-
30	00		13.5	129
30	30		17.5	197
60	00		19.8	236
60	30		22.5	281
120	00		24.3	311
LSD (5%)		=	1.8	
CV (%)		=	7.1	

TABLE 5.11 Sesame plant height, number of leaves and capsule number at 81 days after sowing.

TREATMENT			PLANT HEIGHT (cm)	% Increase over zero	LEAF NO.	CAPSULE NO.	% Increase over zero
00	00	00	111.6	-	9	6	-
30	00	00	125.5	12	5	20	233
30	30	00	137.6	23	8	31	417
30	00	30	124.4	11	8	16	167
60	00	00	120.9	8	6	29	383
60	30	00	126.6	13	7	47	683
60	00	30	126.3	13	6	35	483
120	00	00	109.9	-2	4	52	767
LSD (5%) =			2.9		3	8	
CV (%) =			6.4		26.9	17.7	

TABLE 5.12 Dry matter tops for sesame at 81 DAS.

TREATMENT Kg N/ha			DRY MATTER TOPS (g)
00	00	00	5.2
30	00	00	11.0
30	30	00	14.9
30	00	30	12.7
60	00	00	15.1
60	30	00	19.0
60	00	30	18.5
120	00	00	20.8
LSD (5 %) =			2.1
CV (%) =			9.6

TABLE 5.13 Regression analysis for sesame capsule number, dry matter tops versus percentage nitrogen in leaves at node 9, node 8 and node 7 at 40 DAS.

Y - Variate Percentage nitrogen in leaf at node	Equation for dry matter tops (g)	Percentage variance accounted for
9	y = 0.1144 x + 1.457	85.3
8	y = 0.1214 x + 1.135	74.5
7	y = 0.1453 x + 0.818	82.4
Leaf at node	Equation for Capsule Number	
9	y = 0.03964 x + 1.882	88.1
8	y = 0.04253 x + 1.573	78.9
7	y = 0.05006 x + 1.364	84.1

6 EFFECT OF PHOSPHORUS APPLICATION ON NUTRIENT UPTAKE OF SESAME

ABSTRACT

The effect of different rates of phosphorus on Yori 77 sesame growth and phosphorus uptake was studied in an pot experiment with virgin Fenton clay loam and virgin Venn sandy clay loam.

There was a significant response in sesame plant height at 40 DAS to an initial application of 15kg/ha phosphorus. Sesame biomass increased for applications up to 30kg/ha phosphorus on the virgin Venn sandy clay loam compared to 15kg/ha phosphorus on the virgin Fenton clay loam.

INTRODUCTION

The majority of the soils in the Northern Territory are low in phosphorus. Studies by Day (1977) showed under good rainfall conditions optimum phosphorus application was 45kg/ha on virgin Fenton clay loam for sorghum. In later studies (Day at al 1982) has listed responses based on the amount of P required to produce 90% of the estimated maximum S. hamata dry matter as 15kg/ha for Venn and 35kg/ha for the Katherine Fenton. In earlier studies Arndt and Phillips (1961) indicated responses up to 35kg/ha phosphorus with peanuts, sorghum an cotton on virgin Fenton clay loam at Katherine. Garside and Buchanan (1981) found a response to 80kg/ha phosphorus for soybean or virgin Fenton at Douglas Daly district. Generally a wide range of responses have been recorded depending on the crop and soil type.

Sesame is a developing crop in the Northern Territory. Current recommendations are based to rates of phosphorus application developed for sesame grown at Kununurra (W.A.) on Cununurra clays and Cockatoo sands, i.e. 20kg P/ha. This recommendation requires confirmation for the Northern Territory. Hence a pot experiment was established to evaluate the effect of various rates of phosphorus on sesame biomass and phosphorus uptake on virgin Venn and Fenton. Further field experiments are required to confirm these results.

MATERIALS AND METHOD

The soil types used in the experiment were virgin Venn (sandy clay loam) and virgin Fenton (clay loam) was collected (0-15cm) from the area known as the Venn Irrigation Area at DDRF, and Low Phosphorus Area at CSIRO, Katherine, respectively. (Table 6.1).

Experimental design was a split plot with soil type as main plot - Fenton and Venn, and level of phosphorus application as sub plot equivalent to 0, 15, 30 and 60 kg P/ha. There was 4 replications.

