INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
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SMR.705 - 23

COLLEGE ON SOIL PHYSICS

(6 - 24 September 1993)

"Soil Conservation"

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These are preliminary lecture notes, intended only for distribution to participants.

SOIL CONSERVATION

SOIL CONSERVATION is the physical application of land and water management knowledge with the goal of protecting our soil resources from degradation processes and effects.

SOIL CONSERVATION PRACTICES are designed to use land wisely and to manage runoff properly, to control erosion by water or wind and soil degradation in general, taking into consideration that we can do little to change climate, inherent soil characteristics, and topography. They may be:

- **STRUCTURAL OR SUPPORT PRACTICES** (bench terraces, channel terraces, contour bunds, sediment basins)
- **CULTURAL OR AGRONOMIC PRACTICES** (conservation tillage, rotations, surface mulches)
- **A COMBINATION OF STRUCTURAL AND CULTURAL PRACTICES** (contour planting, grassed waterways, grass barriers, strip cropping)

The extent to which soil surfaces are protected by vegetation, mulches, or other cover, may greatly influence the soil's susceptibility to erosion by rainfall and runoff. As splash inter-rill erosion is initiated by the raindrop impact effects on unprotected soil, and rill erosion is caused by the depth and velocity of the concentrated

flow, the most effective soil conservation measures are those based on protecting the soil surface, preventing raindrop impact, and decreasing runoff amount and its velocity. Covers dissipate raindrop impact energy and the forces of flowing runoff. If the cover is tall plant canopy, it may absorb most of the raindrop energy, but replace it with very erosive large drips from the canopy. If at the same time there is little or no surface-contact cover, runoff erosion is not prevented, and even enhanced in some cases.

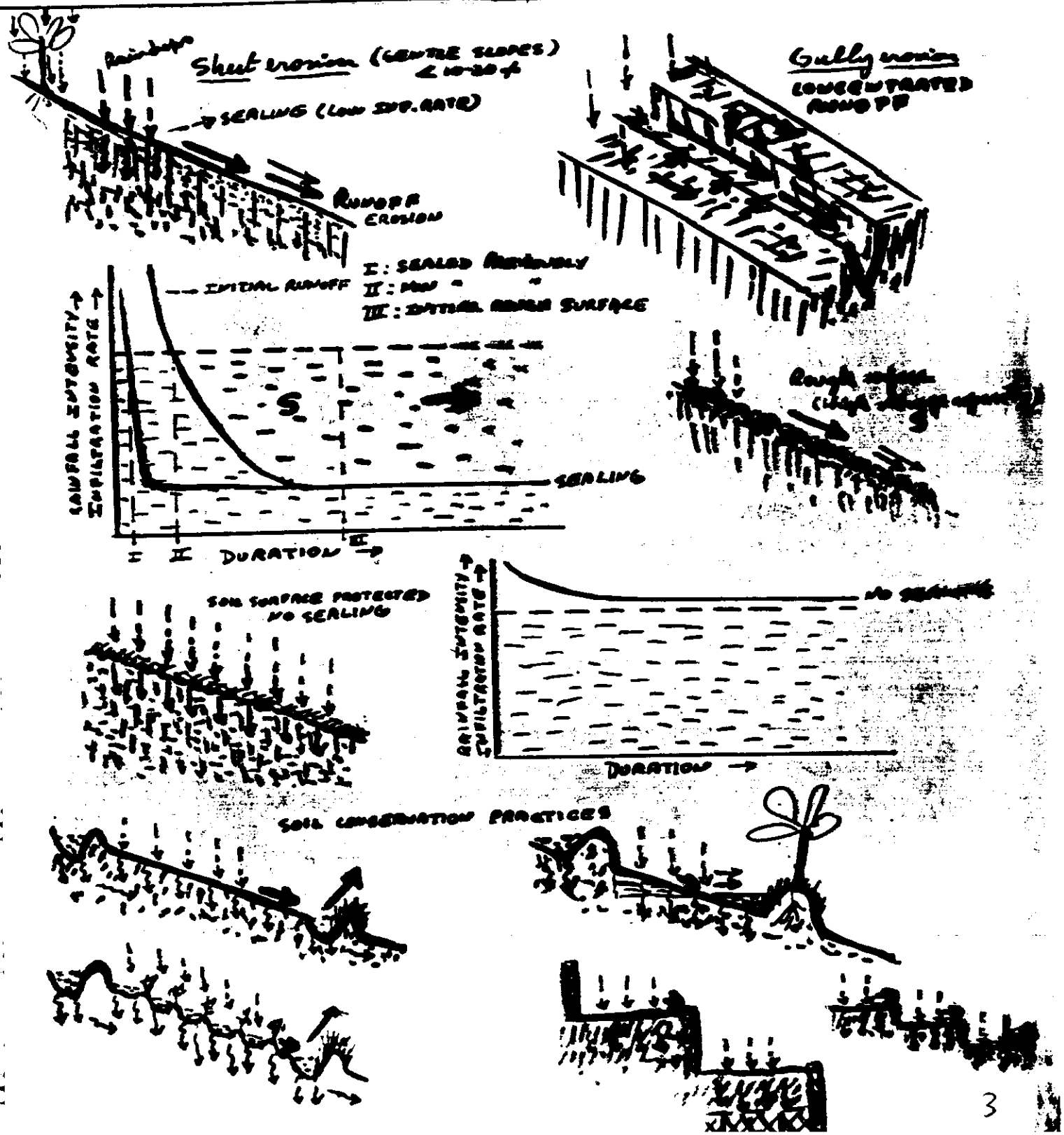
In conclusion, SOIL CONSERVATION PRACTICES are the ones affecting the major degradation processes, improving soil characteristics, and reducing sediment movement by absorbing raindrop impact energy, absorbing runoff scour forces, reducing the quantity and rate of runoff, slowing runoff velocities, and preventing mass movements. The practical measures to achieve these vary among soils, ecosystems and farming systems:

SOIL PROTECTION FROM RAINDROP IMPACT
- → VEGETATION MANAGEMENT (Minimum soil disturbance, Multiple cropping)
- → SOIL MANAGEMENT (Conservation tillage, Mulch)
- → CROP MANAGEMENT (Ensure adequate ground cover)

RUNOFF MANAGEMENT
- → INCREASING INFILTRATION (Mulch farming,
- → DECREASING RUNOFF VELOCITY (Mechanical or bio-logical systems,
- → RUNOFF DIVERSION (Engineering structures)

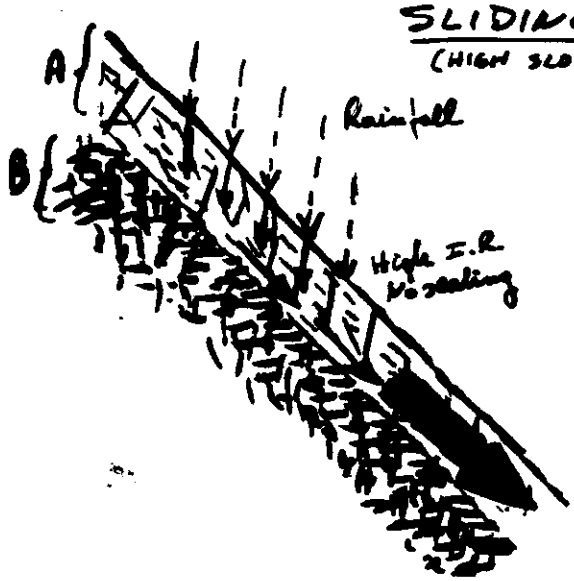
4) The rate of detachment of soil particles by surface flow
5) The transport capacity of the runoff.

