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TRAINING REPORT

ICRISAT 15 MAY TO 22 NOVEMBER 1985

MICROCLIMATOLOGICAL STUDIES IN PEARL MILLET (BK 560) GROUNDNUT (TMV2) INTERCROP

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I - INTRODUCTION

THE SEMI-ARID TROPICS are characterized by height climatic water demand, the mean temperature is 18°C and the rainfall exceeds the evapotranspiration from two to seven months annually.

In several Pegion of' the Semi-Arid Tropics the average annuel precipitation appears l-o be suffisant f o r one two goods crops years, but the rainfall are eratic. (Virmani)

Millet and Groundnut. two of the major crops wit.h ICRISAT deal must be adapted to such **climatic** region ; then it is **important** to find out from how two crops feet in S .A.T. condition .

1 OBJECTIFS :

To study growht and ressource used and microclimate of Pearl millet and Groundnut inter Crop.

2 MATARIALS AND METHODS :

Fie d experiment was conducted on red soil (Alfisol 1 ! RCW 12 B of ICRISAT Center, Pantancheru (India) .
Before start of the experiment the soil (0-30 cm) was analysed for physico chemical properties.

Soil Depht cm	pH	EC ($m_{mhos/cm}$)	Carganic bone %	Available phosphorus IN-PPm
0 - 15	7 - 75	0,20	0,80	6,0
15 - 30	7,45	0,15	0,50	5,5

Seeds Millet.. BK 560, Groundnut TMV2 (were obtained from the training program) .

Fertilizer Diammonium phosphate 100 kg/ha before planting for all the plots.
Beteween 3 to 4 weeks after emergence applaying 62 kg/N ha 1135 kg urée/ka).

3. EXPERIMENTAL DETAILS :

Randomized block design with3 replications and 3 traitemnts :

- T1 Sole Millet
- T2 Sole Groundnut
- T3 1 Millet/3 Groundnut inter crop.

4. CROSS AND NET PLOT SIZES WERE 10 M LENGHT 4,5M WIDE (3 Beds)

In the experiment we studie :

1) Rainfall
2) Soi.1 moisture
3) Leaf area measurement on the Crop
4) Dry matter Accumulation and partitionning
5) LEAF temperature
6) Light interception

7) Relative humidy
8) Soil temperature
9) Plant phenology
10) Yield.

II - RESULTS AND DISCUSSION

- Rainfall

Total rainfall this year (1 June to 30 october) is 477mm. 19 % below the total rain in 1984 (591.8mm).
In the month of june the cumulative rainfall WGS 88,6 mm, 4 % below june 84. July rainfall was about july 84. Rainfall. in August was only 46,2 mm 69 % below the same month in 1984. We receive during september 75,8 mm 24 % below, September 84 -- but rain in october was 93,0 mm 13 % above october 84.

This year Crops are suffering from water deficit mostly in the month of Rugust. The few rain in September have been very helpful for the survival of Crops (Fig. 1)

RAINFALL(mm) RECORDED IN METEOROLOGICAL OBSERVATORY AT ICRISAT

YEAR	JUNE	JULY	AUGUST	SEPTEIYBER	OCTOBER	TOTAL
1984	92.3	171.7	147.7	99.2	80.9	591.8
1985	88.6	173.4	"46.2	75.8	93.0	477

OPEN - PAN EVAPORATION

Open pan evaporation during this year was observed (1 June to 30 october) the lowest pan data was 4.7mm/day during october. The bigest pan evaporation data was 9.5 mm/day during june. During july, the open pan evaporation was 5.7 mm day. August 5.4 mm days , september 5.3 mm days. (Fig.2).

SOIL TEMPERATURE

Soil temperature was observed in 2 conditions 5 cm and 15 cm depht.
Recording data 2 times days 8 AM - 2 PM the higest average daily soil temperature were recorded during september :

5 cm depht 25.6°C at 8 AM, and 5 cm depht 33°C at 2 PM, during july. The lowest average daily soil temperature were recorded during august on 5 cm and 15cm at 8 AM, 24,6°C (Fig.3).

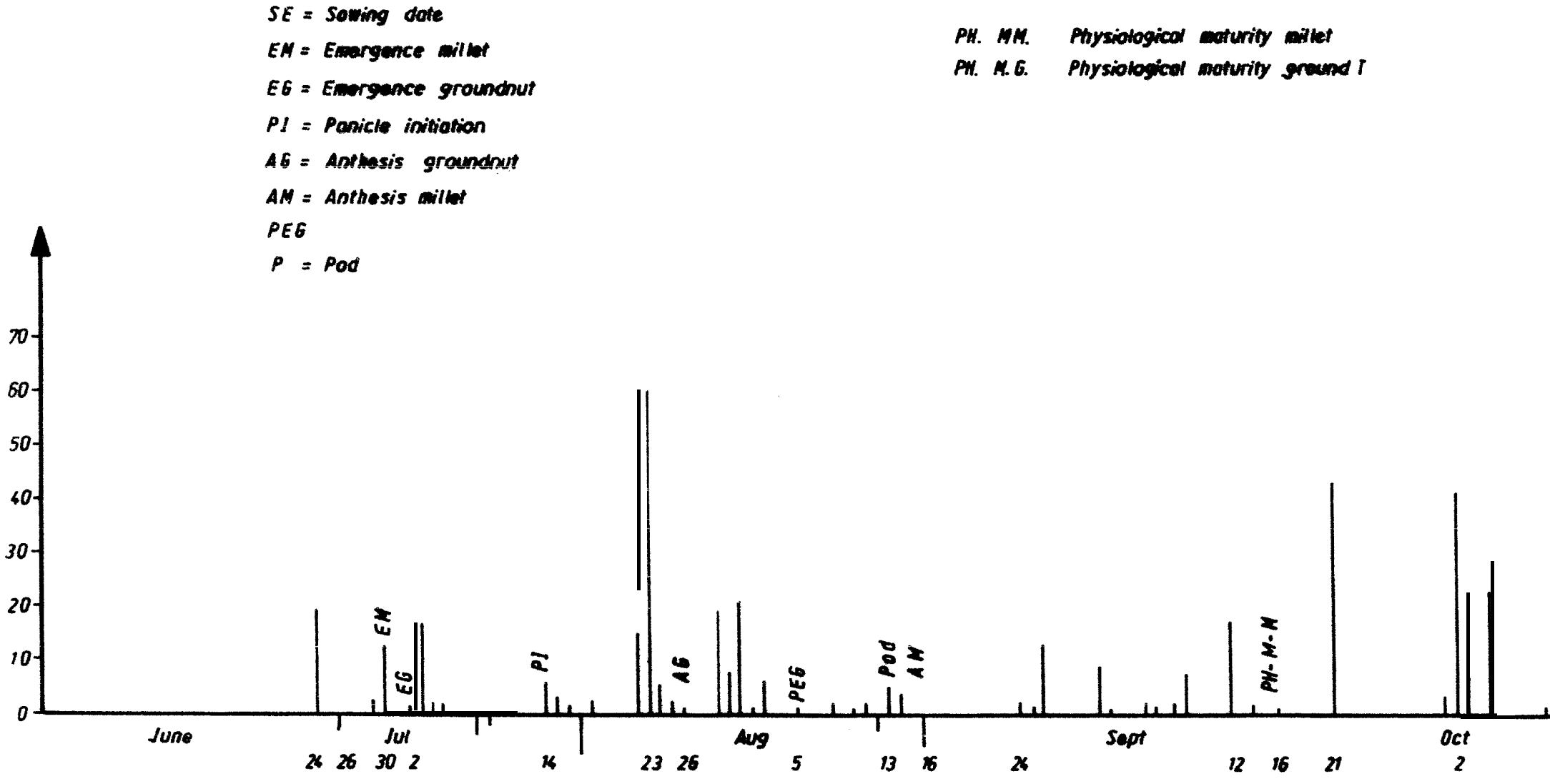

Fig 1 : Rain fall (mm) at ICRISAT Center
RCW 14 (1985)

