III.2.6 Ridge Height Examination Trial in Furrow Irrigation

(1) Objectives

To investigate the adequate ridge height in peat -muck soil in the flood plain edge.

(2) Results and discussions

Stem length on the 20 cm ridge height plot at W-2 and M-5-1 fields in the early growth stage was bigger than in other plots but this difference was no longer apparent in the later growth stage. Leaf yellowing which was related to acid soil occurred at M-5-1 field in the early growth stage but improved gradually following the successive rains. Growth was afterwards generally good, especially at the W-2 field whose soils included sandy soil. The tried variety at the W-2 and M-5-1 fields reached maturation at the end of November and beginning of December, and were harvested on the 14th of December.

The results of the yield survey shows the unit yield at W-2 field for the 10 cm and 15 cm ridge height plots as 3,923 kg/ha, the yield of the 20 cm plot at the same field was 4,066 kg/ha. The unit yield at M-5-1 for the 10 cm and 20 cm ridge height plots was 1,699 kg/ha and the yield of the 15 cm plot at the same field was 2,144 kg/ha. According to the results mentioned above, the difference of unit yield among plots was small at W-2 field whose soil included sandy soil and a low ground water level, but at M-5-1 field whose peat-muck soil was pilled up more than 1m thick, the unit yield of 15 cm plot was higher than the other plot. The difference of the unit yield between W-2 and M-5-1 field came out more than twice bigger than expected. Therefore this made it clear that the selection of an adequate verification area for upland crop irrigation is quite important. The results of the yield survey and the growth observation are shown in Tables III.2.12 and III.2.13.

Table III.2.1 Rainfall Frequency and Return Period at Mongu

Ranking	Year	Observed Rainfall	Probability	Return Period
1	1982	724.3	3.84615	26.000000
2	1984	752.5	11.53846	8.666667
3	1983	760.2	19.23077	5.200000
4	1985	763.4	26.92308	3.714286
5	1987	779.6	34.61539	2.888889
6	1988	835.6	42.30770	2.363636
7	1990	876.5	50.00000	2.000000
8	1980	883.7	57.69231	1.733333
9	1981	920.9	65.38461	1.529412
10	1986	927.7	73.07692	1.368421
11	1979	950.3	80.76923	1.238095
12	1991	966.1	88.46154	1.130435
13	1989	1078.2	96.15384	1.040000

Table III.2.2 Daily Rainfall (mm) at Mongu 1983

DAY \ MON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	4.8	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	4.6
2	1.0	0.0	0.0	0.0	15.5	0.0	0.0	0.0	0.0	0.0	0.4	16.0
3	0.6	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
5	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
7	1.0	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5
8	0.0	0.0	39.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4	0.0
9	1.4	3.7	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
10	0.0	25.8	38.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	13.8	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6
12	0.0	5.2	0.4	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
13	0.0	1.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.9
14	27.4	0.3	1.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	7.6
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1
19	7.6	14.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
20	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	5.6
21	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0
22	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	26.1	15.6
23	2.4	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.4
24	9.3	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	2.5	17.8
25	0.2	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1
26	31.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.3
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	8.5
29	36.3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0
30	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
31	28.8		0.0		0.0		0.0	0.0		0.0		4.0
TOTAL	236.9	125.0	102.9	27.1	15.5	0.0	0.0	0.0	0.0	32.4	77.7	142.8