Nitrogen and phosphorus was applied as urea and triple-superphosphate powder respectively. Basal fertiliser application was equivalent to 2kg Zn/ha, 2kg Cu/ha, 30kg S/ha, 73kg K/ha and 60kg N/ha. All chemicals were mixed prior to planting with 10kg of sieved soil and placed in 25cm diameter pots.

The experiment was sown on November 24, 1988 in the greenhouse at Katherine Rural College. Ten seeds were sown in each pot. Seven days after sowing plants were thinned to 3 plants/pot. Pots were watered each day with rain water to maintain soil moisture status at field capacity.

Recordings and Data Collection

Plant height was recorded at 40 DAS, and plants were harvested and dried at 60--C for 48 hours. Dry weights were recorded for leaf material at node 9, node 8 and node 7 plus remaining plant sample. Samples were milled to pass a 0.5mm screen for plant nutrient analyses.

Soil samples were taken to determine residual phosphate.

RESULTS AND DISCUSSION

Plant Height

There was a significant response to only the first 15kg P/ha for both soil types (Table 6.2) Sesame plants at the zero treatment were significantly taller on Fenton soil than their counterparts on Venn soil. This was due to higher initial soil phosphorus fertility (Table 5.1). At all other phosphate levels sesame was taller on the Venn soil type (Table 6.2).

Available soil phosphorus at 40 DAS

There was no significant difference between soil types in available phosphorus levels at 40 DAS (Table 6.3). Phosphorus levels increased from an average of 3.1 ppm for the zero treatment to 13.5 ppm for an application of phosphorus equivalent to 60kg P/ha.

Biomass

Sesame biomass significantly increased up to 30kg P/ha applied to Venn soil, whereas the response on the Fenton soil was to 15kg P/ha (Table 6.4 and appendix). There was no increase in sesame biomass to higher levels of phosphorous application.

This is the reverse of the results Day et al (1982) obtained for S.hamata.

Phosphorus uptake

Leaves at node 9, node 8

There was a significant increase in phosphorus uptake with increasing phosphorus application (Table 6.5). There was no difference in phosphorus uptake between soil types.

Leaf at node 7

There was no significant differences statistically (Table 6.5) between soil type or fertiliser application for phosphorus in sesame leaves at node 7. The lack of significance was due to a high degree of variability between the measurements recorded.

Nutrient uptake, plant dry matter tops.

Generally there was a response in nutrient uptake to the first 15kg P/ha applied (Table 6.6).

Regression analysis

Results of regression analysis between percentage phosphorus in leaf material at node 9, node 8 and node 7 versus available soil phosphorus or sesame dry matter tops are presented in Table 5.7.

In all cases linear regression was not suitable in describing response to application of phosphorus fertiliser.

TABLE 6.1: Soil analysis, 0-15cm.

	Fenton, Katherine	Venn, Douglas Daly
pH	6.6	6.6
Cond. (ms/cm)	0.04	0.02
Avail. P (ppm)	5.3	0.6
Avail. K (ppm)	205.0	73.0
Avail. Ca (ppm)	825.0	475.0
Avail. Mg (ppm)	150.0	55.0
Avail. S (ppm)	2.7	6.5
Avail. Cu (ppm)	1.1	0.2
Avail. Zn (ppm)	1.5	0.2
Avail. Fe (ppm)	4.8	3.8
Total nitrogen (%)	0.04	0.08

TABLE 6.2: Average plant height (cm) for sesame at 40 days after sowing.

	Phosphorus fertiliser applied (kg P/ha)			
	0	15	30	60
Soil				
Venn	36.8	71.8	71.4	71.2
Fenton	54.9	62.0	65.9	64.0

LSD (5%) = 4.5(same soil type)
4.1(between soil types)

CV (%) = 4.8

TABLE 6.3: Available soil phosphorus (ppm) at 40 days after sowing.

		Phosphorus fertiliser applied (kg P/ha)			
		0	15	30	60
Soil					
Venn		2.0	3.7	9.4	13.0
Fenton		4.2	6.1	8.8	14.0
LSD (5%)	=	3.9		(same soil type)	
		3.7		(between soil types)	
CV (%)	=	34.0			

TABLE 6.4 **Sesame biomass (g) at 40 days after sowing.**

		Phosphorus fertiliser applied (kg P/ha)			
		0	15	30	60
Soil					
Venn		0.6	4.4	5.7	5.9
Fenton		2.2	4.5	4.7	5.4
LSD (5%)	=	1.0		(same soil type)	
		1.0		(between soil types)	
CV (%)	=	16.7			

TABLE 6.5 Phosphorus content (mg/plant) for sesame at 40 days after sowing.