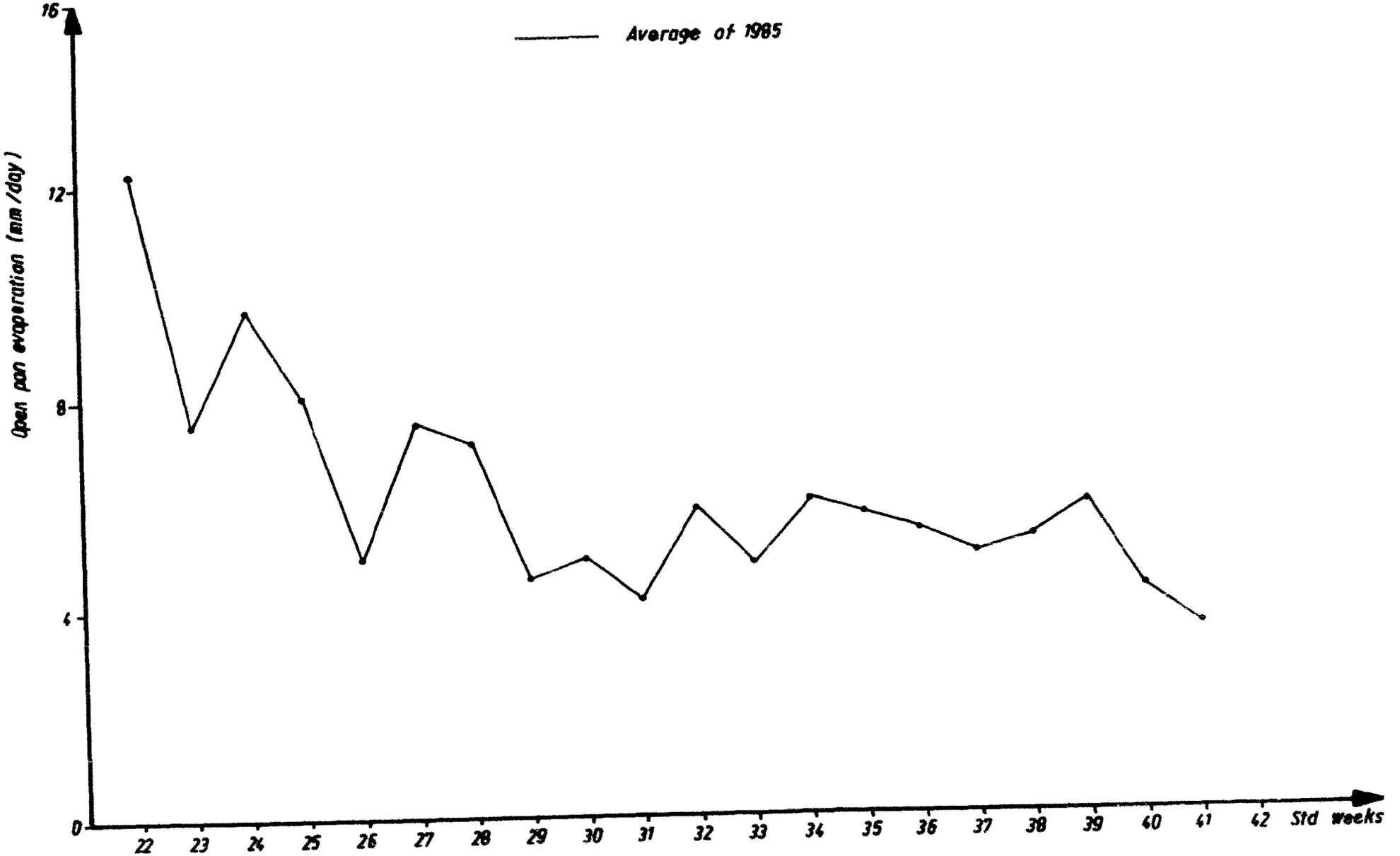

Fig 2 : Average weekly open pan evaporation at ICRISAT Center during the rainy season (1985)

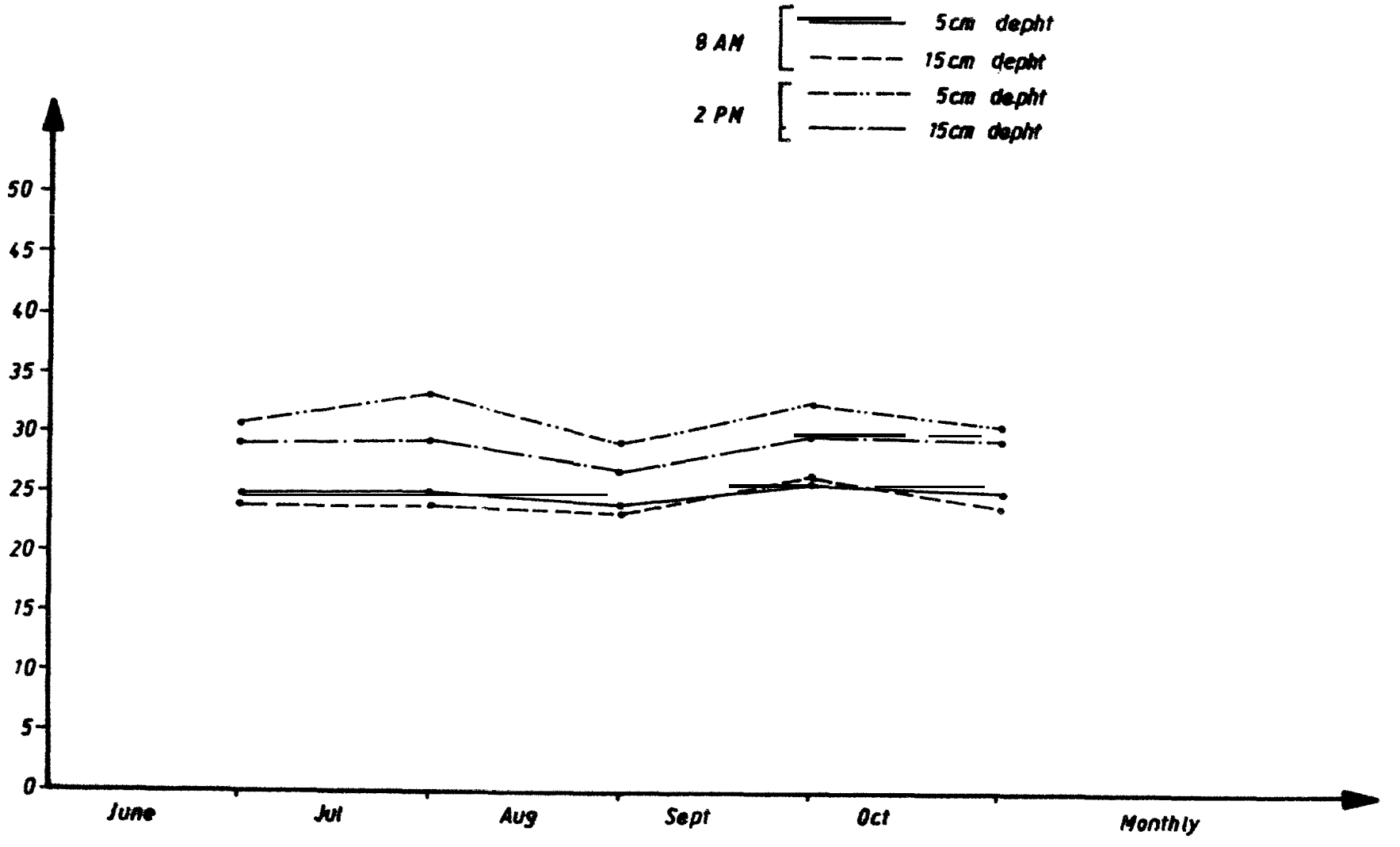

Fig 3 : Soil temperature in different depht
RCW 12 B (1985)

LIGHT INTERCEPTION

In millet light interception by sole millet was relatively higher than intercrop at the bigining, but at the end 64 ADE to 80 DEA. Light interception in sole millet was less than millet intercrop.

In Groundnut : Light interception by sole groundnut was the lowest at begining but at 69-DAE to 98-DAE light interception is higher than intercrop at the 69 - DAE to 98-DAE decrased. The difference in light interception beteween two treatements was due to effect of rows pearl millet (Fig.5).

RELATIVE HUMIDITY

Relative humidity of air recorded in millet sole and Groundnut at 13h 30 at RCW 12B was higher on sole Millet 47-DAE to 70-DAE. The higher relative humidity 64 % was recorded at the first observation 39-DAE on intercrop and also the Lowest RH recorded on the same treatement at 63-DAE 44.5 %.

On Groundnut RH recorded was higher in intercrop at 39-DAE, 63-DAE and 98-DEA.
Higher RH-64, 5 % was recorded at 39-DAE on groundnut intercrop and the lowest RH recorded at 69-DAE 44,5 % (Fig. 6,7)

I II - MICROCLIMATOLOGICAL STUDIES

We study water storage and EVAPO-transpiration in the combinaison - Millet/Groundnut intercrop,
Light interception by sole millet, sole groundnut and intercrop and related to total biomass production under differents conditions.

