MOISTURE PROBES - A GROWERS VIEW

Hugh Holland (Agronomist, Telleraga Station, Moree)

SYNOPSIS

PART 1 - Answers to the questions:

(i) How do I find and use probes for scheduling irrigations?

(ii) Are they used as the only scheduling tool?

(iii) How do we use our water most effectively?

PART 2 - Identification of end points;
(Field Capacity and Refill Point)

PART 3 - Other uses for the probe.

PART 1 MOISTURE PROBES - A GROWERS VIEW

Q. How do I find and use probes for scheduling irrigations?

A. The neutron probe is probably the most accurate instrument yet devised to quickly measure the soil moisture content at any given point of time. The accuracy and speed of measurement allows me to take multiple readings of soil moisture over a short period of time and thus gain a very accurate calculation of the crop's daily water use. By extrapolating this water use figure up to ten days in advance (which is the lead time that we need to order water from Copeton Dam) I am able to, quite accurately schedule irrigations.

Q. Are they used as the only scheduling tool?

A. Basically, yes. The neutron probe can and has been used as the only irrigation scheduling tool on Telleraga. With some experience, the neutron probe can be an enormously successful scheduling tool provided some basic procedures are followed.

Firstly it is important that the access tubes are placed in a part of the field that is typical of the whole field. If this is not possible then consideration may have to be given to use of more than one site in the field, or, in the case of a small field then the soil type that tends to have a lower water holding capacity should be chosen. It is better to irrigate parts of a

PART 1 MOISTURE PROBES - A GROWERS VIEW CONT.

field before they reach fefill point than to allow other parts to stress. At best, even a mild moisture stress is losing growing time.

Secondly it is obviously, most important that you use the correct refill point and once that is established then it should be quite repeatable, even from season to season provided the access tubes are placed in the same spot and that there has been no dramatic change to land use. Methods of determining refill point will be dealt with elsewhere in this paper.

Thirdly, the most critical point of all, is that it is imperative that sufficient readings be taken to give an accurate estimate of water use. As a guide, a minimum of two readings per week when there are no dramatic diurnal variations in the weather would be sufficient. Obviously, after rainfall, irrigation or just leading up to irrigation then more frequent reading may be required. Even with a neutron probe frequent readings are time consuming and I have found the computer probe and the Tandy 1000 computer/N.P.S. software a tremendous aid in making a sometimes labourious job a little more pleasant.

Q. How do we use our water most effectively?

A. At Telleraga, we have a water allocation of 14000

PART 1 MOISTURE PROBES - A GROWERS VIEW CONT.

megalitres which is sufficent to grow 1650 ha or 4080 ac of cotton. We do, in fact regularly grow around 2200 ha or 5500 ac. We rely quite heavily on off allocation, high flow water. We have the capacity to store up to 7000 megalitres on farm and we have a very efficient tailwater recirculation system. We also have a "through the bank" outlet irrigation system which is not only labour efficient but allows us to water our country very quickly, thus avoiding waterlogging problems in the crop and cutting back on transmission loses through evaporation. Our irrigation system is very flexible and it is possible to water fields in any sequence. This is important because we are then able to make maximum use of the neutron probe's ability to identify the precise timing of irrigation. The probe also aids in improving water use efficiency by virtue of the fact that it can identify the soil moisture level at which refill is required. In some instances, by using the probe, irrigation timing may be delayed and in cases where rainfall or lower temperatures occur, the probe may even save one or more irrigations.

PART 2 IDENTIFING END POINTS; (Field Capacity and Refill Point)

Determining Full Point or Field Capacity

This, obviously, can only be accurately done by taking a probe reading within 24 - 48 hours following an irrigation. If probes have been used in a field previously, then it is reasonable to assume figures from a previous year initially. If not, then a 0 - 70 cm soil moisture content of between 220 - 330 could be assumed. This can be updated following an irrigation.

Determining Refill Point

As a rough guide. Previous years data can be used (if available). Otherwise, a deficit of between 60 - 70 mm should be used for first irrigation.