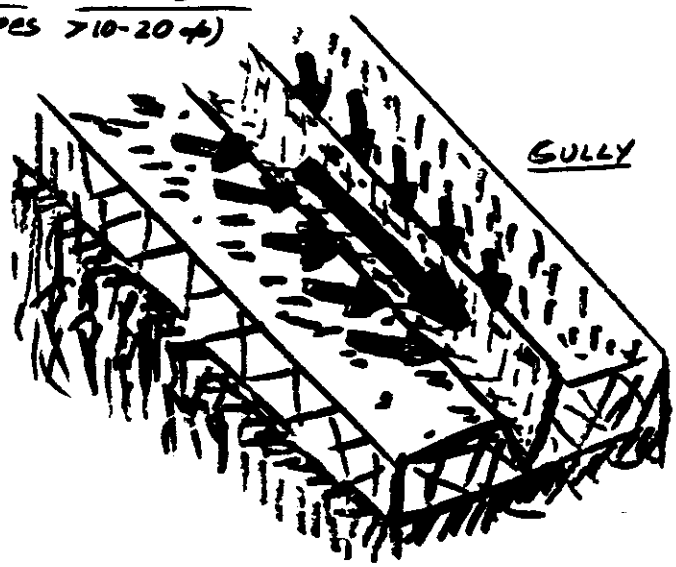
Soil loss, calculated by comparing the availability of detached material for transport with the transport capacity, is either detachment or transport limited.

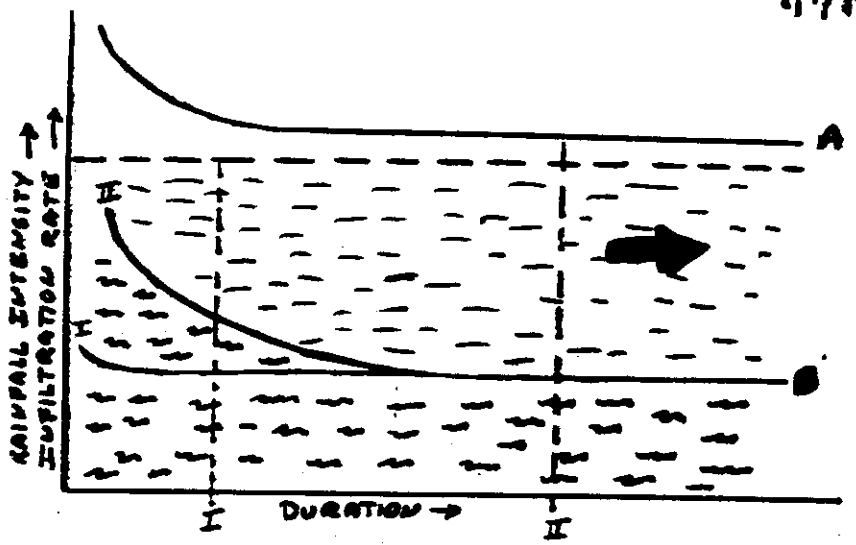


SLIDING EROSION

(HIGH SLOPES >10-20%)







-- COMPLETE SATURATION OF A. INITIAL SLIDING.

I: SOIL INITIALLY WET

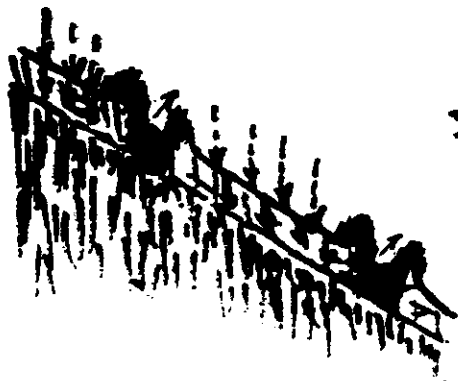
II: SOIL INITIALLY DRY

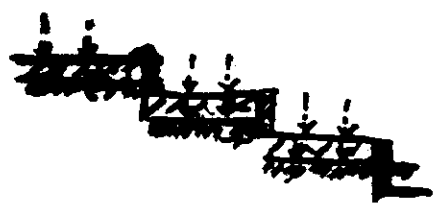
MASS MOVEMENT (SOIL SATURATED WITH WATER) (HIGH FLUIDITY)