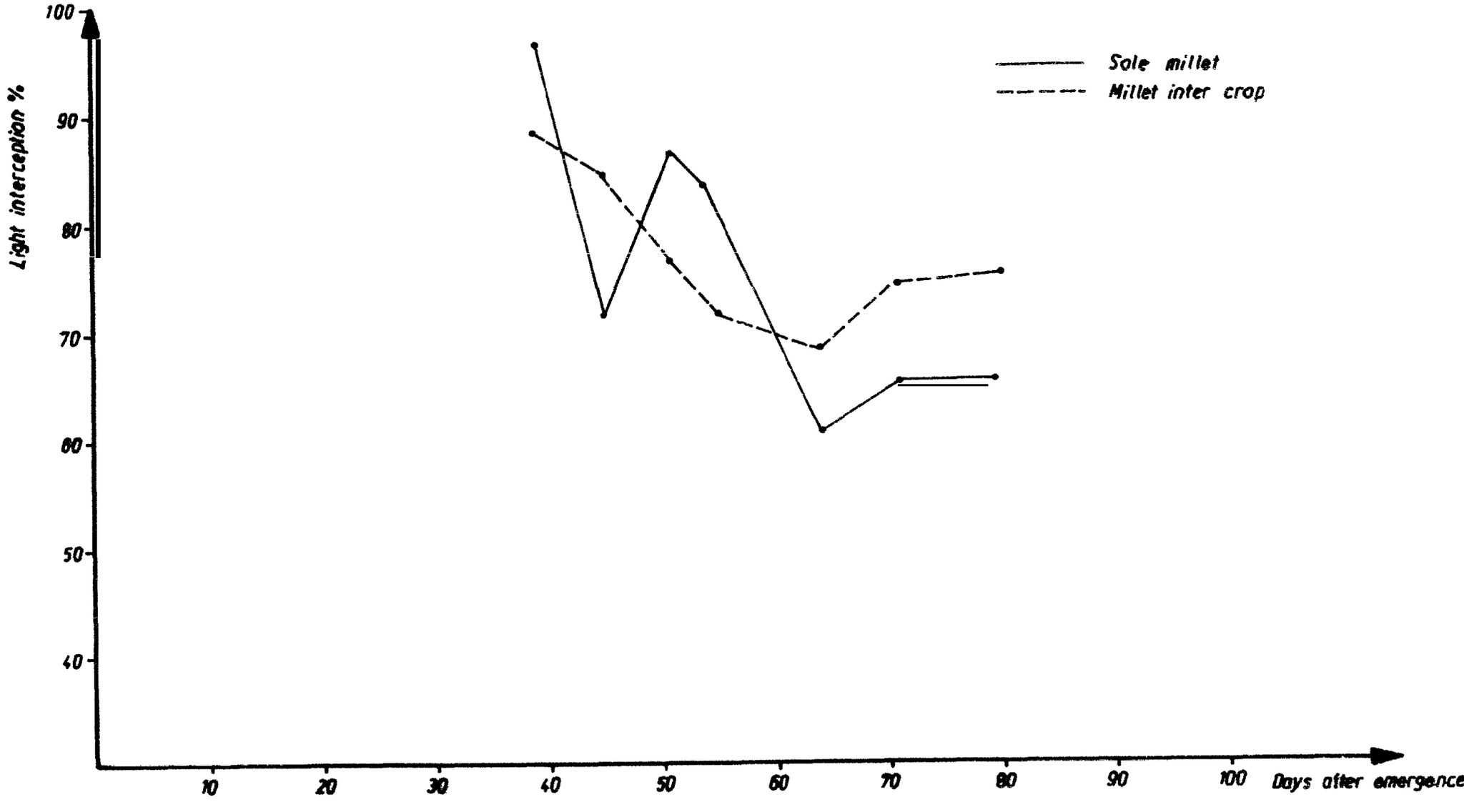

Fig 4: Measured light interception in millet sole and inter crops at 13°30 RCW 12 B (1985)

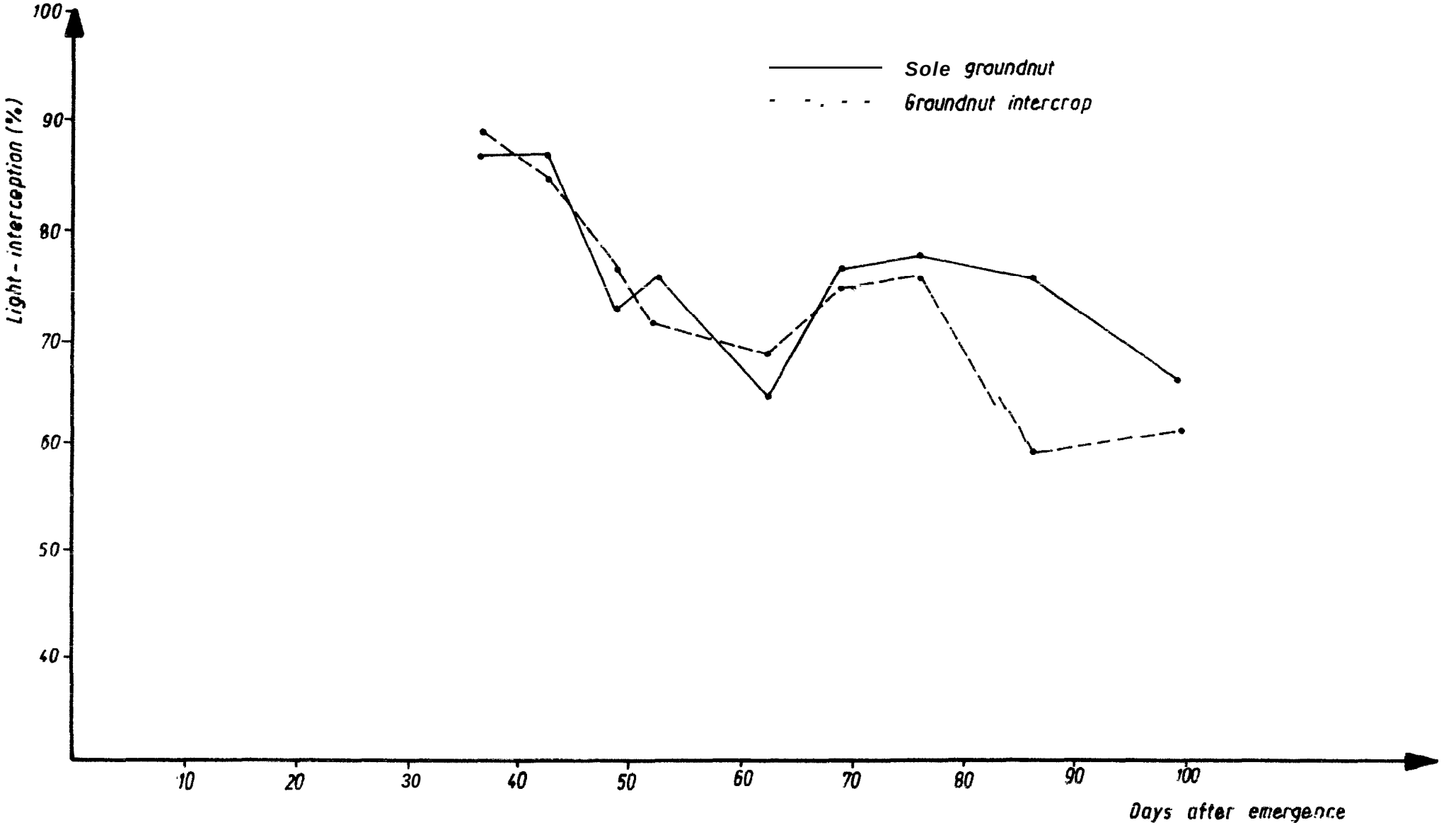

Fig. Measured light interception in groundnut sole and intercrop at 13h 30 (RCW 12 B 1985)