	Leaf at node						Remaining Plant Material	
	9		8		7			
Fertiliser applied kg/ha	B	F	B	F	B	F	B	F
0	*	*	*	1.4	*	2.3	2.4	12.3
15	0.4	0.5	1.2	1.7	2.2	3.6	23.2	30.0
30	0.8	0.9	2.1	2.3	11.8	2.9	31.5	31.6
60	1.7	1.4	3.9	3.1	10.9	8.8	45.9	37.2
LSD(5%)								
between soil types =		0.7		0.8		NS		5.3
same soil types		0.5		0.9		NS		5.1
CV (%) =		36.5		26.3		112.3		12.8

B = Venn F= Fenton

* no plant material.

TABLE 6.6 (i) Nutrient content (g/plant) for sesame at 40 days after sowing.

Phosphorus applied (kg/ha)	N B	N F	Ca B	Ca F	Mg B	Mg F	K B	K F	S B	S F
0	0.2	0.3	*	0.1	*	*	0.1	0.3	*	*
15	0.3	0.5	0.2	0.2	*	0.1	0.4	0.6	*	*
30	0.3	0.4	0.2	0.1	0.1	0.1	0.5	0.8	*	*
60	0.3	0.4	0.2	0.2	0.1	0.1	0.5	0.8	*	*

* Less than 0.0 grams

B = Venn F = Fenton

TABLE 6.6 (ii) **Nutrient uptake (mg/plant) for sesame at 40 days after sowing.**

Phosphorus applied (kg/ha)	Cu		Zn	
	F	B	F	B
0	*	0.14	0.54	0.35
15	0.10	0.19	0.90	0.71
30	0.11	0.19	0.94	0.86
60	0.06	0.16	0.95	0.63

B = Venn F= Fenton

TABLE 6.7 **Regression analysis for sesame plant biomass, available soil phosphorus versus percentage phosphorus in leaves at node 9, node 8 and node 7 at 40 DAS**

Y-Variate Percentage Phosphorus in leaf at node	Equation sesame biomass (g)	Percentage variance accounted for
9	y =-0.0105 x + 0.403	1.1
8	y = 0.0016 x + 0.323	-
7	y = 0.0104 x + 0.266	-

Leaf at node	Equation for available soil phosphorus	Percentage variance accounted for
9	y = 0.00318 x + 0.319	10.9
8	y = 0.00492 x + 0.284	21.3
7	y = 0.00543 x + 0.268	17.5

APPENDIX Sesame biomass for 3 plants at 40 days after sowing for Venn soil type.

	Phosphorus fertiliser applied (kg P/ha)			
	0	15	30	60
Weight of leaf				
at node 9	0.0	0.2	0.3	0.4
at node 8	0.0	0.5	0.8	0.9
at node 7	0.0	0.9	1.4	1.5
Weight of remaining plant material	1.7 1.7	11.7 13.8	14.6 17.1	14.8 17.6

2. **Sesame biomass for 3 plants at 40 days after sowing for Fenton soil type.**

	Phosphorus fertiliser applied (kg P/ha)			
	0	15	30	60
Weight of leaf				
at node 9	0.0	0.2	0.2	0.4
at node 8	0.3	0.5	0.6	0.8
at node 7	0.4	1.1	0.8	2.2
Weight of remaining plant material	5.9 6.6	11.8 13.6	12.3 13.9	12.8 16.2

7. EFFECT OF HERBICIDE CONTROL OF PIGWEED AND SUMMER GRASS ON SEED YIELD OF SESAME

ABSTRACT

Chemical weed control in sesame has been re-investigated due to the withdrawal of alachlor from the market.

The sesame cultivar, Yori 77, was established on a Fenton clay loam at CSIRO, Katherine in the 1988/89 wet season. Herbicides used to control pigweed and summergrass in this experiment included trifluralin, metolachlor, alachlor (new experimental formulation), pendimethalin, fluazifop, sethoxydim, pyridate and Agil.

Pendimethalin (0.33 kg a.i./ha) and metalachlor (0.72 kg a.i./ha) proved to be the most effective herbicide for pigweed and total weed control. Fluazifop (0.212 kg a.i./ha) and Agil (1 L/ha) were the most effective against grass weeds.