LAND-SLIDE

ROAD CUT

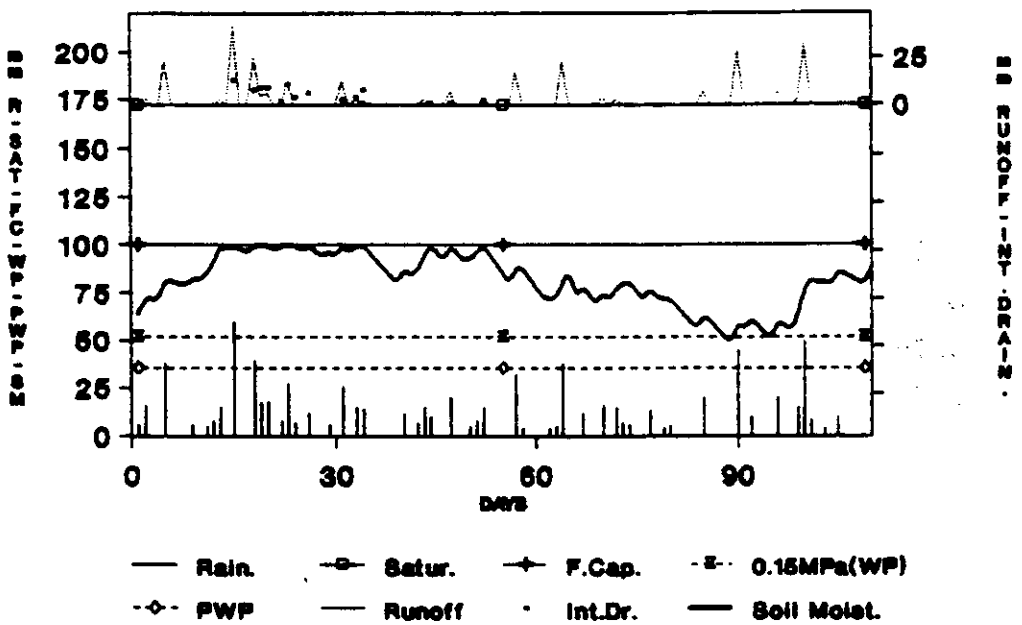
BINDING ACTION OF PLANT ROOTS. ANCHORAGE OF SURFACE SOIL



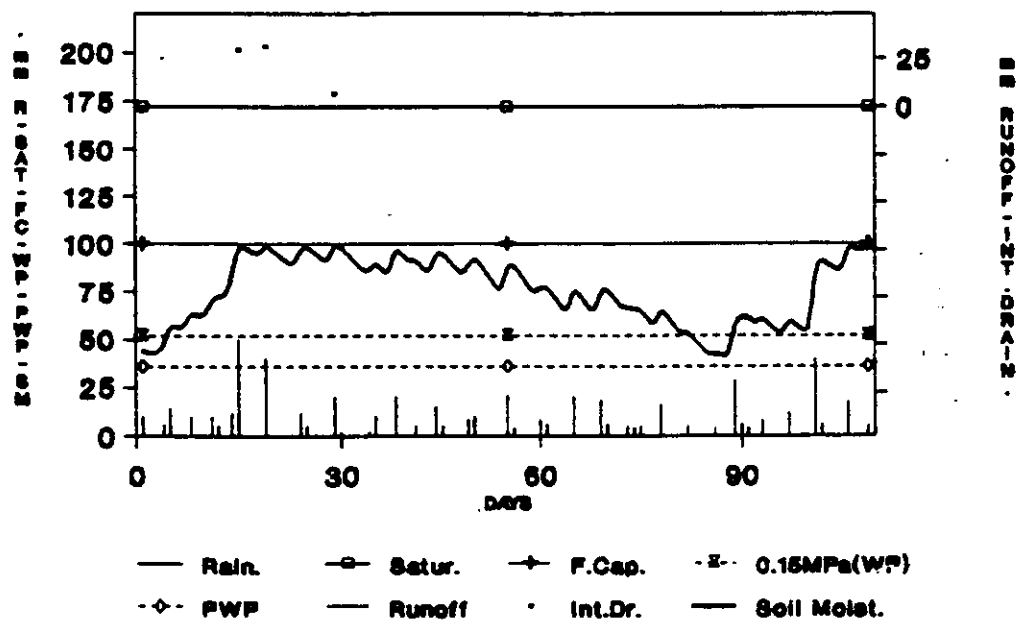


CONSERVATION PRACTICES

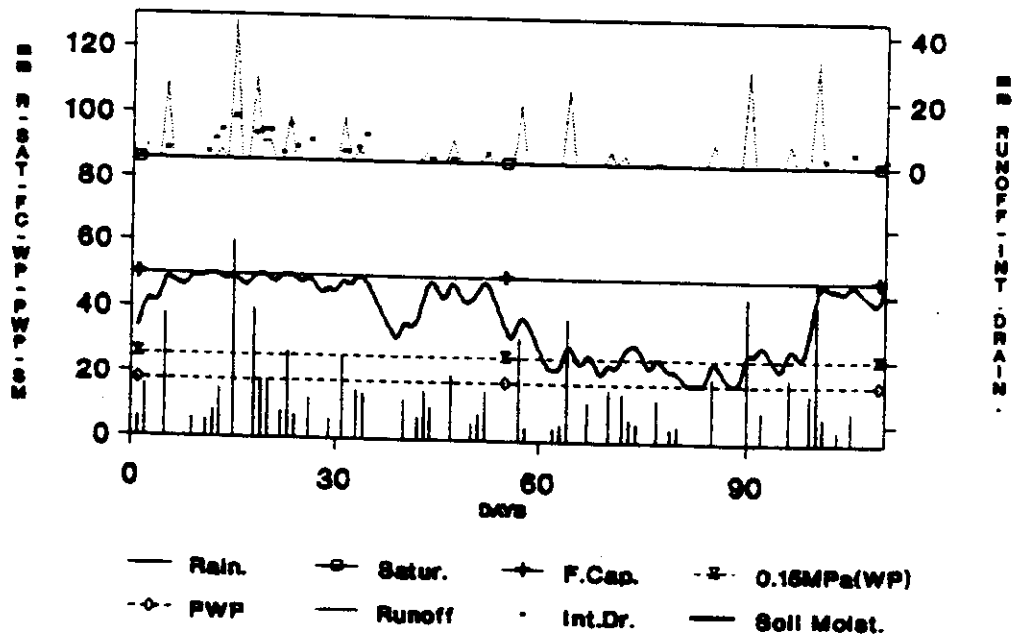
Soil Moisture Regime (CHAGUARAMAS)
1 June-20 Sept.(Sorghum.40cm Root Depth)
(6% Slope. Bare. Average Rainfall)



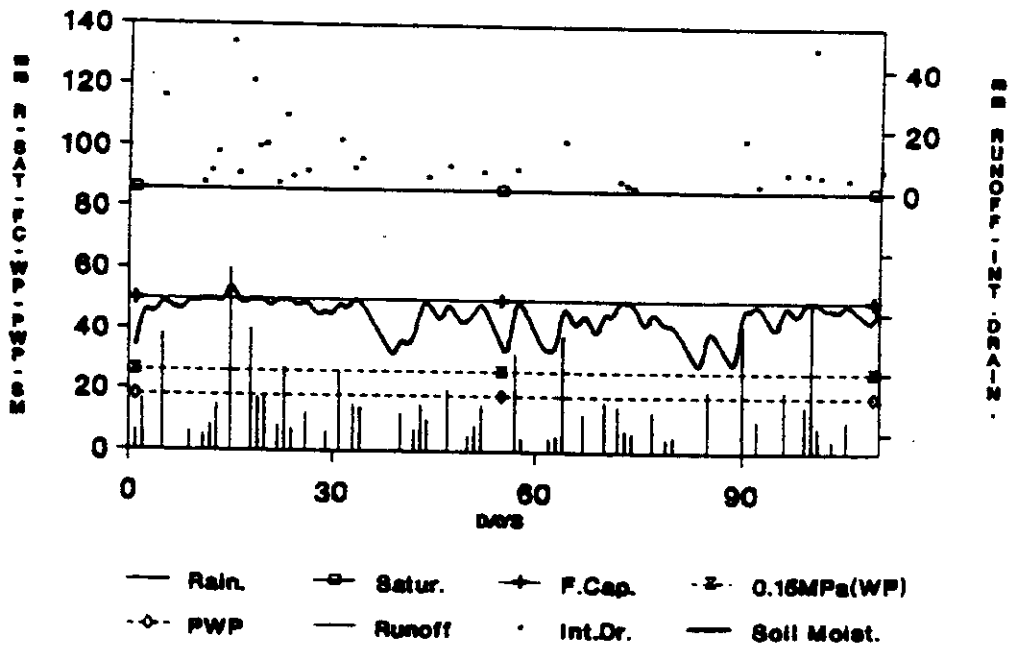
Soil Moisture Regime (CHAGUARAMAS)
1 June-20 Sept.(Sorghum.40cm Root Depth)
(6% Slope. Mulch Cover. Low Rainfall)



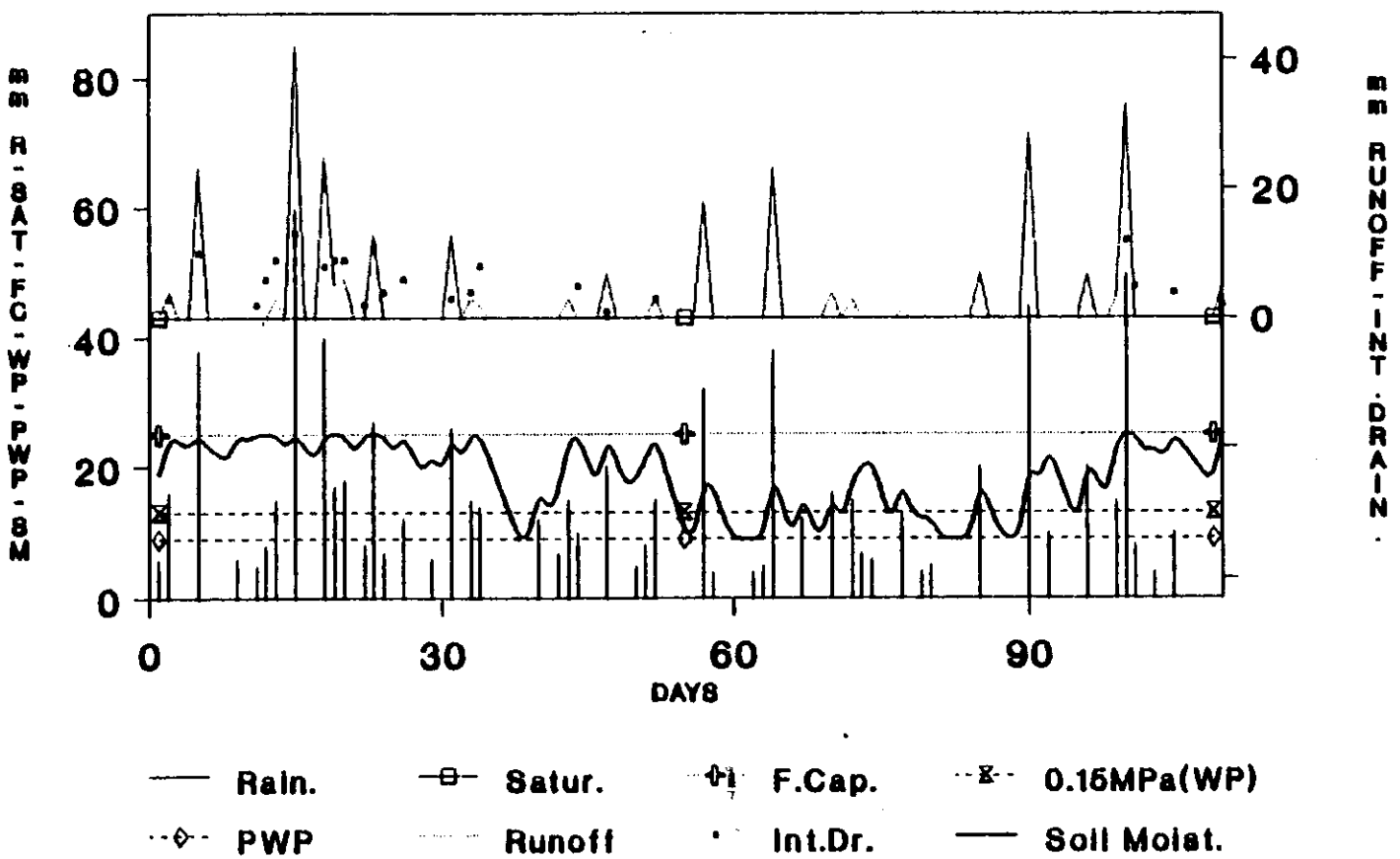
Soil Moisture Regime (CHAGUARAMAS)
1 June-20 Sept.(Sorghum.20cm Root Depth)
(6% Slope. Bare. Average Rainfall)