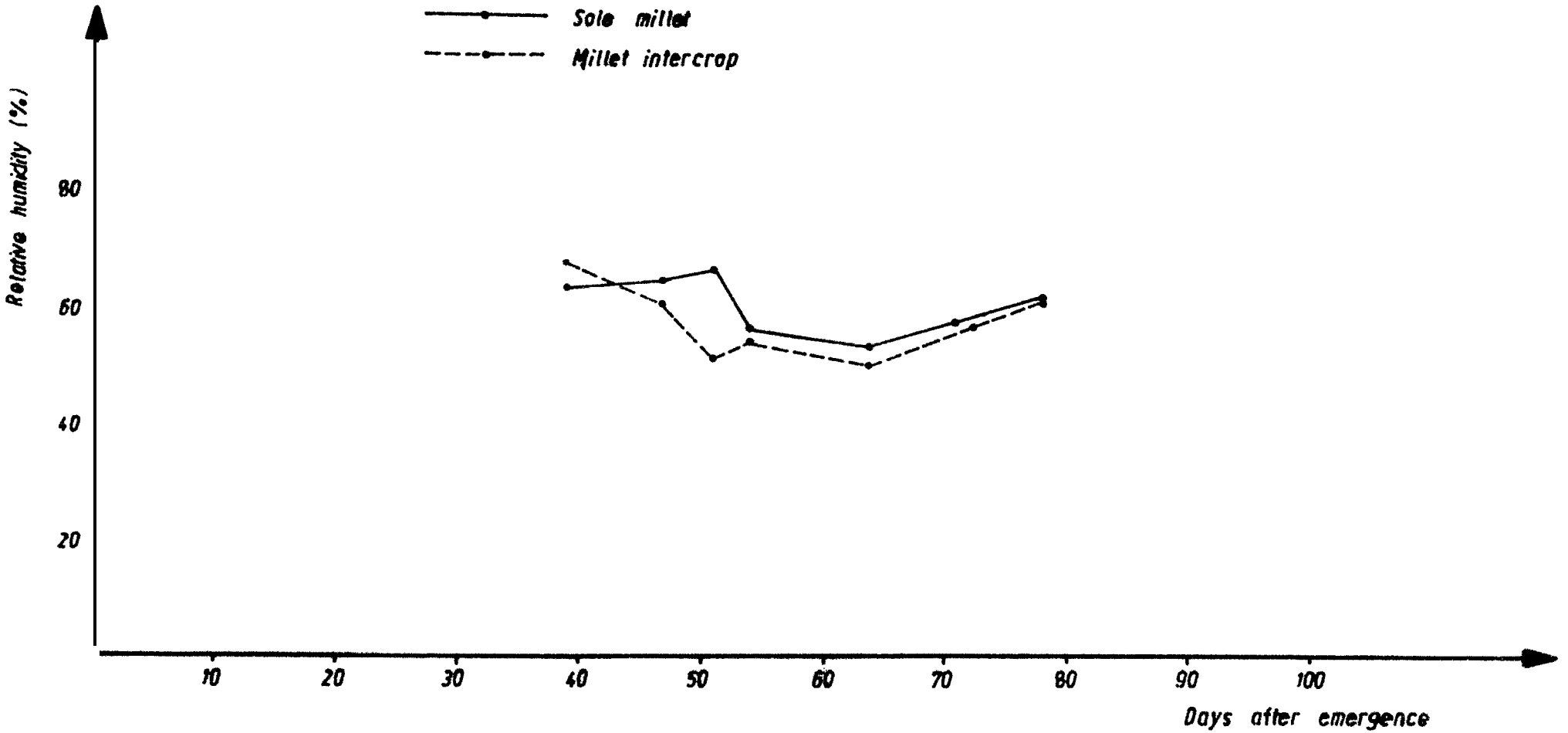

Fig. Relative humidity % (RCW 12 B) at 13h30 1985

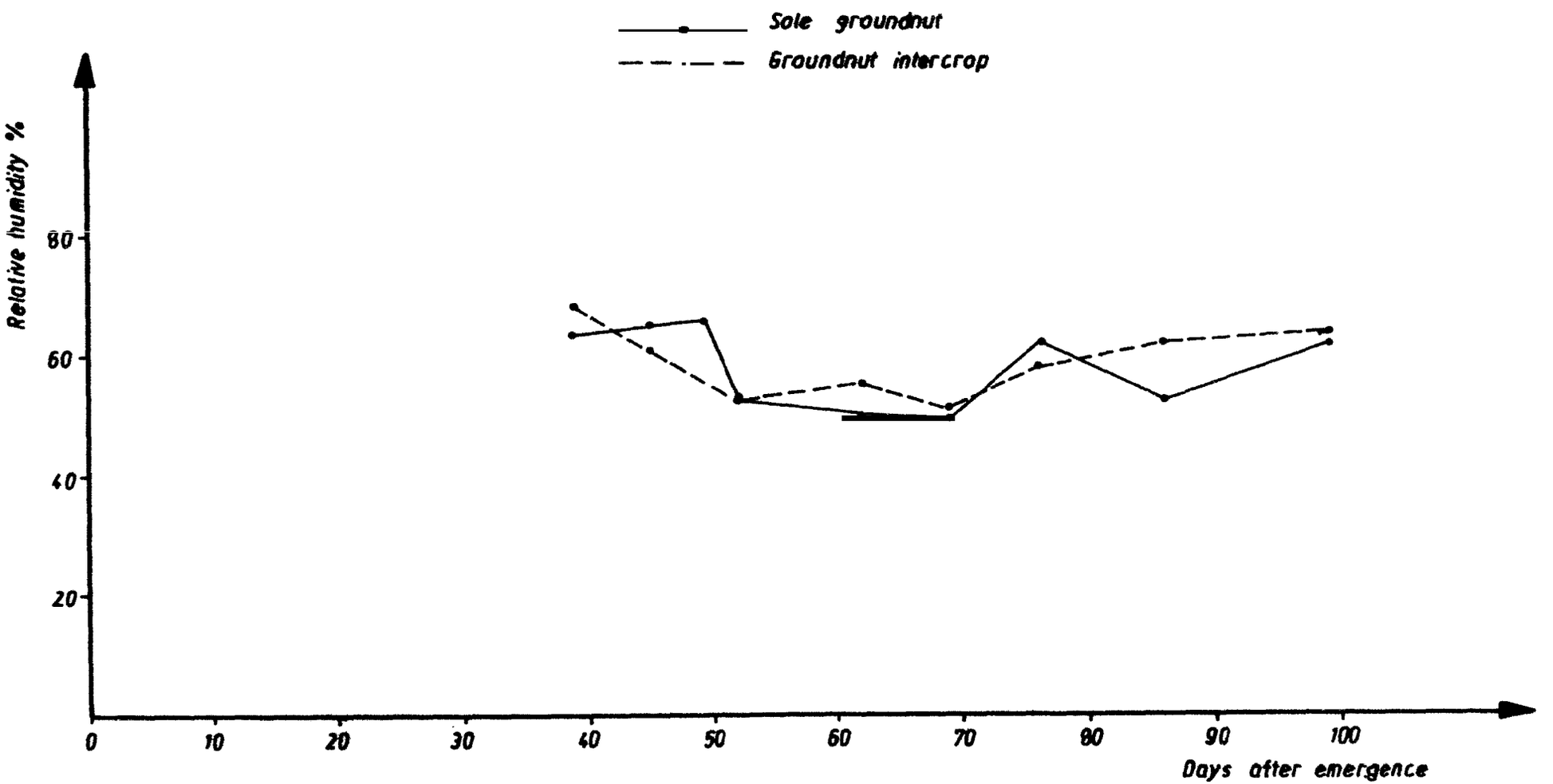

Fig. Relative humidity % in groundnut (RCW 12B 1985) at 13h 30

PEARL/MILLET MAIN PLANT PHENOLOGY DATA

Sowing date : 26.6.85

Emergency date : 30.6.85

Traitements	Panicle initiation	DAE	Anthesis	DAE	Physiological maturity	DAE:
Sole millet	14.7.85	14	10.8.85	41	10.9.85	72
Miller inter crop	14.7.85	14	11.8.85	42	10.9.85	72

TILLERS

Sowing date : 26.6.85

Emergency : 30.6.85

Traitements	Panicle initiation	DAE	Anthesis	DAE	physiological maturity	DAE
Sole millet	14.7.85	14	16.8.85	47	16.9.85	78
Millet inter crop	1.4.7.85	14	15.8.85	4 6	16.9.85	78

In the treatements, we found variations the tillers took one week more for overtake the stage than main plant.

GROUNDNUT

Date of sowing : 26.6.85

Date of emergency : 2.7.85

Traitements	Anthesis	DAE	Peg.	DAE	Physiolo. maturity	DAE
Sole groundnut	26.6.85	24	5.8.85	34	27.10.85	117
Inter crop	27.6.85	25	6.8.85	35	28.10.85	118

In millet Gnt one day more for overtake the stage than sole groundnut..

LEAF AREA INDEX (LAI) MILLET BK 560

Sole millet produced greater LAI than intercrop in both combinaison the Tillers produced more LAI than Main plant. The leaf area increased rapidity from 15-DEA 7045-DAEA.

In all the treatements peack value FOL leaf area were 1.2 , 4 , 3 , 6.0 r espectively for Main plant, Tillers , total Main and Tillers .

- For intercrop peack value of LAI were 0.7, 4.1, 4.8 respectively for main plant, Tillers, total. Main + Tillers contribution of Tillers at the begining was less 18 % at 30-DEA. The Tillers contribution incxease to 80 % at 45-DAE.

- For Groundnut sole crop proceded LAI greater: than intercrop. Leaf area increased more from 28-DAE to 42-DEA.
In all the treatements the peack value of LAI were 0.9 and 2.8 for intercrop - according to intercrop and sole Groundnut.
The leaf area index in sole Groundnut was 35.7 % more than intercrop. (Fig. 10).

DRY MATTER PARTITIONNING

a) Millet

Dry matter production and its partitioning to different plant parts was greater in sole Millet than millet intercrop. The difference total dry matter among treatement were important (Total dry matter sole 2460 g/m2) intercrop -- 920/m2.

b) Groündnut

13 DAE the dry matter produced by leaves was 20 g/m2 in both treatements 28 DAE. The dry matter production and its partitioning into different plant parts was greater in sole Groundnut than Groundnut intercrop. Total dry matter produced by leaves was 240g/m2 and Groundnut intercrop 140g/m2. The effect of intercrop is important.

The produced Groundnut this year is caused by the low rainfall and drought during poding and peging period.