No herbicide was effective in translating weed control into an significant seed yield increase.

INTRODUCTION

Chemical weed control in sesame has been studied in Queensland and Western Australia. Alachlor applied post-planting pre- emergence was the most acceptable herbicide (Schrodter et al, 1984). However, alachlor was withdrawn from the market. Trifluralin, sethoxydim and pendimethalin also showed benefits when compared with alachlor in control of summer grass (Brachiaria sp. and Digitaris ciliaris) and/or pigweed (Trianthema protulacastrum) Eagleton (1986).

Herbicides used in this included trifluralin, metolachlor, alachlor (new formulation), pendimethalin, fluazifop, sethoxydin, pyridate and Agil. The treatments also included weed and weed free controls.

MATERIALS AND METHODS

Design, treatments and management

Experimental design was a randomised complete block with 3 replications.

Treatments and levels of application are indicated in Table 7.1.

The reason for the 20 week hand weeding treatment is that it provides an environment where sesame is not competing with any weeds for moisture and light throughout the life of the crop.

Sesame, cv Yori 77 was planted on 11 January, 1989, at 300,000 plants/ha. All plots were 7 rows x 3.5 m long, and row spacing was 30 cm.

Supplementary irrigation was applied 1, 3, 7 and 8 days after sowing (DAS), each of approximately 15 mm, to ensure establishment.

Recording and data collection

At 42 DAS, sesame, pigweed, grass and other weed dry matter production was determined from the centre 3 rows x 1.2 m for sesame and the 4 inter-row spaces for weed biomass.

Within a week after physiological maturity, harvest population and seed weight were measured by sampling the centre 5 rows x 1.0m. Plots were hand harvested.

RESULTS

Effect of herbicides at 42 DAS on.:

Sesame Biomass

There was no significant reduction in sesame dry matter production at 42 DAS However sesame plants in plots sprayed with pyridate (0.64 kg a.i./ha) appeared to be recovering from phytotoxic affects of the chemical. Average sesame biomass was 1534kg/ha.

Grass Biomass

There was no significant effect of herbicide on grass dry matter production. However fluazifop (0.212 kg a.i./ha) and Agil% 1L/ha tended to be the most successful in suppressing grass weeds. Metolachlor (0.72 kg a.i./ha) and Alachlor (1.00 kg a.i./ha) were also effective in reducing summer grass biomass levels (Table 7.3).

Pigweed Biomass

There was no significant effect of herbicides on pigweed development. However metolachlor (0.72 kg a.i./ha) and pendimethalin (0.33 kg a.i./ha) were successful in reducing pigweed dry matter levels (Table 7.4).

Total weed biomass

Again, there was no significance difference in herbicide effects on total weed biomass (Table 7.5). Trends indicated that pendimethalin (0.33kg a.i./ha) suppressed weed development with Metolachlor (0.72kg a.i./ha) and pyridate (0.64kg a.i./ha) being the next most effective in suppressing weed development.

Plant population

Herbicides did not effect sesame populations, though sesame plant stands in plots sprayed with pendimethalin (0.33kg a.i./ha) and pyridate (0.64kg a.i./ha) tended to be lower. (Table 7.6). Average sesame population at harvest was at 214,000 plants/ha.

Seed yield

There was no significant increase in seed yield for controlling weeds in sesame (Table 7.7). However all treatments [except for the pyridate (0.64kg a.i./ha)] produced higher seed yields than no weed control, but lower seed yields than complete weed control.

DISCUSSION

No significant herbicide effects were identified, though the following trends or points were recognised.

Firstly, pyridate (0.64kg a.i./ha) is not suitable for weed control in sesame, because applications greater than 0.64kg a.i./ha cause a phytotoxic reaction from sesame, suppressing both growth and seed yield.

Pendimethalin (0.33kg a.i./ha) and metolachlor (0.72 a.i./ha) were the most effective chemicals in controlling weed development. However this did not translate into improved sesame seed yield.

It is to be noted that a significant difference in seed yield would have occurred if plots had been machine harvested. The presence of weeds reduces the throughput of harvester hence exacerbating shattering losses; however, these problems are not measured in hand harvesting sesame.

TABLE 7.1: Treatments and levels of herbicide application.