Table III.2.3 Daily Mean Temprtature (°C) at Mongu 1983

DAY \ MON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	22.4	23.2	26.1	24.6	24.3	19.6	20.4	18.9	21.8	27.9	26.1	22.8
2	22.4	23.2	25.3	24.6	23.8	19.9	20.3	19.7	22.2	28.4	25.8	22.2
3	22.2	25.4	25.0	24.9	23.1	19.5	18.3	19.2	23.2	28.9	23.4	21.0
4	23.6	22.1	25.1	23.8	23.2	19.8	17.3	19.2	24.0	27.3	24.2	23.5
5	22.9	25.0	24.9	22.3	21.8	20.2	17.8	18.8	24.7	27.3	26.8	21.9
6	21.1	21.9	25.1	22.6	21.1	20.8	18.8	19.1	24.3	27.2	26.9	23.7
7	21.5	23.7	24.9	21.3	20.6	21.6	20.4	18.5	23.3	26.9	26.4	22.6
8	24.5	22.7	24.3	22.7	21.5	20.8	20.8	19.1	23.6	28.1	26.1	23.5
9	23.3	22.9	23.3	23.0	21.8	20.5	20.1	16.8	22.5	27.0	20.5	23.5
10	22.9	20.8	22.1	22.8	22.6	19.2	19.0	16.8	24.5	27.8	24.1	24.2
11	24.6	22.2	22.3	24.0	23.7	19.6	18.9	17.6	23.7	27.1	24.6	22.4
12	25.0	20.8	22.8	22.7	23.6	20.9	18.6	16.6	21.1	27.9	25.3	23.1
13	22.4	23.1	23.3	22.3	22.9	18.3	18.0	16.7	23.1	27.0	25.4	22.1
14	21.6	24.5	22.9	24.5	22.4	19.1	18.9	17.2	22.9	28.0	22.1	23.5
15	22.5	23.4	24.8	21.1	24.0	20.4	19.3	18.0	22.7	26.4	24.9	24.6
16	23.6	23.5	23.4	24.1	23.6	20.8	19.6	18.6	24.2	24.3	21.5	24.5
17	22.9	24.2	24.3	25.2	24.0	21.2	20.1	19.6	24.1	23.9	24.3	20.8
18	23.2	23.6	24.1	24.3	23.4	18.3	18.7	20.8	23.7	25.6	24.7	21.1
19	22.4	24.0	23.5	24.5	22.8	14.7	17.9	19.6	21.6	22.2	26.2	22.4
20	23.1	25.7	23.8	25.2	21.9	15.9	18.0	20.3	22.9	24.9	23.9	21.6
21	22.1	23.6	25.0	23.8	22.1	17.6	18.5	19.1	22.3	24.6	21.2	21.8
22	22.1	24.9	21.3	22.8	21.3	18.3	19.4	19.4	21.3	23.9	23.6	21.7
23	23.2	26.1	24.3	21.5	19.3	18.3	20.1	20.0	19.3	20.1	20.4	23.0
24	22.3	25.9	25.4	22.3	17.9	17.7	20.5	18.5	20.4	21.9	23.9	21.4
25	23.2	26.2	22.3	22.6	19.3	19.3	19.8	18.4	22.1	23.5	22.8	22.3
26	21.4	25.3	23.5	21.6	22.1	18.7	20.6	19.2	22.3	26.0	23.5	23.2
27	23.3	25.9	25.3	20.8	20.5	18.6	19.4	20.3	24.0	24.5	24.9	23.1
28	22.6	27.6	24.7	21.6	18.6	17.9	17.9	22.1	23.9	25.5	24.8	20.7
29	22.4		22.8	22.5	18.1	18.3	18.6	23.4	23.7	26.2	22.5	22.9
30	24.6		23.4	24.6	17.5	20.6	19.0	25.5	23.7	25.5	23.9	23.6
31	23.7		24.2		18.7		18.8	24.2		25.6		21.7
MEAN	22.9	24.0	24.0	23.2	21.7	19.2	19.2	19.4	22.9	25.9	24.2	22.6

Table III.2.4 Daily Mean Relative Humidity (%) at Mongu 1983

DAY \ MON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	83	79	82	56	59	39	47	49	33	32	53	83
2	83	83	88	58	60	48	45	42	35	32	57	83
3	83	73	66	60	67	50	46	34	33	39	68	74
4	79	83	70	71	64	45	53	33	34	44	65	83
5	80	79	73	78	67	44	49	45	29	40	50	74
6	87	86	72	71	61	47	47	41	26	25	49	80
7	84	83	73	83	63	52	49	43	32	30	53	76
8	71	85	78	75	55	54	54	25	31	29	54	75
9	80	86	83	76	57	54	51	21	25	32	88	73
10	80	93	86	78	56	51	47	34	25	29	72	81
11	72	86	86	74	54	52	49	35	29	23	66	81
12	68	90	83	80	57	58	45	40	31	26	66	84
13	80	83	82	82	62	68	46	40	22	23	63	77
14	88	76	84	73	66	60	41	38	25	39	79	69
15	87	79	76	69	61	48	39	33	33	43	65	68
16	83	71	83	72	62	51	33	29	30	58	71	88
17	89	68	69	67	56	52	33	28	30	59	64	89
18	81	66	72	69	56	47	44	27	32	55	62	83
19	89	78	82	62	57	42	56	28	22	73	56	86
20	87	67	81	53	60	47	52	30	26	51	70	87
21	87	67	74	53	58	53	52	35	31	64	89	88
22	92	67	68	55	62	48	43	29	38	69	75	82
23	83	63	77	58	40	48	39	28	26	89	87	88
24	92	66	77	57	32	52	36	44	19	81	74	83
25	83	67	91	54	43	45	43	49	15	70	80	61
26	95	65	83	57	44	41	42	49	18	54	77	76
27	84	66	71	65	48	38	35	43	28	53	69	95
28	86	43	63	64	36	43	24	37	25	59	70	82
29	86		65	57	43	50	31	39	25	48	77	82
30	76		59	54	40	50	50	35	28	57	67	77
31	78		56		33		50	27		56		85
MEAN	83	75	76	66	54	49	44	36	28	48	68	80