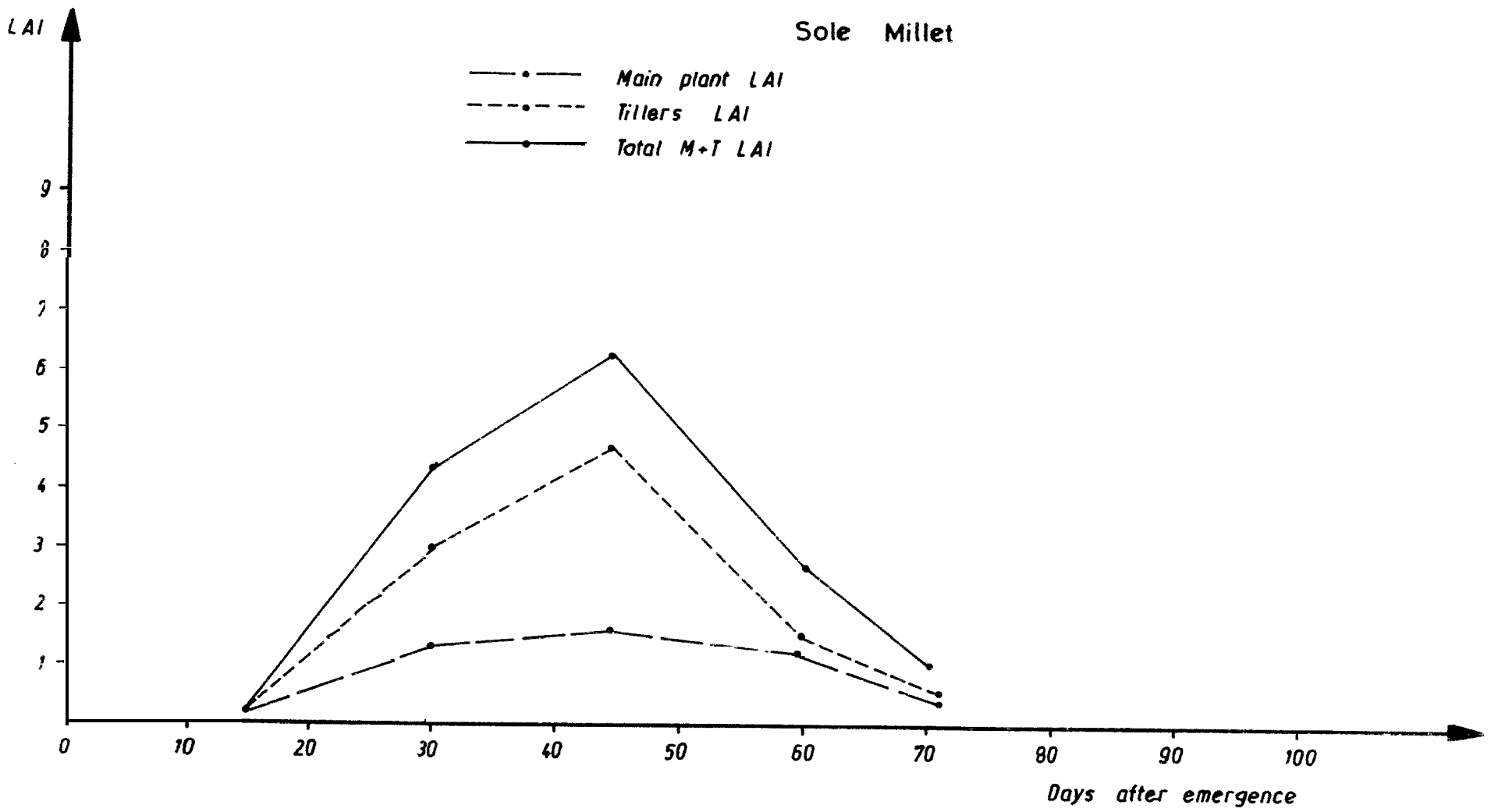

Fig. :Leaf area index (LAI) sole millet BK 560 (RCW 12 B 1985)

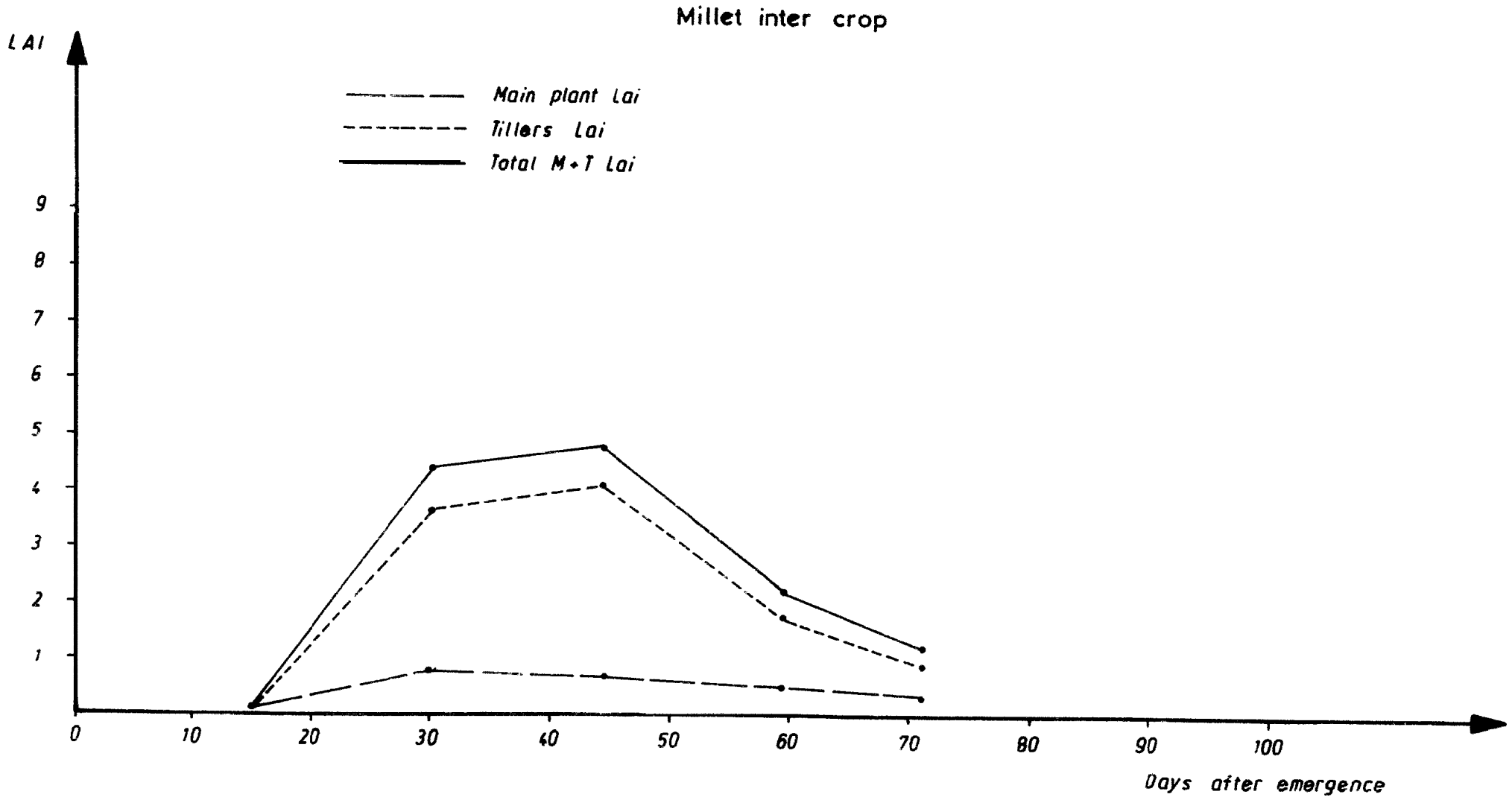

Fig. :Leaf area index millet inter crop BK 560 RCW 12B (1985)