TREATMENT	REGISTERED NAME	LEVEL OF APPLICATION (kg a.i./ha)
Pendimethalin(i)	Stomp	0.33
Metolachlor (ii)	Dual	0.72
Trifluralin (i)	Treflan	0.40
Alachlor (i)	Lasso	1.00
Fluazifop (iii)	Fusilade	0.212
Sethoxydin (iii)	Sertin	0.18
Pyridate (iii)	Lentagran	0.64
N.R. (iii)	Agil	1L/ha
No herbicide		-
Hand weeding		20 weeks

(i) Pre-plant incorporated
(ii) Post-plant incorporated
(iii) 2 weeks post plant
N.R.= Active ingredient not released by Bayer.

TABLE 7.2 Effect of herbicide on sesame dry matter production at 42 days after sowing.

Treatment		Sesame biomass (kg/ha)
Trifluralin	0.40kg a.i./ha	1847
Metolachlor	0.72kg a.i./ha	1729
Pendimethalin	0.33kg a.i./ha	1221
Alachlor	1.00kg a.i./ha	1680
Fluazifop	0.212kg a.i./ha	1694
Sethoxydin	0.187kg a.i./ha	1580
Pyridate	0.64kg a.i./ha	752
Agil	1L/ha	1978
No herbicide	-	1430
Hand weeding	20 weeks	1535
Average		1534
Level of significance		N.S.

TABLE 7.3 Effect of herbicide on grass dry matter production at 42 days after sowing.

Treatment		Grass biomass (kg/ha)
Trifluralin	0.40kg a.i./ha	27.3
Metolachlor	0.72kg a.i./ha	4.2
Pendimethalin	0.33kg a.i./ha	19.7
Alachlor	1.00kg a.i./ha	1.4
Fluazifop	0.212kg a.i./ha	0
Sethoxydin	0.187kg a.i./ha	6.5
Pyridate	0.64kg a.i./ha	17.6
Agil	1L/ha	0
No herbicide	-	19.3
Hand weeding	20 weeks	0
Level of significance		N.S.

TABLE 7.4 **Effect of herbicide on pigweed dry matter production at 42 days after sowing.**

Treatment		Pigweed biomass (kg/ha)
Trifluralin	0.40 kg a.i./ha	289
Metolachlor	0.72 kg a.i./ha	81
Pendimethalin	0.33 kg a.i./ha	19
Alachlor	1.00 kg a.i./ha	432
Fluazitop	0.212 kg a.i./ha	379
Sethoxydin	0.187 kg a.i./ha	287
Pyridate	0. 64 kg a.i./ha	142
Agil	1L/ha	198
No herbicide	-	383
Hand weeding	20 weeks	0
Level of significance		N.S.

TABLE 7.5 **Effect of herbicide on total weed dry matter production at 42 days after sowing.**

Treatment		Total weed biomass (kg/ha)
Trifluralin	0.40 kg a.i./ha	384
Metolachlor	0.72 kg a.i./ha	155
Pendimethalin	0.33 kg a.i./ha	97
Alachlor	1.00 kg a.i./ha	478
Fluazifup	0.212 kg a.i./ha	481
Sethoxydin	0.187 kg a.i./ha	392
Pyridate	0.64 kg a.i./ha	185
Agil	1L/ha	269
No herbicide	-	447
Hand weeding	20 weeks	0
Level of significance		N.S.

TABLE 7.6 Effect of herbicide on sesame plant population.

Treatment		Plant Population (x1000)
Trifluralin	0.40 kg a.i./ha	219
Metolachlor	0.72 kg a.i./ha	228
Pendimethalin	0.33 kg a.i./ha	179
Alachlor	1.00 kg a.i./ha	238
Fluazitop	0.212 kg a.i./ha	207
Sethoxydin	0.187 kg a.i./ha	219
Pyridate	0.64 kg a.i./ha	160
Agil	1L/ha	247
No herbicide	-	211
Hand weeding	20 weeks	244
Average		214
Level of significance		N.S.

TABLE 7.7 Effect of weed control of weed production on sesame seed yield.

Treatment		Seed Yield (kg/ha)
Trifluralin	0.4 kg a.i./ha	1044
Metolachlor	0.72 kg a.i./ha	946
Pendimethalin	0.33 kg a.i./ha	926
Alachlor	1.00 kg a.i./ha	1011
Fluazitop	0.212 kg a.i./ha	1015
Sethoxydin	0.187 kg a.i./ha	1030
Pyridate	0.64 kg a.i./ha	646
Agil	1L/ha	1030
No herbicide	-	886
Hand weeding	20 weeks	1064
Level of significance		N.S.