The most reliable and accurate method with the probe is to take frequent readings close to an expected irrigation. These readings should be daily, or at least every two days. They must be taken at the same time of the day. From this the daily water use can be calculated. The point at which daily water use changes is the refill point. (Figure 1 & Figure 2)

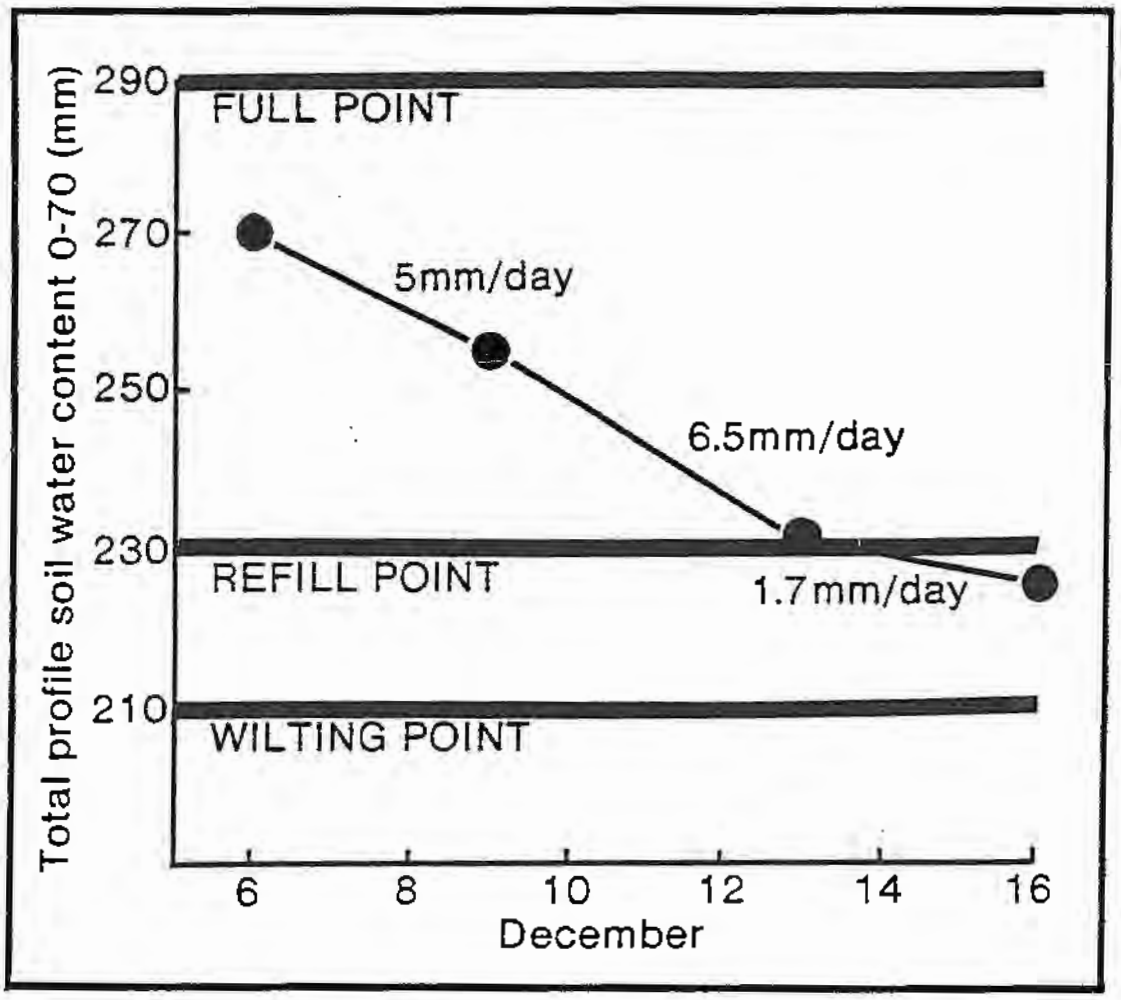


FIGURE 1 CHANGE IN DAILY WATER USE TO INDICATE REFILL POINT

TELLERAGA STATION
READINGS REPORT

FIELD NAME:FIELD 18 CROP: COTTON HECTARES: 121 FIELD/SITE: 18 / 3

ROOT ZONE	DEPTH	FULL POINT	REFILL POINT	DATE 11/10	DATE 14/10	DATE 21/10	DATE 24/10	DATE 26/10	DATE 28/10	DATE 31/10	DATE 5/11	DATE 06/11	DATE 08/11	DATE 14/11	DATE 19/11
1	20 cm	37.8	23.9	16.6	22.0	16.4	16.4	IRRIG	31.0	25.8	24.4	IRRIG	34.1	27.6	27.1
2	30 cm	43.3	28.9	31.1	34.6	31.8	31.6		41.6	37.7	36.4		42.7	37.9	37.0
3	40 cm	46.9	37.1	40.1	41.6	40.8	40.7		46.6	44.0	43.9		46.7	44.3	43.9
4	50 cm	45.1	40.2	40.8	41.3	41.2	41.2		44.9	44.7	43.8		45.1	44.7	44.6
5	60 cm	42.7	40.3	37.8	37.5	37.7	37.7		42.7	41.9	42.2		42.5	42.3	42.6
6	80 cm	38.7	38.7	32.6	32.6	32.7	32.8		34.2	34.3	34.9		37.1	37.8	37.6
7	100 cm	36.9	36.9	32.4	32.5	32.5	32.7		32.8	33.0	33.3		33.8	34.4	34.4
8	120 cm	34.2	34.2	30.6	30.5	30.7	30.8		31.0	31.2	31.3		31.7	32.9	32.7