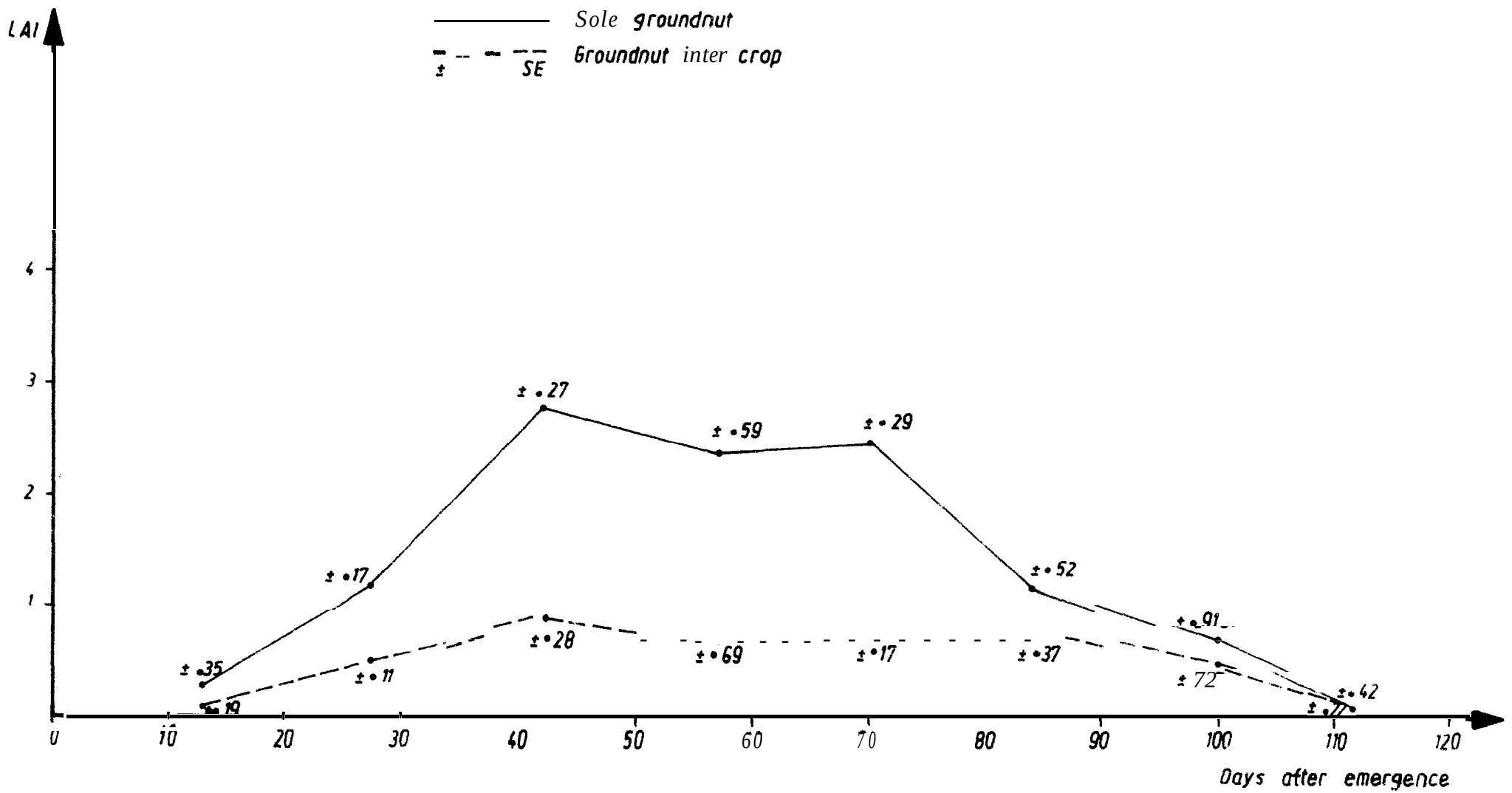

Fig. : Leaf area index (LAI) of groundnut TMV2 indifferent traitements (RCW 12

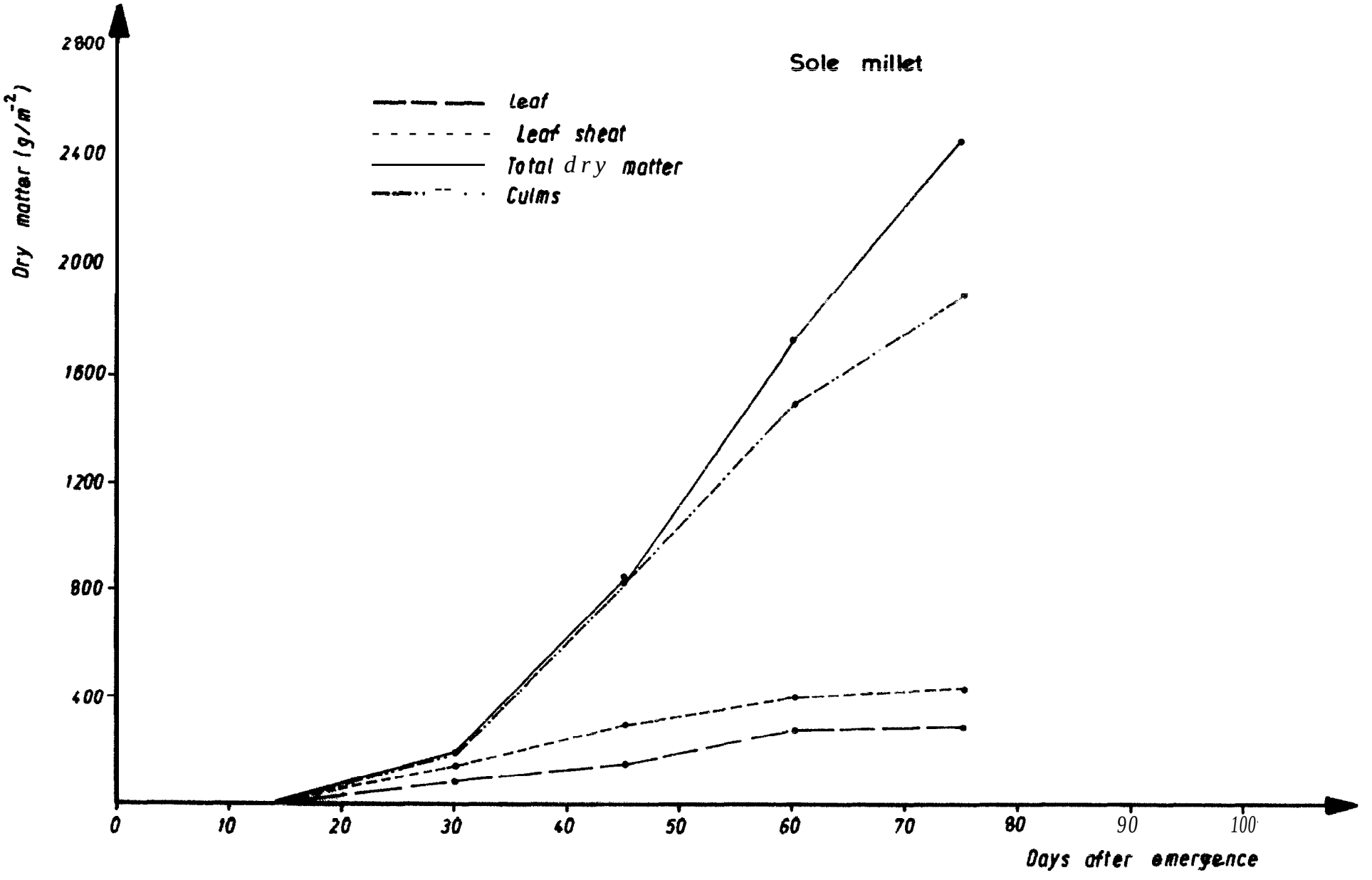

Fig. Total dry matter of pearl millet (BK-560) and its partitioning to different plant part RCW 12 B (1985)

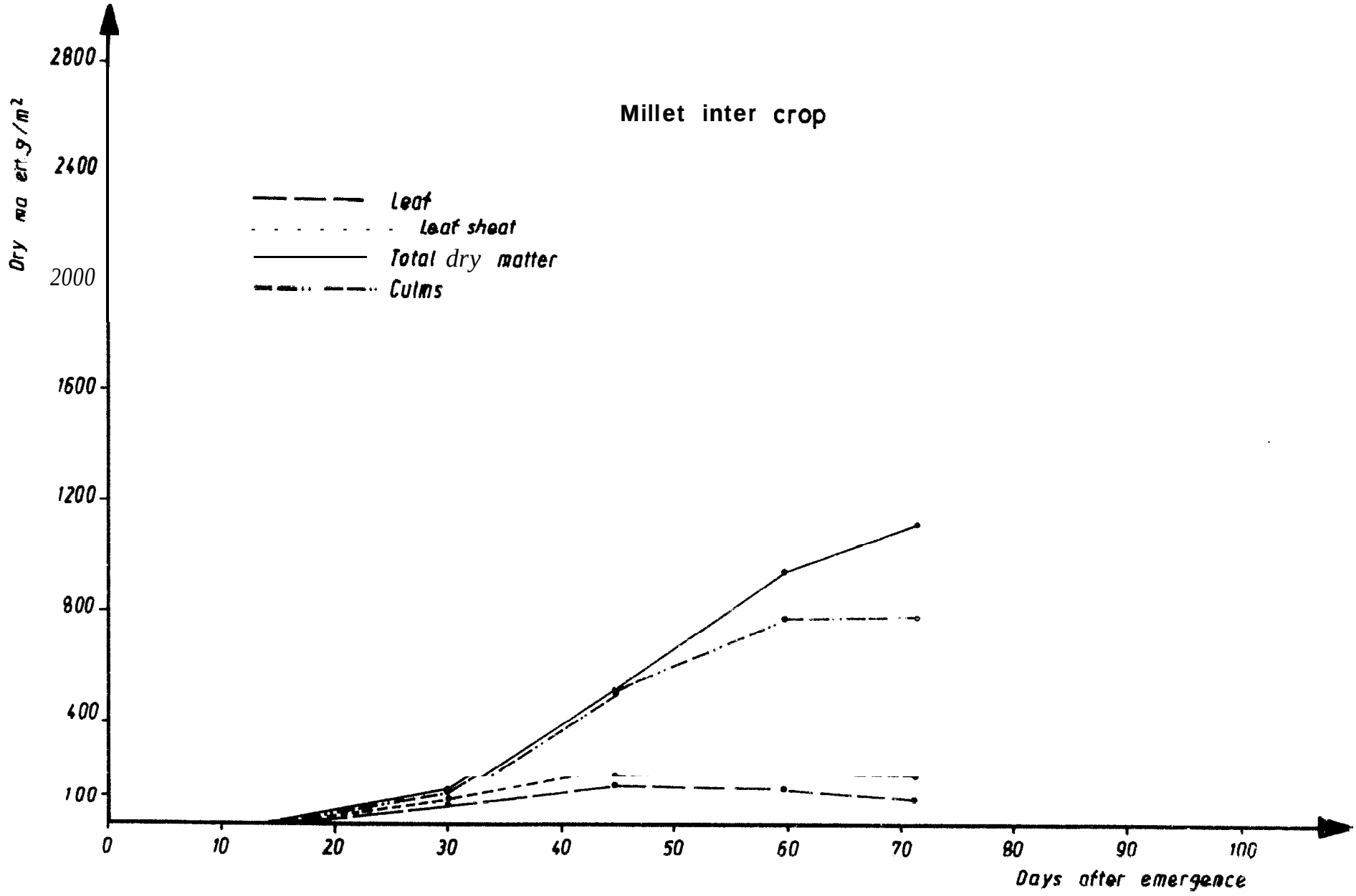

Fig. : Total dry matter of pearl millet (BK-560) and its partitioning ta plant part RCW Y2 B(1985)