Soil Moisture Regime (CHAGUARAMAS)
1 June-20 Sept.(Sorghum.20cm Root Depth)
(6% Slope.Mulch Cover. Average Rainfall)

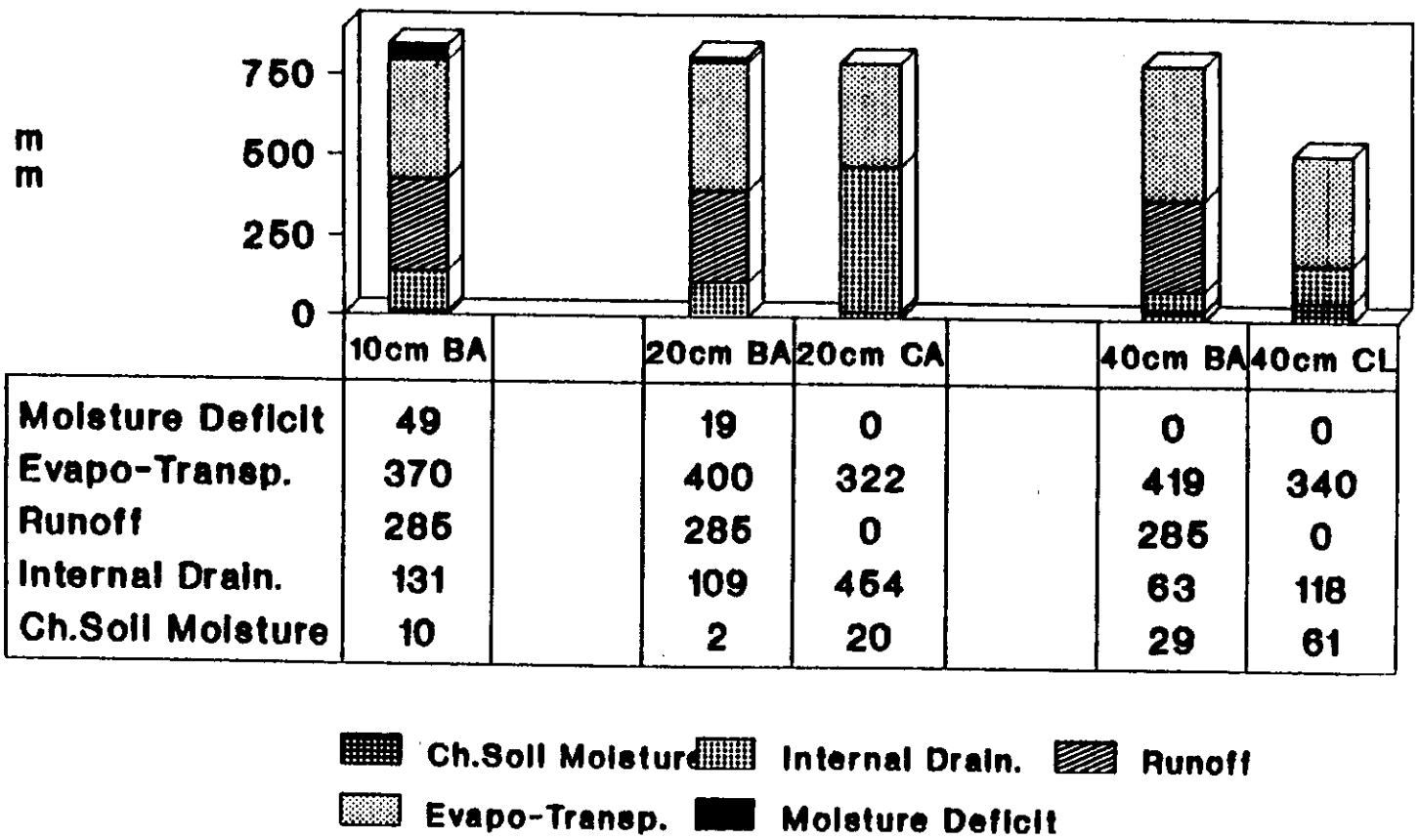


Soil Moisture Regime (CHAGUARAMAS)
1 June-20 Sept.(Sorghum.10cm Root Depth)
(6% Slope. Bare. Average Rainfall)



Water Balance (CHAGUARAMAS)

(Sorghum growing cycle + 10 days)
(RAINIAverage:A;Low:L)(Bare:B;Cover:C)



	10cm BA		20cm BA	20cm CA		40cm BA	40cm CL
Moisture Deficit	49		19	0		0	0
Evapo-Transp.	370		400	322		419	340
Runoff	285		285	0		285	0
Internal Drain.	131		109	454		63	118
Ch.Soil Moisture	10		2	20		29	61

TUREN (Corn — Sesame)

- (AVERAGE RAINFALL;15CM ROOT DEPTH;BARE SOIL;NO SURFACE DRAINAGE) -

• Location, Climate and Crop:

Location: Turen. Latitude: 9 ° North. Longitude: 69 ° West. Altitude: 275 m.
Rainy Season (period): May-October. Rainfall= 1280 mm.
Dry Season (period): November-April. Rainfall= 120 mm. Annual Rainfall: 1400 mm.
Year: Average rainfall. Return period: 2 years.
Slope: 0 % Crop(s): Corn-Sesame.
Interval #1: from May 15 of 1980 , to September 20 of 1980
Interval #2: from September 21 of 1980 , to February 28 of 1980

• Given Conditions and Values:

Possibilities of runoff or surface drainage: ..... No.
Effective rooting depth of the soil .....(DS)= 150 mm.
Average rainfall intensity .....(RI)= 50 mm/h.
Average infiltration rate .....(IR)= 2 mm/h.
Saturated hydraulic conductivity of the subsoil .....(KSS)= 1 mm/h.
Soil moisture (vol/vol) of soil DS at saturation.....(θSS)= 0.50
Soil moisture (vol/vol) of soil DS at liquid limit.....(θLL)= 0.42
Soil moisture (vol/vol) of soil DS at plastic limit.....(θPL)= 0.35
Soil moisture (vol/vol) of soil DS at field capacity.....(θFC)= 0.40
Soil moisture (vol/vol) of soil DS at a tension of 0.15 MPa .(θTW)= 0.20
Soil moisture (vol/vol) of soil DS at a tension of 1.5 MPa ..(θPW)= 0.15
Soil moisture (vol/vol) of soil DS the first day.....(θS1)= 0.20

• Identification of Variables:

(HR) Rainfall in mm.
(HET) Evapo-transpiration in mm.
(HSD) Water losses by runoff or surface drainage in mm.
(HWL) Water-logging in mm.
(TWL) Duration of water-logging in hours.
(HID) Water losses by internal drainage in mm.
(TID) Duration of water losses by internal drainage in hours.
(TLI) Duration of viscous fluid consistence in hours.
(HAS) Runoff after saturation in mm.
(HDS) Soil moisture at rooting depth in mm.
(HDS/DS) Soil moisture (vol/vol) at rooting depth (θDS).
(HIR) Irrigation water requirements in mm.

• Classification of Days:

(DW) Day with water-logging.
(DS) Day with water-saturated soil (θDS=θSS).
(DL) Day with excessive soil moisture for tillage (θDS=>θPL).
(DE) Day with excessive soil moisture for the crop (θDS>θSS-0.1).
(DA) Day with appropriate soil moisture (θFC>=θDS>θTW).
(DT) Day with moderate deficiency of soil moisture (θTW>=θDS>θPW).
(DP) Day with extreme deficiency of soil moisture (θDS=<θPW).
(DI) Day with complementary irrigation requirement (θDS<θPW).