TOTAL 0-70		294	226	210	229	211	211		275	254	248		284	259	257
TOTAL25-70		199	167	169	174	170	170		197	189	187		198	190	189
TOTAL 0-130		513	446	401	420	403	404		471	451	447		489	469	467
DAILY USE(ET)					-6.3	2.6				7.0	1.2			4.2	0.4

ROOT ZONE	DEPTH	FULL POINT	REFILL POINT	DATE 21/11	DATE 25/11	DATE 27/11	DATE 3/12	DATE 6/12	DATE 11/12	DATE 17/12	DATE 18/12	DATE 19/12	DATE 20/12	DATE 21/12	DATE 27/12
1	20 cm	37.8	23.9	27.0	26.1	30.2	31.6	31.8	32.3	27.4	26.4	25.7	IRRIG	37.8	28.9
2	30 cm	43.3	28.9	36.9	35.9	38.6	40.0	40.2	40.9	37.2	36.3	35.9		43.3	37.6
3	40 cm	46.9	37.1	44.2	43.6	44.5	45.4	45.5	46.1	44.0	43.3	43.6		46.9	43.8
4	50 cm	45.1	40.2	44.2	44.4	44.4	45.0	45.2	45.3	44.6	44.0	44.3		45.1	44.4
5	60 cm	42.7	40.3	42.0	42.1	42.1	42.9	42.3	42.4	42.5	42.1	42.5		42.7	42.4
6	80 cm	38.7	38.7	37.6	38.3	37.8	38.3	38.3	38.5	38.4	37.3	38.3		38.7	38.5
7	100 cm	36.9	36.9	34.4	35.0	34.8	35.0	35.4	36.1	36.6	35.6	36.2		36.9	36.8
8	120 cm	34.2	34.2	32.5	32.8	32.9	32.8	32.6	33.1	32.8	33.3	33.6		34.2	34.8
TOTAL 0-70		294	226	256	252	266	274	274	277	258	253	252		294	261
TOTAL25-70		199	167	188	187	191	195	194	196	190	187	188		199	189
TOTAL 0-130		513	446	465	465	477	486	487	492	474	465	468		514	481
DAILY USE(ET)				0.5	1.0	-7.0	-1.3		-0.6	3.2	5.0	1.0			5.5