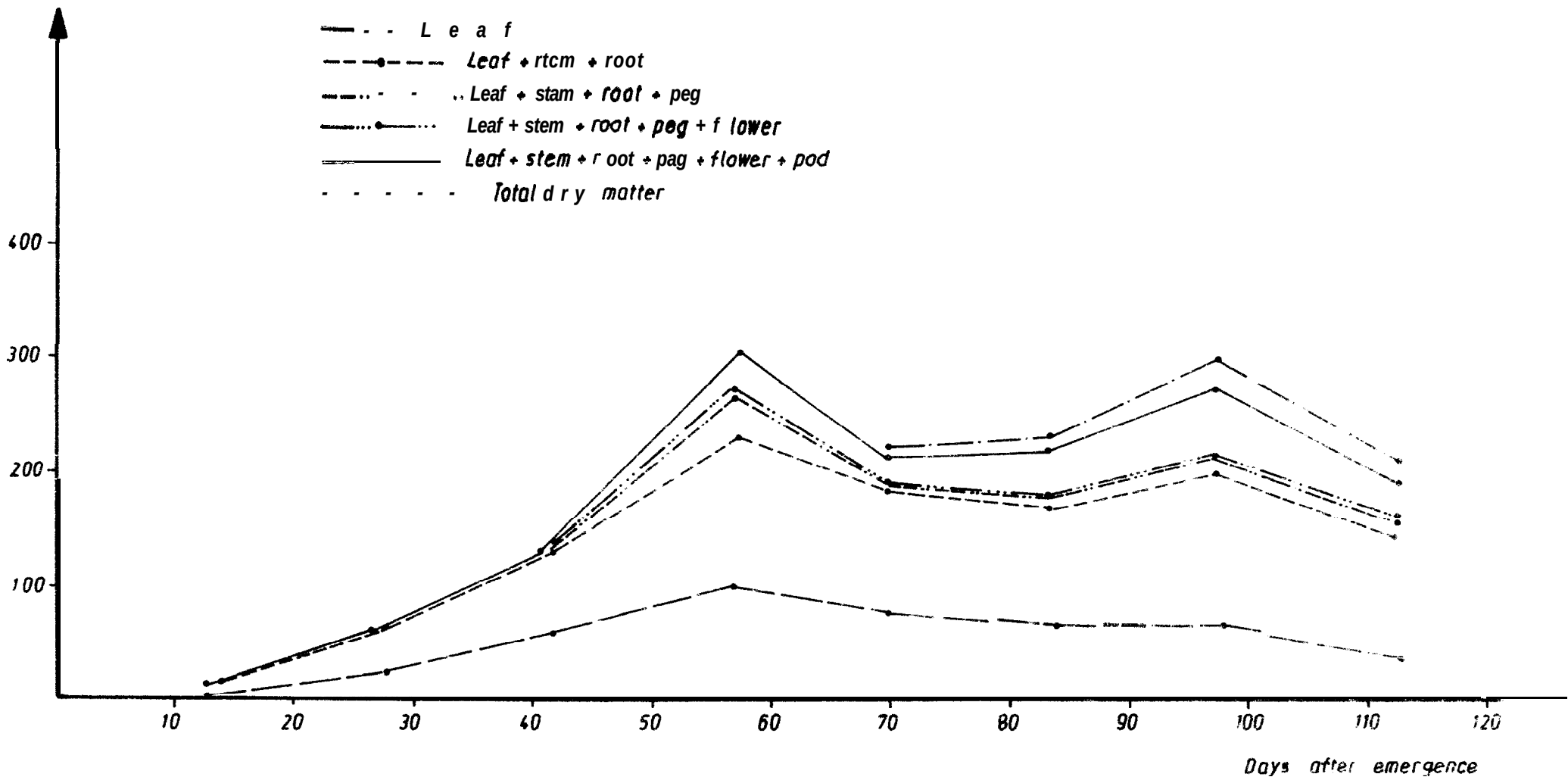

Fig. Dry **matter** production (**g/m²**) **and** its **partitioning of groundnut (TMV2) sole (RCW 12 B 1985)**

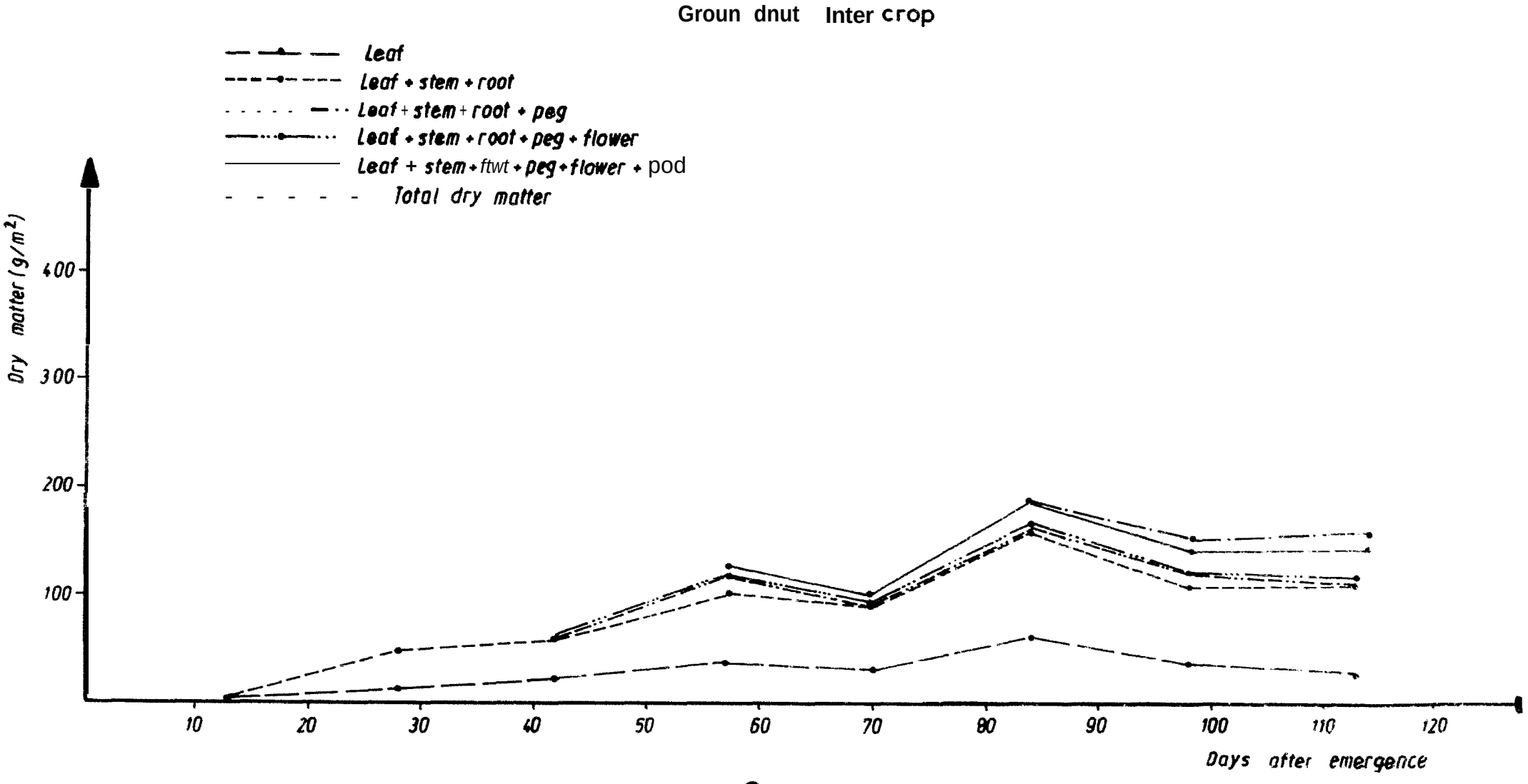

Fig. **Dry matter production (g/m^2) and its partitioning** of **groundnut (TMV2) intercrop (RCW 12 B 1985)**

IV WATER STORAGE AND EVAPOTRANSPIRATION

Table 1 - 2 - 3 show us the water storage (mm) in each treatement.

In all treatements during 24-7-85 upto 16-8-85, water storage is more, and 28-8-85 upto 19-9-85 water storage is less.