8. EFFECT OF MULCH COVER, PLANTING DEPTH AND SOIL COVER DEPTH (AND PRESSWHEELS) ON ESTABLISHMENT OF SESAME

ABSTRACT

Sesame cv Yori 77 was sown at four depths - 0, 15, 30 and 45 mm, covered or not covered with soil to the equivalent sowing depth, finally covered or not covered with sorghum mulch. Sesame establishment was evaluated for a Fenton clay loam on the 5th and 9th day after sowing. Soil contact with the seed and sowing depth were the major factors affecting establishment. Soil contact allowed adequate moisture imbibing to initiate germination while soil cover reduced soil temperatures and moisture losses to allow successful establishment. The most successful establishment of sesame seedlings occurred in slots 30 to 45 mm deep, covered with soil. The presence of mulch did not effect establishment.

INTRODUCTION

Sesame (<u>Sesame indicum</u>) is one of the few crops that offers the Northern Territory an edge on other agricultural areas in Australia. Whilst efforts have been made to grow this crop elsewhere, nowhere does it show as much potential as in the Northern Territory. However, as sesame is still historically and scientifically a third world crop. Very little effort has been made to increase its machine harvestable yield potential, and much research is needed to achieve this. Improving the crop's plant establishment and improving machine harvesting techniques for this crop are two challenges in the agricultural engineering area which will, if achieved, substantially increase harvested yield.

A study was initiated in November 1988 to evaluate the effects of planting depth, soil cover and mulch cover on sesame establishment. An investigation into the effect of seed firming presswheels was also initiated during this study.

MATERIALS AND METHODS

Experimental Conditions

Air temperature during the study ranged from a maximum of 40.9°C to a minimum of 23.2°C (TABLE 7.1).

Soil type was a Fenton clay loam which was irrigated prior to soil to simulate adequate sowing moisture to allow successful seedling emergence.

Design, Treatments and Management

Experimental design was a split/split plot with mulch cover as main plots, four planting depths - 0, 15, 30 and 45 mm as sub plots and soil cover as sub-sub plots. There was 3 replications. Sub-sub plots (slots) were 1 m in length. Forty sesame seeds were planted in each slot on 27 October, 1988. The seed was tested at 87% germination. The experimental site at CSIRO Katherine was irrigated in the evening of the 3rd and 5th day after sowing.

Recordings and Data Collection

Gravimetric soil moisture and soil temperatures were recorded at 2.00 pm each day. Soil moisture was recorded at depth of 0-15 mm, 15-30 mm and 30-45 mm. Temperatures were recorded at 0 (surface), 15, 30 and 45 mm.
Seedling emergence counts were taken 5 and 9 days after sowing. Sampling on the 9th day after sowing included determining number of non-emerge live seedlings.

RESULTS

Soil Temperature

Soil temperature instrumentation was unable to measure temperatures greater than 55°C. Bare soil surface temperatures were greater than 55°C, hence soil surface temperature measurements were discontinued after the 2nd day.

Sub-surface soil temperatures ranged from 52.0°C to 36.2°C for bare soil and 45.5°C to 32.°Cfor the mulch covered soil (Table 8.2).

The average reduction in soil temperatures, due to sorghum mulch cover, was 6°C. Soil temperatures decreased with depth though the difference between 15 mm and 45 mm depth was generally 2°C.

Irrigation 3 days after sowing reduced soil temperature by approximately 12°C. Soil temperature at all depths were the same, 33.5°C for the mulch cover treatment and 36.7°C for bare soil. This effect only lasts 24 hours, the differences between soil temperatures under mulch cover and bare soil were quickly eliminated.

Gravimetric Soil Moisture

Soil moisture ranged from 11.4% to 18.4% for the mulch covered soil, and 7.0% to 17.1% for the bare soil (Table 8.5).

The average difference in soil moisture due to sorghum mulch cover was 3.1%. Soil moisture increased with depth, the difference between 0-15mm and 30-45 mm for mulch cover and no mulch cover was 1.5% and 4.0% respectively.

Establishment Counts

DAY 5

Mulch cover did not significantly influence sesame establishment. However, sesame establishment was significantly higher for sowing depths of 30 and 45 mm filled with soil than any other treatment combination (Table 8.4).

DAY 9

Similar results to that of Day 5 after sowing. Mulch cover did not significantly influence sesame establishment. While sesame establishment was higher for sowing depths of 30 and 45 mm filled with soil (Table 8.5).