• Summary of Results in 30 Days Periods for One Year:

	Periods												
(from)	1	31	61	91	121	151	181	211	241	271	301	331	
(to)	30	60	90	120	150	180	210	240	270	300	330	360	Totals.
Var.													
HR	390	204	201	223	141	119	42	20	26	6	0	0	1372 mm.
HET	97	135	150	105	49	55	62	60	35	16	0	0	764 mm.
HSD	0	0	0	0	0	0	0	0	0	0	0	0	0 mm.
HID	262	78	62	101	89	72	0	0	0	0	0	0	664 mm.
HIR	0	0	0	0	0	0	0	30	9	10	0	0	49 mm.
Cla.													
DW	7	1	2	2	1	1	0	0	0	0	0	0	14 days
DS	1	1	1	1	1	1	1	1	1	1	0	0	10 days
DL	29	20	16	22	30	28	0	0	0	0	0	0	145 days
DE	17	9	5	10	11	10	0	0	0	0	0	0	62 days
DA	12	21	25	20	19	20	28	3	3	0	0	0	151 days
DT	0	0	0	0	0	0	2	9	16	0	0	0	31 days
DP	0	0	0	0	0	0	0	18	11	11	0	0	40 days
DI	0	0	0	0	0	0	0	16	9	10	0	0	35 days

Dav	HR (mm)	HET (mm)	HSD (mm)	HWL-TWL (mm)	(h)	HID-TID (mm)	(h)	TLI (h)	HAS (mm)	HDS (mm)	HIR (mm)	Class.	
1	47	5.0	0	45	23	12	12	14	0	60	0	DW	DE
2	9	3.0	0	9	4	6	6	6	0	60	0	DE	DL
3	29	4.0	0	28	14	24	24	24	0	61	0	DW	DE
4	0	2.0	0	0	0	0	0	0	0	59	0	DA	DL
5	0	2.0	0	0	0	0	0	0	0	57	0	DA	DL
6	30	5.0	0	29	14	22	22	24	0	60	0	DW	DE
7	0	2.0	0	0	0	0	0	0	0	58	0	DA	DL
8	0	2.0	0	0	0	0	0	0	0	56	0	DA	DL
9	0	2.0	0	0	0	0	0	0	0	54	0	DA	DL
10	23	4.0	0	22	11	13	13	14	0	60	0	DE	DL
11	5	2.0	0	5	2	3	3	2	0	60	0	DE	DL
12	17	4.0	0	16	8	13	13	14	0	60	0	DE	DL
13	10	3.0	0	10	5	7	7	7	0	60	0	DE	DL
14	0	2.0	0	0	0	0	0	0	0	58	0	DA	DL
15	0	2.0	0	0	0	0	0	0	0	56	0	DA	DL
16	0	2.0	0	0	0	0	0	0	0	54	0	DA	DL
17	0	2.0	0	0	0	0	0	0	0	52	0	DA	
18	15	4.0	0	14	7	3	3	4	0	60	0	DE	DL
19	0	2.0	0	0	0	0	0	0	0	58	0	DA	DL
20	0	2.0	0	0	0	0	0	0	0	56	0	DA	DL
21	73	5.0	0	70	24	24	24	24	0	75	0	DW	DS
22	0	3.0	0	25	13	24	24	12	0	73	0	DW	DE
23	0	3.0	0	0	0	10	10	10	0	60	0	DE	DL
24	0	3.0	0	0	0	0	0	0	0	57	0	DA	DL
25	23	4.0	0	22	11	16	16	17	0	60	0	DE	DL
26	8	3.0	0	8	4	5	5	5	0	60	0	DE	DL
27	40	5.0	0	38	19	24	24	24	0	71	0	DW	DE
28	28	5.0	0	27	13	24	24	24	0	70	0	DW	DE
29	12	5.0	0	12	6	17	17	19	0	60	0	DE	DL
30	21	5.0	0	20	10	16	16	18	0	60	0	DE	DL
31	18	4.0	0	17	9	14	14	15	0	60	0	DE	DL
32	12	4.0	0	12	6	8	8	9	0	60	0	DE	DL
33	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
34	16	4.0	0	15	8	8	8	9	0	60	0	DE	DL
35	10	4.0	0	10	5	6	6	7	0	60	0	DE	DL
36	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
37	0	4.0	0	0	0	0	0	0	0	52	0	DA	
38	13	4.0	0	12	6	1	1	2	0	60	0	DE	DL
39	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
40	10	4.0	0	10	5	2	2	3	0	60	0	DE	DL
41	18	4.0	0	17	9	14	14	15	0	60	0	DE	DL
42	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
43	0	4.0	0	0	0	0	0	0	0	52	0	DA	
44	0	4.0	0	0	0	0	0	0	0	48	0	DA	
45	4	4.0	0	4	2	0	0	0	0	48	0	DA	
46	15	5.0	0	14	7	0	0	0	0	58	0	DA	DL
47	0	5.0	0	0	0	0	0	0	0	53	0	DA	DL
48	8	5.0	0	8	4	0	0	0	0	56	0	DA	DL
49	0	5.0	0	0	0	0	0	0	0	51	0	DA	
50	3	5.0	0	3	1	0	0	0	0	49	0	DA	
51	0	5.0	0	0	0	0	0	0	0	44	0	DA	
52	8	5.0	0	8	4	0	0	0	0	47	0	DA	
53	17	5.0	0	16	8	0	0	1	0	59	0	DA	DL
54	0	5.0	0	0	0	0	0	0	0	54	0	DA	DL
55	12	5.0	0	12	6	1	1	3	0	60	0	DE	DL

Day	HR (mm)	HET (mm)	HSD (mm)	HWL-TWL (mm)	(h)	HID-TID (mm)	(h)	TLI (h)	HAS (mm)	HDS (mm)	HIR (mm)	Class.	
56	30	5.0	0	29	14	24	24	24	0	61	0	DW	DE
57	0	5.0	0	0	0	0	0	0	0	56	0	DA	DL
58	0	5.0	0	0	0	0	0	0	0	51	0	DA	
59	10	5.0	0	10	5	0	0	0	0	56	0	DA	DL
60	0	5.0	0	0	0	0	0	0	0	51	0	DA	
61	11	5.0	0	11	5	0	0	0	0	57	0	DA	DL
62	23	5.0	0	22	11	15	15	17	0	60	0	DE	DL
63	16	5.0	0	15	8	11	11	13	0	60	0	DE	DL
64	0	5.0	0	0	0	0	0	0	0	55	0	DA	DL
65	0	5.0	0	0	0	0	0	0	0	50	0	DA	
66	5	5.0	0	5	2	0	0	0	0	50	0	DA	
67	12	5.0	0	12	6	0	0	0	0	57	0	DA	DL
68	0	5.0	0	0	0	0	0	0	0	52	0	DA	
69	10	5.0	0	10	5	0	0	0	0	57	0	DA	DL
70	0	5.0	0	0	0	0	0	0	0	52	0	DA	
71	26	5.0	0	25	12	13	13	15	0	60	0	DW	DE
72	0	5.0	0	0	0	0	0	0	0	55	0	DA	DL
73	0	5.0	0	0	0	0	0	0	0	50	0	DA	
74	30	5.0	0	29	14	15	15	17	0	60	0	DW	DE
75	0	5.0	0	0	0	0	0	0	0	55	0	DA	DL
76	0	5.0	0	0	0	0	0	0	0	50	0	DA	
77	2	5.0	0	2	1	0	0	0	0	47	0	DA	
78	13	5.0	0	12	6	0	0	0	0	55	0	DA	DL
79	0	5.0	0	0	0	0	0	0	0	50	0	DA	
80	3	5.0	0	3	1	0	0	0	0	48	0	DA	
81	15	5.0	0	14	7	0	0	0	0	58	0	DA	DL
82	0	5.0	0	0	0	0	0	0	0	53	0	DA	DL
83	0	5.0	0	0	0	0	0	0	0	48	0	DA	
84	12	5.0	0	12	6	0	0	0	0	55	0	DA	DL
85	0	5.0	0	0	0	0	0	0	0	50	0	DA	
86	23	5.0	0	22	11	8	8	10	0	60	0	DE	DL
87	0	5.0	0	0	0	0	0	0	0	55	0	DA	DL
88	0	5.0	0	0	0	0	0	0	0	50	0	DA	
89	0	5.0	0	0	0	0	0	0	0	45	0	DA	
90	0	5.0	0	0	0	0	0	0	0	40	0	DA	
91	11	4.0	0	11	5	0	0	0	0	47	0	DA	
92	46	4.0	0	44	22	24	24	24	0	65	0	DW	DE
93	0	4.0	0	0	0	1	1	2	0	60	0	DE	DL
94	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
95	0	4.0	0	0	0	0	0	0	0	52	0	DA	
96	1	4.0	0	1	0	0	0	0	0	49	0	DA	
97	0	4.0	0	0	0	0	0	0	0	45	0	DA	
98	2	4.0	0	2	1	0	0	0	0	43	0	DA	
99	0	4.0	0	0	0	0	0	0	0	39	0	DA	
100	12	4.0	0	12	6	0	0	0	0	47	0	DA	
101	25	4.0	0	24	12	8	8	9	0	60	0	DE	DL
102	8	4.0	0	8	4	4	4	5	0	60	0	DE	DL
103	0	4.0	0	0	0	0	0	0	0	56	0	DA	DL
104	4	4.0	0	4	2	0	0	0	0	56	0	DA	DL
105	17	4.0	0	16	8	9	9	10	0	60	0	DE	DL
106	0	3.0	0	0	0	0	0	0	0	57	0	DA	DL
107	0	3.0	0	0	0	0	0	0	0	54	0	DA	DL
108	14	3.0	0	13	7	5	5	5	0	60	0	DE	DL
109	1	3.0	0	1	0	0	0	0	0	58	0	DA	DL
110	0	3.0	0	0	0	0	0	0	0	55	0	DA	DL