ROOT ZONE	DEPTH	FULL POINT	REFILL POINT	DATE 28/12	DATE 29/12	DATE 30/12	DATE 31/12	DATE 2/1	DATE 4/1	DATE 5/1	DATE 7/1	DATE 8/1	DATE 9/1	DATE 11/1	DATE 13/1
1	20 cm	37.8	23.9	28.2	27.0	26.2	27.7	25.9	25.1	25.6	23.9	25.0	16.2	14.9	IRRIG
2	30 cm	43.3	28.9	37.1	36.0	35.1	34.5	33.7	31.5	31.5	29.9	29.2	25.6	24.6	
3	40 cm	46.9	37.1	44.0	42.9	42.6	42.1	41.1	39.8	39.8	38.1	37.5	35.4	34.2	
4	50 cm	45.1	40.2	44.5	43.9	43.9	43.3	43.0	42.0	42.4	41.2	40.8	38.9	38.5	
5	60 cm	42.7	40.3	42.8	42.2	42.5	42.1	42.1	41.9	41.5	41.3	41.2	40.3	40.2	
6	80 cm	38.7	38.7	38.6	38.4	38.4	38.3	38.3	38.3	38.4	38.3	38.0	38.5	38.4	
7	100 cm	36.9	36.9	37.0	37.0	36.8	37.0	36.9	36.8	36.9	37.2	36.9	37.5	37.2	
8	120 cm	34.2	34.2	34.8	35.1	34.9	35.0	35.0	34.6	34.4	35.0	35.0	34.6	34.7	
TOTAL 0-70		294	226	260	253	251	252	246	239	240	231	232	201	195	
TOTAL25-70		199	167	190	186	185	183	181	176	176	171	169	160	158	
TOTAL 0-130		513	446	481	474	471	473	466	458	459	452	451	422	415	
DAILY USE(ET)				1.0	7.0	2.0	-1.0	3.0	3.5	-1.0	4.5	-1.0	31.0	3.0	

FIGURE 2 USING DAILY WATER USE CHANGES TO DETERMINE REFILL

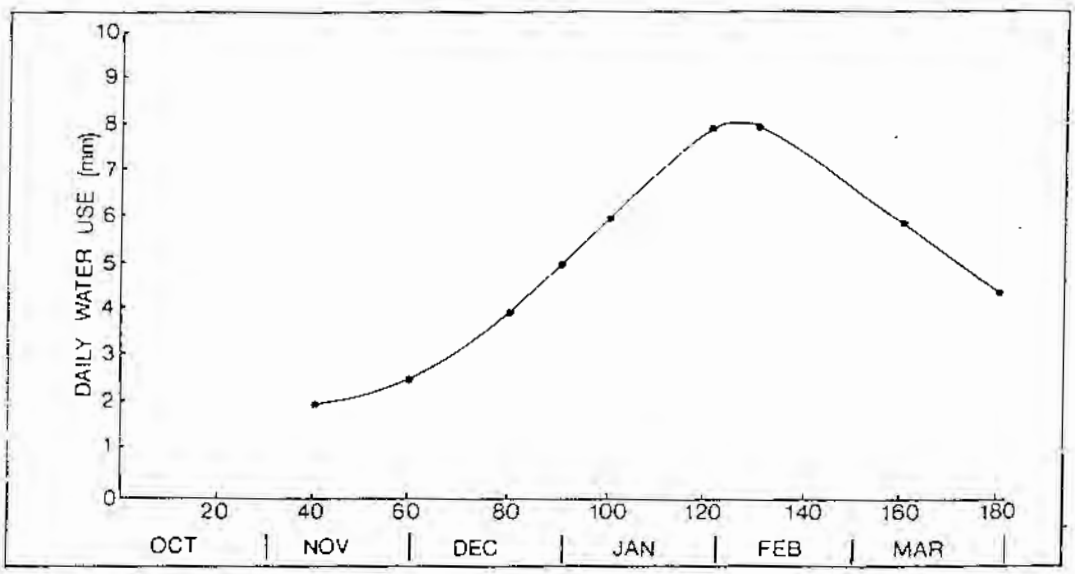


FIGURE 3 DAILY WATER USE FOR COTTON IN THE NAMOI VALLEY

Figure 3 gives a rough guide to expected daily water use for an average season. This can be useful in cases where water needs to be ordered well in advance to meet an anticipated irrigation date. At Telleraga the water storages are used to store water if weather conditions delay irrigation or if anticipated daily water use has not been realised.

PART 2 IDENTIFYING END POINTS CONT.