Evapotranspiration from sole millet plots was considerably less than sole Groundnut and intercrop 1 millet/3 Groundnut.

Cumulative ET in sole millet during the growth period was 294.28 mm, and in sole Groundnur 498.4mm, in this cas water use by inter crop was greater than sole Groundnut and sole millet (table 4-5-6).

WATER STORAGE (112 cm DEEPHT)

Table 1 :

Date	Crop	Total-Water mean (mm)	SDT	SE
27.6.85	Millet	209.17	6.18	3.09
5.7.85	Sole	218.51	2.56	1.28
11.7.85		LOS.54	8.76	4.38
17.7.85		203.76	8.03	4.01
24.7.85		225.92	4.44	2.22
2.8.85		245.85	3.35	1.76
8.8.85		206.81	5.41	2.70
16.8.85		230'79	20.21	10.11.
23.8.85		176.61	5.05	2.53
30.8.85		155.41	12.80	6.40
6.9.85		167 .94	7.41	3.70
13.9.85		163.60	14.55	7.28
19.9.85		170.32	4.77	2.39

Table 2

Date	Groundnut Sole	Total.-water mean (mm)	SDT	SE
27.6.85		220.41	14.07	7.04
5.7.85		220.0%	15.86	7.93
11.7.85		206.61	23.33	11.69
17.7.85		216.27	1.7.90	8.95
24.7.85		233.24	14.81	7.41
2.8.85		236.24	21.09	i0.54
3.8.85		209.70	33.19	1.6.60
16.8.85		243.75	22.62	13.31
23.8.85		179.61	15.07	7.53
30.8.85		176.02	7.35	3.68
6.9.85		178.26	18.05	9.02
'L3.9.85		177.28	19.12	9.56
19.9.85		164.25	15.65	7.83
27.9.85		183.61	1.5.90	'7.95

WATER STORAGE (mm) 112 em DEPHT

Table 3

Date	Crop	Total-Watt-r mean (mm)	SDT	SE
	Inter crop 1 millet/3 Gnt			
27.6.85	234.73	234.73	9.17	4.58
5.7.85	228.34	228.34	21.23	10.62
11.7.85	224.35	224.35	18.70	9.35
17.7.85	233.50	233.50	11.41	5.71
24.7.85	247'05	247.05	17.58	8.79
2.8.85	256.15	256.15	23.62	11.81
8.8.85	228.40	228.40	11.94	5.98
16.8.85	222.87	222.87	20.62	10. 31
23.8.85	195.45	195.45	16.53	8.26
30.8.85	186.45	186.45	15.18	7.5'9
6.9.85	187.93	187.93	17.10	8.55
13.9.85	195.10	195.10	18.55	9.27
19.9.85	171.73	171.73	16.55	8.28
27.9.85	191.7%	191.72	12.02	6.01

CROP : **MILLET** (Sole) EVAPOTRANSPIRATION

Table 4

Dates	Data	ET
27.6 To 5.7.85	24.6 + 209.17 - 218.51	15.3
5.6 To 11.7.85	0.6 + 218.51 - 205.54	13.6
11.6. Te 17.7.85	10.2 + 205.54 - 203.76	12.0
17.6. To 24.11.85	82.8 + 203.76 - 225.92	60.6
24.7. To 2.x8.85	34.4 + 225.92 - 245.85	14.5
2.8. To 8.8.85	1.4 + 245.85 - 206.81	40.4
8.8. To 16.8.85	12.4 + 206.81 - 230.79	11.58
16.8 To 23.8.85	0. + 230.79 - 176.61	54.2
23.8 To 30.8.85	15.8 + 176.61 - 155.41	37.0
30.8 To 6.9.85	11.7 + 155.41 - 167.94	0.8
6.9 To 13.9.85	26.6 + 167.94 - 163.60	30.9
13.9 To 19.9.85	2.4 + 163.60 - 170.32	4.3
	TOTAL.....	**294.28**

GROUNDNUT SOLE : EVAPOTRANSPIRATION

Table 5

Dates	Data	E T
26.6 To 5.7.85	24.6 + 220.41 - 220.02	24.8
5.7 To 3.1.7.85	0.6 + 220.02 -- 206.61	14.2
11.7 To 17.7.85	10.2 t 206.61 -- 216.27	**0.5**
17.7 To 24.7.85	82.8 + 216.27 - 233.24	65.8
24.: To 2.8.85	34.4 + 233.24 - 236.24	31.4
2.8 Tc 8.8.85	1.4 + 236.24 - 209.70	27.9
8.8 Tc 16.8.85	12.4 + 209.70 - 243.75	21.6
16.8 To 23.8.85	0 + i43.75 - 179.61	64.1
23.8 To 30.8.85	15.8 + 179.61 - 176.02	19.3
30.8 To 6.9.85	11.5 + 176.02 - 173.76	11.7
6.9. To 3.3.9.85	26.6 + 178.26 - 177.28	27.6
13.9 To 19.9.85	2.4 + 177.28 - 164.25	15.4
19.9 To 27.9.85	43.0 + 164.24 - 183.61	23.6
27.9 To 7.10.85	99.5 + 183.61 - 209.69	73
7.10.85 To 14.10	12.4 + 209.69 - 232.58	22.9
14.10 To 21.10	0 + 232.58- 213.62	19.0
	TOTAL	462.8

INTER CROP 1 MILLET/3 Gnt - EVAPOTRANSPIRATION

Table

Dates	Data	E T
27.6 To 5.7.85	24.6 + 234.73 - 228.34	31
5.7 To 11.7.85	0.6 + 228.34 - 224.35	4.6
11.7 To 17.7.85	10.2 t 224.35 - 233.50	1.1
17.7 To 24.7.85	82.8 t 233.50 - 247.05	69.3
24.7 To 2.8.85	34.4 + 247.05 -- 256.15	25.3
2.8 To 8.8.85	1.4 + 256.15 - 228.40	29.2
8.8 To 10.8.85	12.4 + 228.40 - 222.27	18.5
16.8 To 23.8.85	0 + 222.27 - 195.45	26.8
23.8 To 30.8.85	15.8 + 195.45 - 186.45	24.8
30.8 To 6.9.85	11.7 + 186.45 - 187.93	10.2
6.9 To 13.9.85	26.6 + 187.93 - 195.10	19.4
13.9 To 19.9.85	2.4 + 195.10 - 17:.73	25.6
19.9 To 27.9.85	43.0 t 171.73 - 191.72	23
27.9 To 7.10.85	99.5 + 191.72 -- 214.97	76.3
7.10 To 14.10.85	12.4 + 214.97 -- 215.04	12.3
14.10 To 21.10.85	0 + 215.04 - 204.70	10.3

V YIELD DATA

Somary of selected characters

Lower grain this year is attributed to low rainfall 47 / mm and distribution, and the severe drought during its grain felling period and peding.

In this experiment in sole millet Main plant produced more, than tillers, but in inter crop tillers produced more than Main plant in the treatement with combinaison brad difficulty to growth.

The produced groundnut this year is caused by the low rainfall and drought during pediny and peging period.

YIELD DATA - SOMMARY OF SELECTED CHARACTERS

traitements	P. MILLET			GROUNDNUT							Total dry matter kg/ha		LER
	Sole P. Millet			Inter crop			Sole		Inter crop				
	Main Plants	Tillers	Total	Main Plants	Tillers	Total	Productions	Kernels	Productions	Kernels	Sole	Inter crop	
ole P. Millet	2139	1205	3344	-	-	-	-	-	-	-	-	-	1
ole Groungnut	-	-	-	-	-	-	394.44	133.33	-	-	1688.89	1027.76	1
P. Millet + 3 Groundnut	-	-	-	680	1632	2312	-	-	205.55	405.5	-	-	1.2
T D	178	232	401	57	247	299	-	-	-	-	-	-	
E -	103	134	232	33	142	173	46	34	12	5	87	73	0.54

Hight statically significance beteween sole crop and inter crop.

VI - CONCLUSION

The Agroclimatology studies can contribut to increase food production in the semi-arid Tropics.
The most important way is to know the best climatic for growth of plant and to increase the availability of water, also to decrease the demand of that water to crop production.

REFERENCES

- REDDY, M.S. and VILLEY (1981) : Growth and Ressource use Studies in a intercrop of Pearl Millet/Groundnut.

- ICRISAT, Annual Report (82)

- Agroclimatology Report (1980) : Potential Evapo-Transpiration. Estimates in the S.A.T.

- C. K. ONG and MONTEITH : Respunse Pearl Millet to Light and Temperature.

- PIARASPNG, KANEMASU, CHANDHURI : Water use and Water use Efficiency of Pearl Millet.

- A.K.S. HUDA, SIVAKUMAR MVS - REGO / 1985 : An Analysis Data of Agroclimatic Data - In Relation to Firtilizer use in Dry Land Aera of India.

- JARWAL - S.D., 1984 : CANOPY architecture, 'Light, Interception, Water use and Dry Matter Production. Relationships in Pearl Millet.

- C. DANCETTE ; F. FOREST (1984) : Recent Work on WATER Requierements of Millet and SORGHUM.