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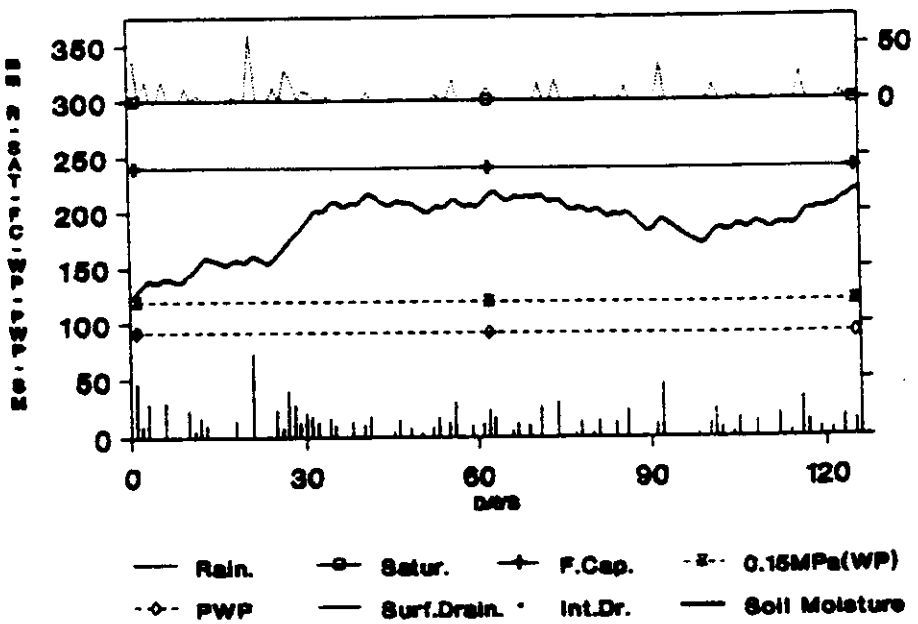
Dav	HR (mm)	HET (mm)	HSD (mm)	HWL-TWL (mm)	(h)	HID-TID (mm)	(h)	TLI (h)	HAS (mm)	HDS (mm)	HIR (mm)	Class.	
111	0	3.0	0	0	0	0	0	0	0	52	0	DA	
112	20	3.0	0	19	10	9	9	9	0	60	0	DE	DL
113	0	3.0	0	0	0	0	0	0	0	57	0	DA	DL
114	5	3.0	0	5	2	0	0	0	0	59	0	DA	DL
115	0	3.0	0	0	0	0	0	0	0	56	0	DA	DL
116	35	3.0	0	34	17	24	24	24	0	64	0	DW	DE
117	14	3.0	0	13	7	15	15	15	0	60	0	DE	DL
118	0	3.0	0	0	0	0	0	0	0	57	0	DA	DL
119	8	3.0	0	8	4	2	2	2	0	60	0	DE	DL
120	0	3.0	0	0	0	0	0	0	0	57	0	DA	DL
121	6	2.0	0	6	3	1	1	0	0	60	0	DE	DL
122	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
123	18	3.0	0	17	9	14	14	14	0	60	0	DE	DL
124	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
125	15	3.0	0	14	7	11	11	11	0	60	0	DE	DL
126	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
127	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
128	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
129	0	1.0	0	0	0	0	0	0	0	56	0	DA	DL
130	8	3.0	0	8	4	1	1	1	0	60	0	DE	DL
131	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
132	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
133	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
134	10	2.0	0	10	5	5	5	4	0	60	0	DE	DL
135	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
136	30	3.0	0	29	14	24	24	24	0	62	0	DW	DE
137	5	2.0	0	5	2	5	5	4	0	60	0	DE	DL
138	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
139	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
140	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
141	0	1.0	0	0	0	0	0	0	0	56	0	DA	DL
142	0	1.0	0	0	0	0	0	0	0	55	0	DA	DL
143	10	3.0	0	10	5	2	2	2	0	60	0	DE	DL
144	8	3.0	0	8	4	5	5	5	0	60	0	DE	DL
145	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
146	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
147	24	3.0	0	23	12	19	19	19	0	60	0	DE	DL
148	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
149	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
150	7	3.0	0	7	3	2	2	2	0	60	0	DE	DL
151	5	3.0	0	5	2	2	2	2	0	60	0	DE	DL
152	3	2.0	0	3	1	1	1	0	0	60	0	DE	DL
153	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
154	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
155	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
156	10	3.0	0	10	5	4	4	4	0	60	0	DE	DL
157	8	3.0	0	8	4	5	5	5	0	60	0	DE	DL
158	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
159	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
160	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
161	7	3.0	0	7	3	1	1	1	0	60	0	DE	DL
162	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
163	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
164	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
165	0	1.0	0	0	0	0	0	0	0	56	0	DA	DL