Other factors to be considered when determining refill point:

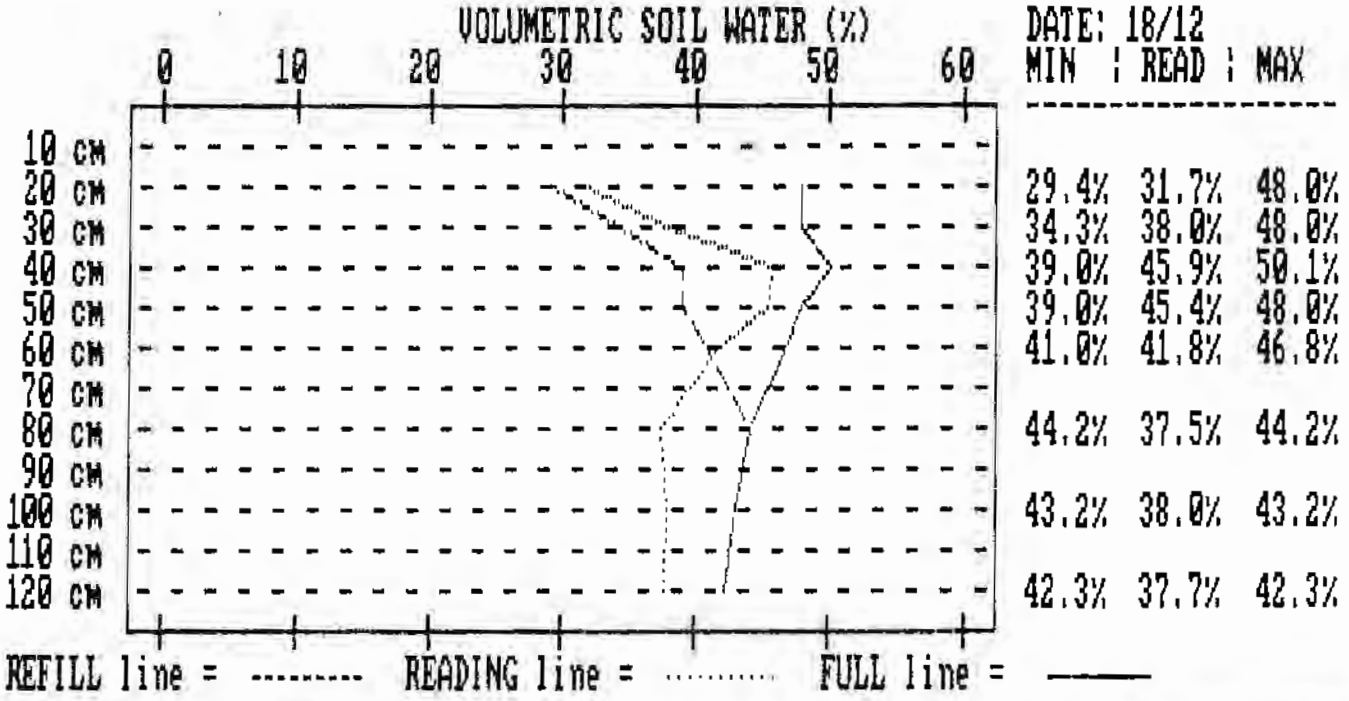
(a) Dry subsoil (Figures 4 and 5) shows that whilst there is ample soil moisture to 40 cm that the available moisture is less lower down. This simply means that the refill point will be higher and that more frequent irrigations will need to be carried out to avoid plant stress.

(b) Differential refill points between first and subsequent irrigations.

In the time leading up to first irrigation, it appears that the plants tend to use water in the upper profile faster than the root system can grow to reach the lower water. Therefore the refill point for first irrigation should usually be higher than for subsequent irrigations.