DAY 10

Emergence of alive sesame seedlings would have probably been completed by 10th day after sowing. There were approximately 2 alive seedling waiting to emerge in all treatments.

The influence of mulch cover on seedling establishment was not significant.

Seeds planted at 45 mm and covered with soil were the most successful in establishing sesame seedling (Table 8.6).

DISCUSSION

The influence of sorghum mulch cover on soil temperatures and soil moisture was to reduce soil temperatures and reduce soil moisture loss. These effects did not readily produce more successful sesame establishment.

Soil contact with the seed and sowing depth were the major factors affecting establishment. Soil contact allowed adequate moisture imbibing to initiate germination while soil cover reduced soil temperatures and moisture loses to allow successful establishment.

Sorghum mulch certainly reduced soil temperatures and moisture loss from surrounding soils, however, there was insufficient soil contact (soil moisture) to initiate germination.

TABLE 8.1: Maximum and minimum air temperature (°C) for Katherine

DAY AFTER SOWING	MAXIMUM	MINIMUM
0 (Nov. 27)	39.5	25.0
1	40.5	27.5
2	40.5	27.8
3	39.3	26.1
4	40.5	26.4
5	40.7	28.0
6	40.8	23.2
7	38.9	25.1
8	38.9	27.2
9	39.3	28.0
10	40.9	27.1
AVERAGE	40.0	26.5

TABLE 8.2: **Soil temperatures (°C) at various depths covered with sorghum mulch or no mulch.**

DAYS AFTER SOWING	MULCH COVER	DEPTH (mm)		
		15	30	45
0	Yes	37.8	36.7	34.5
	No	44.3	42.5	41.5
1	Yes	38.8	37.0	34.8
	No	48.3	45.3	44.0
2	Yes	39.9	39.4	39.0
	No	45.0	43.5	42.6
3	Yes	45.5	45.0	44.6
	No	52.0	48.9	46.0
(Irrigation)				
4	Yes	33.2	33.7	33.6
	No	36.4	37.0	36.8
5	Yes	38.6	37.2	35.0
	No	50.2	48.8	46.8
(Irrigation)				
6	Yes	32.3	32.8	32.9
	No	34.5	35.7	36.2

TABLE 8.3: Gravimetric soil moisture (%) at various depths under sorghum mulch or no mulch

DAYS AFTER SOWING	MULCH COVER	DEPTH (mm) 15	30	45
0	Yes	14.3	16.6	17.8
	No	12.9	16.6	17.1
1	Yes	14.8	16.1	16.4
	No	10.9	14.9	14.9
2	Yes	11.9	12.9	13.2
	No	7.5	10.2	10.9
3	Yes	11.4	12.3	13.2
	No	7.0	10.4	11.9
(Irrigation) 4	Yes	15.1	16.4	16.5
	No	9.2	12.4	13.2
5	Yes	15.1	16.4	16.5
	No	12.6	13.0	13.6
(Irrigation) 6	Yes	16.3	18.1	18.4
	No	10.8	14.8	15.8
7	Yes	16.0	17.2	16.3
	No	7.0	10.4	12.3

TABLE 8.4: Sesame establishment counts 5 days after sowing

	Mulch Cover		
	YES	NO	
Establishment count	4.6	3.7	

	Planting depth (mm)				
	0	15	30	45	LSD (5%)
Establishment Count	0.5	2.2	7.7	6.3	3.7

	Soil cover		
	YES	NO	LSD (5%)
Establishment count	6.9	1.4	4.1

TABLE 8.5: Sesame establishment counts 9 days after sowing

	Mulch cover		
	YES	NO	
Establishment count	12.3	10.1	N.S

	Planting depth (mm)				
	0	15	30	45	LSD (5%)
Establishment count	7.9	8.6	12.6	15.8	4.2

	Soil cover		
	YES	NO	LSD (5%)
Establishment count	15.3	7.1	4.0

TABLE 8.6: Sesame establishment counts 9 days after sowing including non-emerged alive seedlings

	Mulch cover				
	YES			NO	
Establishment count	13.8			12.6	N.S.

	Planting depth (mm)				
	0	15	30	45	LSD (5%)
Establishment count	9.4	10.6	14.1	18.8	3.9

	Soil cover		
	YES	NO	LSD (5%)
Establishment count	18.3	8.2	4.5

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