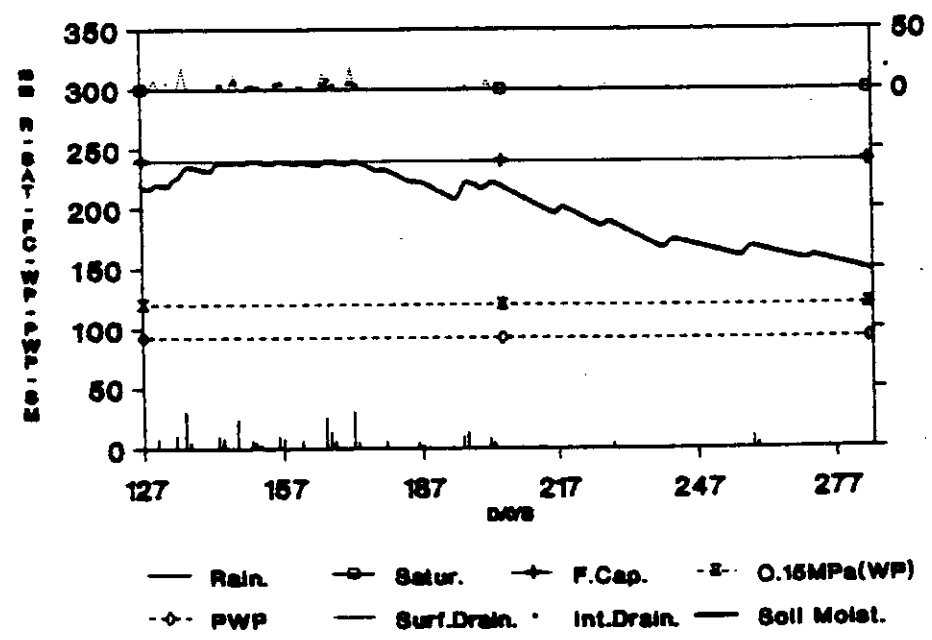
Day	HR (mm)	HET (mm)	HSD (mm)	HWL-TWL (mm)	(h)	HID-TID (mm)	(h)	TLI (h)	HAS (mm)	HDS (mm)	HIR (mm)	Class.	
166	25	3.0	0	24	12	18	18	18	0	60	0	DE	DL
167	14	3.0	0	13	7	11	11	11	0	60	0	DE	DL
168	6	3.0	0	6	3	3	3	3	0	60	0	DE	DL
169	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
170	0	1.0	0	0	0	0	0	0	0	58	0	DA	DL
171	0	1.0	0	0	0	0	0	0	0	57	0	DA	DL
172	30	3.0	0	29	14	24	24	24	0	60	0	DW	DE
173	5	2.0	0	5	2	3	3	2	0	60	0	DE	DL
174	0	1.0	0	0	0	0	0	0	0	59	0	DA	DL
175	0	2.0	0	0	0	0	0	0	0	57	0	DA	DL
176	0	2.0	0	0	0	0	0	0	0	55	0	DA	DL
177	0	2.0	0	0	0	0	0	0	0	53	0	DA	DL
178	0	2.0	0	0	0	0	0	0	0	51	0	DA	
179	6	3.0	0	6	3	0	0	0	0	54	0	DA	DL
180	0	2.0	0	0	0	0	0	0	0	52	0	DA	
181	0	2.0	0	0	0	0	0	0	0	50	0	DA	
182	0	2.0	0	0	0	0	0	0	0	48	0	DA	
183	0	2.0	0	0	0	0	0	0	0	46	0	DA	
184	0	2.0	0	0	0	0	0	0	0	44	0	DA	
185	0	2.0	0	0	0	0	0	0	0	42	0	DA	
186	4	3.0	0	4	2	0	0	0	0	43	0	DA	
187	2	2.0	0	2	1	0	0	0	0	43	0	DA	
188	0	2.0	0	0	0	0	0	0	0	41	0	DA	
189	0	2.0	0	0	0	0	0	0	0	39	0	DA	
190	0	2.0	0	0	0	0	0	0	0	37	0	DA	
191	0	2.0	0	0	0	0	0	0	0	35	0	DA	
192	0	2.0	0	0	0	0	0	0	0	33	0	DA	
193	0	2.0	0	0	0	0	0	0	0	31	0	DA	
194	0	2.0	0	0	0	0	0	0	0	29	0	DT	
195	0	2.0	0	0	0	0	0	0	0	27	0	DT	
196	10	2.0	0	10	5	0	0	0	0	35	0	DA	
197	14	2.0	0	13	7	0	0	0	0	47	0	DA	
198	0	2.0	0	0	0	0	0	0	0	45	0	DA	
199	0	2.0	0	0	0	0	0	0	0	43	0	DA	
200	0	2.0	0	0	0	0	0	0	0	41	0	DA	
201	0	2.0	0	0	0	0	0	0	0	39	0	DA	
202	8	3.0	0	8	4	0	0	0	0	44	0	DA	
203	4	2.0	0	4	2	0	0	0	0	46	0	DA	
204	0	2.0	0	0	0	0	0	0	0	44	0	DA	
205	0	2.0	0	0	0	0	0	0	0	42	0	DA	
206	0	2.0	0	0	0	0	0	0	0	40	0	DA	
207	0	2.0	0	0	0	0	0	0	0	38	0	DA	
208	0	2.0	0	0	0	0	0	0	0	36	0	DA	
209	0	2.0	0	0	0	0	0	0	0	34	0	DA	
210	0	2.0	0	0	0	0	0	0	0	32	0	DA	
211	0	2.0	0	0	0	0	0	0	0	30	0	DA	
212	0	2.0	0	0	0	0	0	0	0	28	0	DT	
213	0	2.0	0	0	0	0	0	0	0	26	0	DT	
214	0	2.0	0	0	0	0	0	0	0	24	0	DT	
215	0	2.0	0	0	0	0	0	0	0	23	1	DF	DI
216	0	2.0	0	0	0	0	0	0	0	23	2	DF	DI
217	0	2.0	0	0	0	0	0	0	0	23	2	DF	DI
218	12	2.0	0	12	6	0	0	0	0	33	0	DA	
219	0	2.0	0	0	0	0	0	0	0	31	0	DA	
220	0	2.0	0	0	0	0	0	0	0	29	0	DT	

Dav	HR (mm)	HET (mm)	HSD (mm)	HWL-TWL (mm)	(h)	HID-TID (mm)	(h)	TLI (h)	HAS (mm)	HDS (mm)	HIR (mm)	Class.	
221	0	2.0	0	0	0	0	0	0	0	27	0	DT	
222	0	2.0	0	0	0	0	0	0	0	25	0	DT	
223	0	2.0	0	0	0	0	0	0	0	23	0	DP	
224	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
225	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
226	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
227	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
228	8	2.0	0	8	4	0	0	0	0	29	0	DT	
229	0	2.0	0	0	0	0	0	0	0	27	0	DT	
230	0	2.0	0	0	0	0	0	0	0	25	0	DT	
231	0	2.0	0	0	0	0	0	0	0	23	0	DP	
232	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
233	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
234	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
235	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
236	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
237	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
238	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
239	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
240	0	2.0	0	0	0	0	0	0	0	23	2	DP	DI
241	5	2.0	0	5	2	0	0	0	0	26	0	DT	
242	7	2.0	0	7	3	0	0	0	0	31	0	DA	
243	0	1.0	0	0	0	0	0	0	0	30	0	DT	
244	0	1.0	0	0	0	0	0	0	0	29	0	DT	
245	0	1.0	0	0	0	0	0	0	0	28	0	DT	
246	0	1.0	0	0	0	0	0	0	0	27	0	DT	
247	0	1.0	0	0	0	0	0	0	0	26	0	DT	
248	0	1.0	0	0	0	0	0	0	0	25	0	DT	
249	0	1.0	0	0	0	0	0	0	0	24	0	DT	
250	0	1.0	0	0	0	0	0	0	0	23	0	DP	
251	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
252	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
253	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
254	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
255	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
256	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
257	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
258	10	3.0	0	10	5	0	0	0	0	30	0	DT	
259	4	2.0	0	4	2	0	0	0	0	32	0	DA	
260	0	1.0	0	0	0	0	0	0	0	31	0	DA	
261	0	1.0	0	0	0	0	0	0	0	30	0	DT	
262	0	1.0	0	0	0	0	0	0	0	29	0	DT	
263	0	1.0	0	0	0	0	0	0	0	28	0	DT	
264	0	1.0	0	0	0	0	0	0	0	27	0	DT	
265	0	1.0	0	0	0	0	0	0	0	26	0	DT	
266	0	1.0	0	0	0	0	0	0	0	25	0	DT	
267	0	1.0	0	0	0	0	0	0	0	24	0	DT	
268	0	1.0	0	0	0	0	0	0	0	23	0	DP	
269	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
270	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
271	0	1.0	0	0	0	0	0	0	0	23	1	DP	DI
272	6	2.0	0	6	3	0	0	0	0	27	0	DT	
273	0	1.0	0	0	0	0	0	0	0	26	0	DT	
274	0	1.0	0	0	0	0	0	0	0	25	0	DT	
275	0	1.0	0	0	0	0	0	0	0	24	0	DT	