TOGO STATION
WATER EXTRACTION PROFILE

FIELD/SITE: 91 / 3
HECTARES: 87
CROP: OP90
FIELD NAME:F91



DATE: 18/12

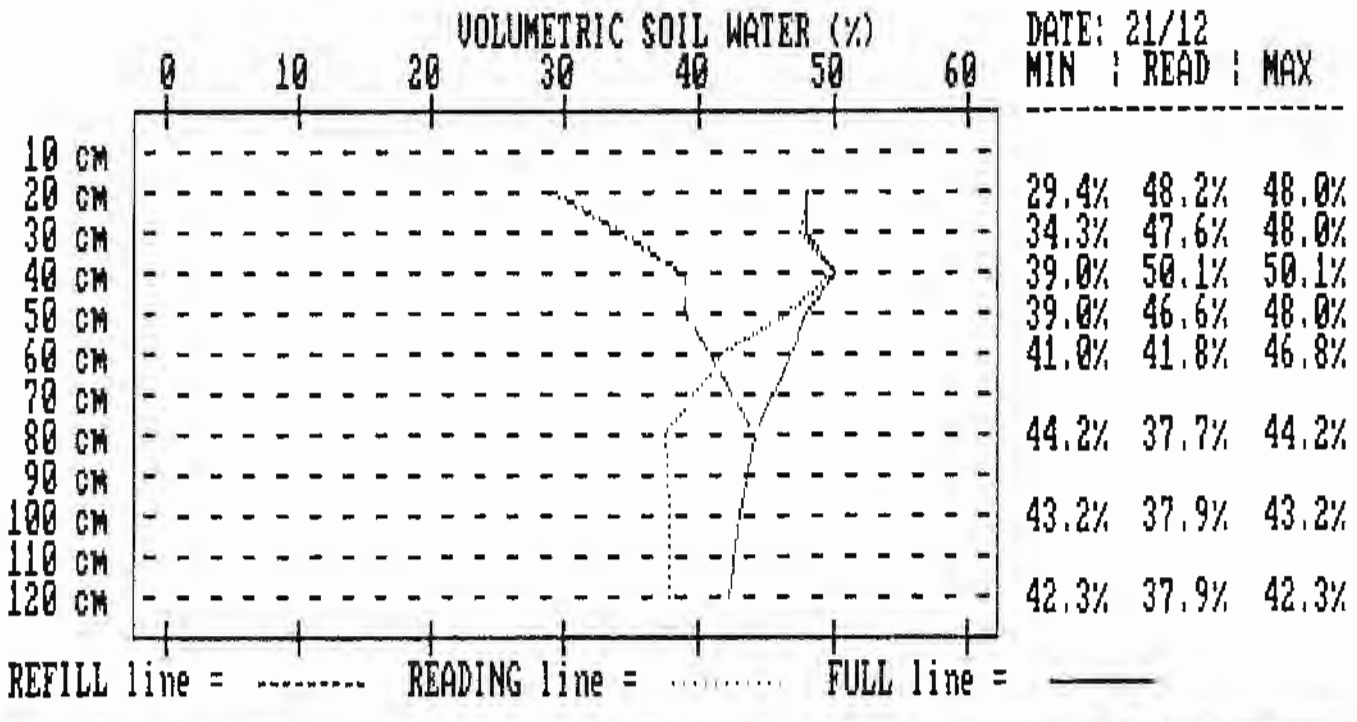
MIN	READ	MAX
29.4%	31.7%	48.0%
34.3%	38.0%	48.0%
39.0%	45.9%	50.1%
39.0%	45.4%	48.0%
41.0%	41.8%	46.8%
44.2%	37.5%	44.2%
43.2%	38.0%	43.2%
42.3%	37.7%	42.3%

DEPTH (cm)	SOIL WATER CONTENT FULL	REFILL	PREV	CURR	DAYS DIFF	DAILY WATER USE	NEXT IRRIGATION DATE	AMOUNT
0- 70	336	247	295	271	4	6.0	22/12	89
25- 70	216	174	200	192	4	2.0	27/12	42
0-130	596	507	522	498	4	6.0	17/12	89

FIGURE 4 DRY SUBSOIL AT TOGO

TOGO STATION
WATER EXTRACTION PROFILE

FIELD/SITE: 91 / 7
HECTARES: 87
CROP: DF90
FIELD NAME:F91

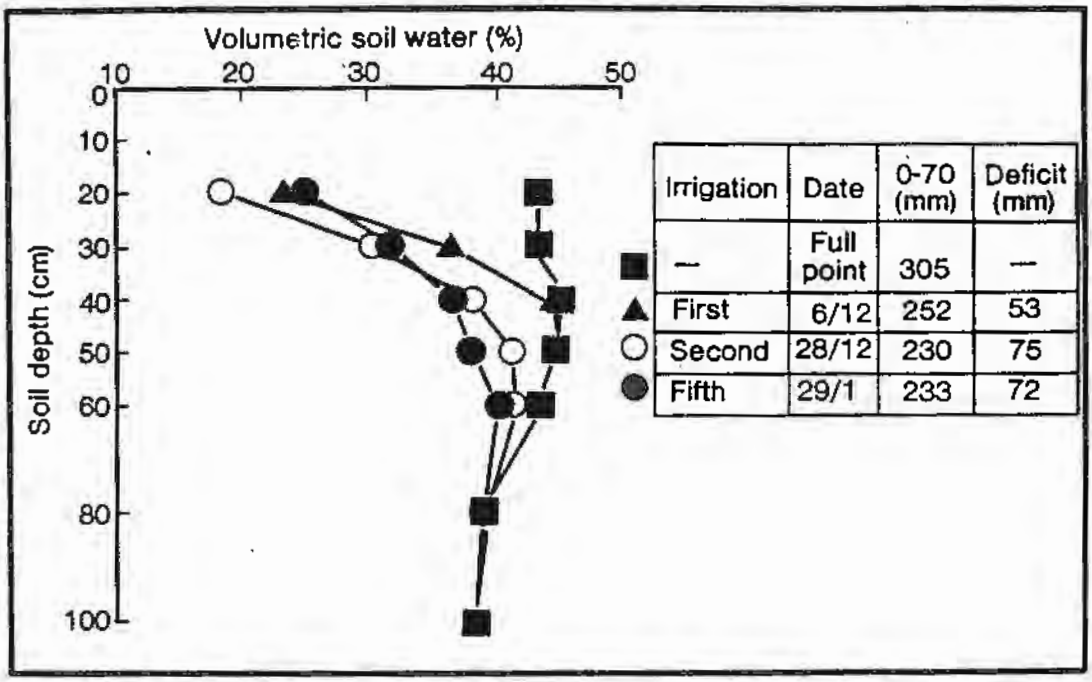


DATE: 21/12

MIN	READ	MAX
29.4%	48.2%	48.0%
34.3%	47.6%	48.0%
39.0%	50.1%	50.1%
39.0%	46.6%	48.0%
41.0%	41.8%	46.8%
44.2%	37.7%	44.2%
43.2%	37.9%	43.2%
42.3%	37.9%	42.3%

DEPTH (CM)	SOIL WATER CONTENT FULL	REFILL	PREV	CURR	DAYS DIFF	DAILY WATER USE	NEXT IRRIGATION DATE	AMOUNT
0- 70	336	247		327				
25- 70	216	174		207				
0-130	596	507		554				

FIGURE 5 DRY SUBSOIL AT TOGO



Irrigation	Date	0-70 (mm)	Deficit (mm)
—	Full point	305	—
First	6/12	252	53
Second	28/12	230	75
Fifth	29/1	233	72

FIGURE 6 DIFFERENTIAL REFILL POINTS BETWEEN FIRST AND SUBSEQUENT IRRIGATIONS.

PART 3 OTHER USES FOR THE PROBE

(i) Early Identification of Soil Compaction

The neutron probe is very useful in identifying compaction zones in the soil profile. Soil compaction leads to a reduced water infiltration into the soil profile. This leads to a shift to the left in the soil water measurements on the volumetric soil water percentage graph. The probe therefore warns of the possible need for more frequent irrigations, a higher refill point and the need for further investigation to facilitate possibe remedial action.

PART 3 USES FOR THE PROBE CONT.

(ii) The use of the probe in conjunction with other water measuring and irrigation scheduling tools.

Plant signs such as stunted growth, fruiting close to the top of the plant etc can be used as a rough guide to determining refill point. The probe can be used to quantify and verify these indications.

The infra red gun and pressure bomb are tools that can measure stress in the plant and are very good for identifying refill points or isolating problem areas within fields. The neutron probe is also a very effective tool for updating information for the Siratac irrigation scheduling program.

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