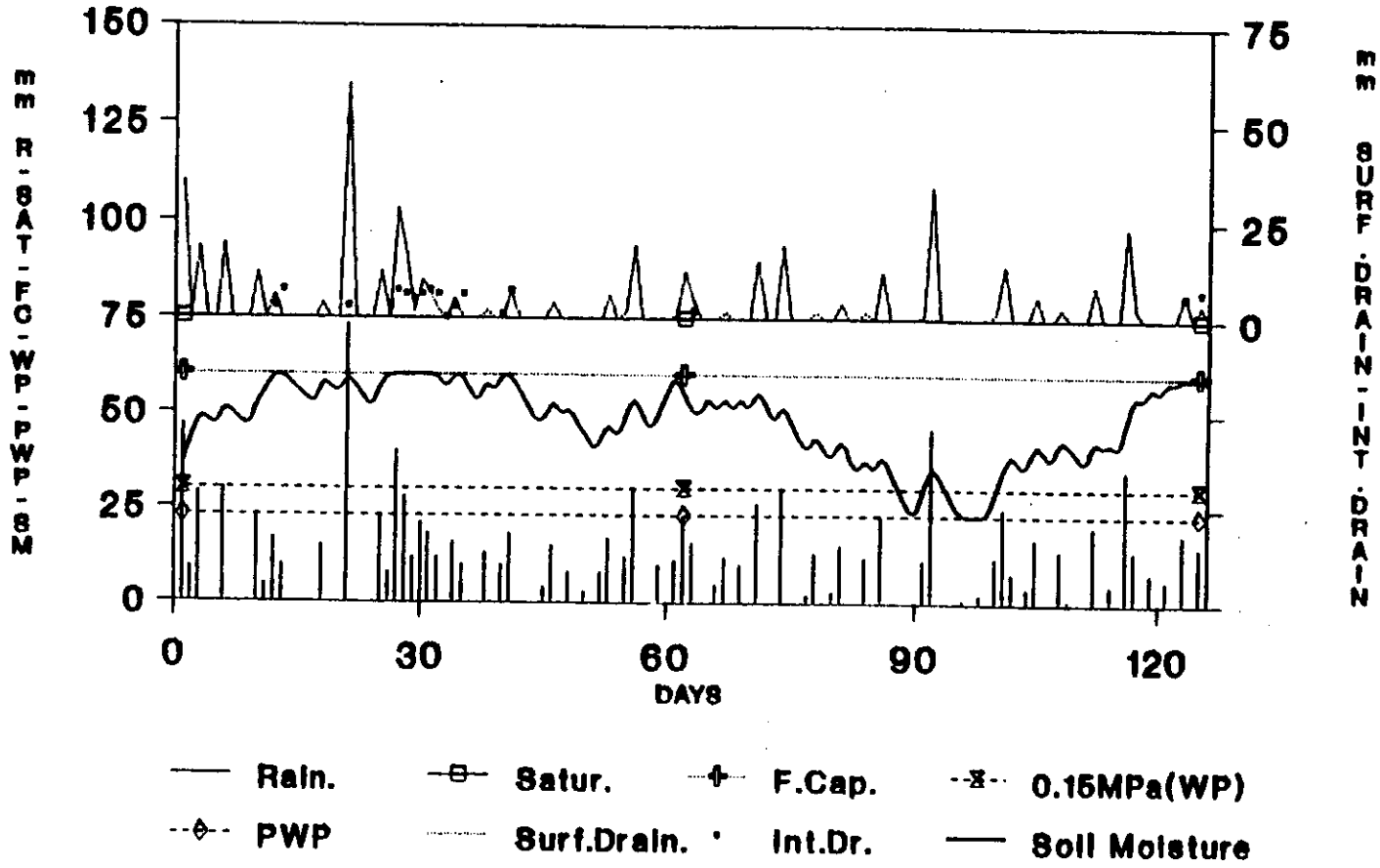
Soil Moisture Regime (TUREN)
15 May-20 Sept.(Corn. 60 cm Root Depth)
(No Slope;Bare;Drainage;Average rain.)



Soil Moisture Regime (TUREN)
21 Sept-28 Feb.(Sesame.60 cm.Root Depth)
(No Slope;Bare;Drainage;Aver.Rainfall)

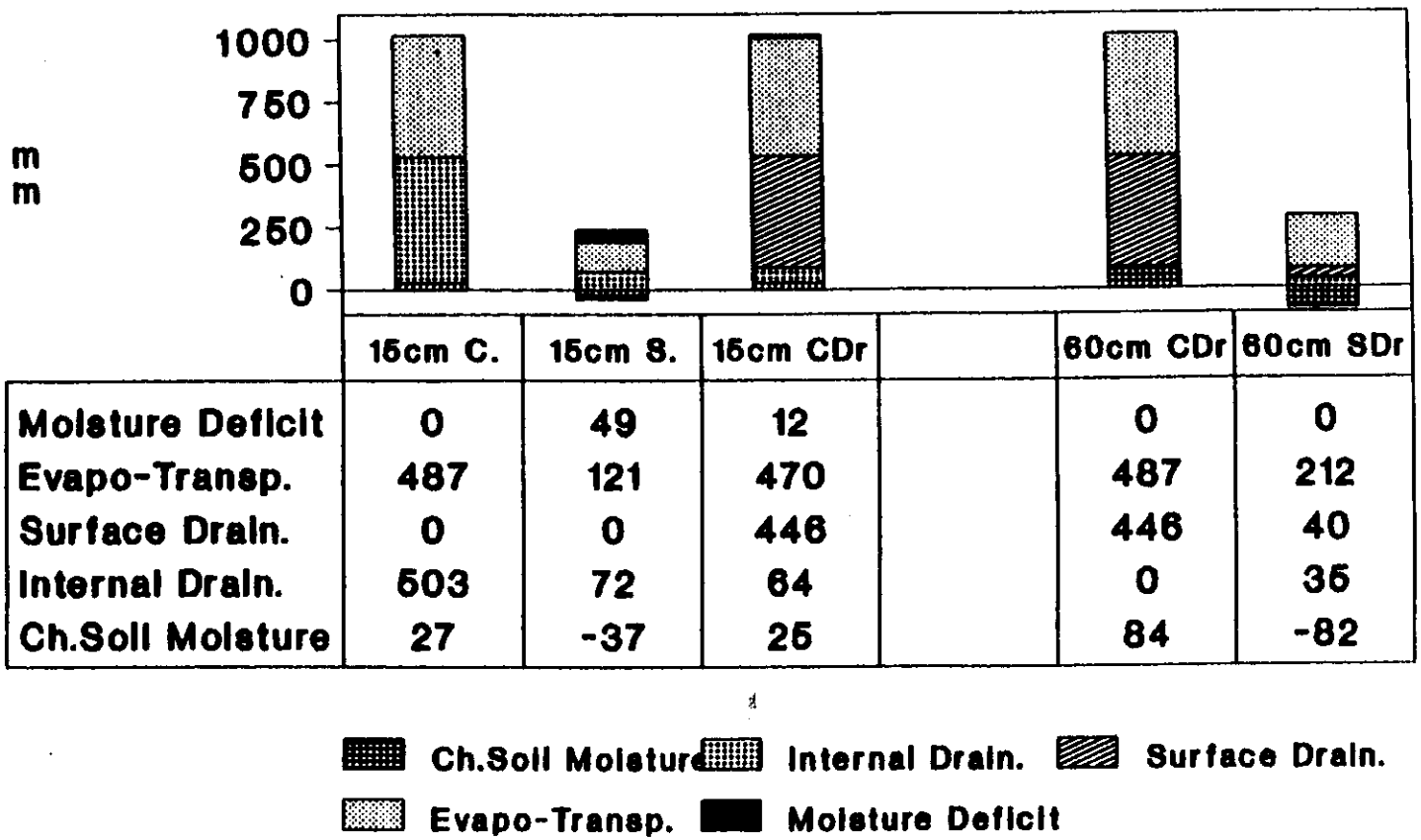


Soil Moisture Regime (TUREN)
15 May-20 Sept.(Corn. 15 cm Root Depth)
(No Slope;Bare;Drainage;Average rain.)



Water Balance (TUREN) (Aver. Rainfall)

Corn(C.) and Sesame(S.) growing cycles
Bare;Without and with(Dr.)surface drain.



	15cm C.	15cm S.	15cm CDr		60cm CDr	60cm SDr
Moisture Deficit	0	49	12		0	0
Evapo-Transp.	487	121	470		487	212
Surface Drain.	0	0	446		446	40
Internal Drain.	503	72	64		0	35
Ch.Soil Moisture	27	-37	25		84	-82