Table III.2.5 Daily Mean Wind Speed (miles/day) at Mongu 1983

DAY \ MON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	48.0	96.0	144.0	48.0	96.0	120.0	216.0	192.0	264.0	264.0	-	96.0
2	96.0	24.0	-	48.0	120.0	96.0	240.0	216.0	288.0	168.0	-	120.0
3	72.0	48.0	-	72.0	120.0	72.0	168.0	-	216.0	120.0	144.0	168.0
4	24.0	24.0	144.0	72.0	144.0	72.0	144.0	-	264.0	168.0	168.0	144.0
5	24.0	96.0	72.0	24.0	-	72.0	96.0	216.0	288.0	144.0	-	144.0
6	48.0	120.0	72.0	48.0	-	96.0	120.0	-	216.0	240.0	-	144.0
7	24.0	120.0	72.0	48.0	192.0	144.0	144.0	-	216.0	96.0	144.0	144.0
8	24.0	120.0	96.0	72.0	168.0	144.0	144.0	168.0	240.0	96.0	192.0	144.0
9	48.0	96.0	96.0	72.0	144.0	168.0	120.0	192.0	264.0	144.0	192.0	120.0
10	24.0	96.0	120.0	72.0	144.0	48.0	120.0	192.0	264.0	192.0	-	144.0
11	48.0	48.0	120.0	48.0	168.0	48.0	168.0	144.0	216.0	168.0	-	144.0
12	48.0	96.0	144.0	48.0	168.0	192.0	192.0	216.0	192.0	216.0	168.0	96.0
13	48.0	72.0	168.0	24.0	168.0	216.0	168.0	288.0	192.0	168.0	216.0	144.0
14	72.0	96.0	168.0	48.0	192.0	168.0	216.0	216.0	168.0	120.0	192.0	120.0
15	48.0	96.0	-	48.0	192.0	48.0	216.0	168.0	168.0	168.0	168.0	192.0
16	24.0	96.0	-	72.0	144.0	-	168.0	144.0	120.0	96.0	144.0	120.0
17	24.0	96.0	168.0	72.0	-	-	-	144.0	168.0	168.0	168.0	144.0
18	24.0	72.0	120.0	48.0	-	144.0	-	144.0	192.0	120.0	144.0	264.0
19	24.0	120.0	-	72.0	192.0	192.0	120.0	120.0	168.0	144.0	96.0	120.0
20	24.0	96.0	-	96.0	168.0	48.0	168.0	144.0	312.0	240.0	144.0	120.0
21	48.0	120.0	-	72.0	144.0	96.0	168.0	192.0	240.0	-	120.0	120.0
22	24.0	72.0	144.0	72.0	-	120.0	240.0	216.0	216.0	-	168.0	168.0
23	24.0	72.0	120.0	72.0	-	96.0	264.0	216.0	-	192.0	168.0	144.0
24	48.0	24.0	96.0	72.0	168.0	192.0	240.0	240.0	-	96.0	168.0	192.0
25	72.0	120.0	24.0	48.0	168.0	216.0	240.0	216.0	264.0	72.0	144.0	120.0
26	24.0	96.0	72.0	48.0	48.0	144.0	216.0	120.0	240.0	192.0	168.0	144.0
27	24.0	120.0	48.0	48.0	96.0	120.0	192.0	192.0	192.0	120.0	192.0	144.0
28	72.0	120.0	96.0	48.0	96.0	96.0	216.0	168.0	168.0	120.0	144.0	144.0
29	-		144.0	0.0	120.0	120.0	144.0	192.0	240.0	120.0	144.0	168.0
30	-		120.0	48.0	24.0	196.0	192.0	120.0	168.0	216.0	144.0	120.0
31	-		120.0		24.0		240.0	192.0		-		24.0
MEAN	41.1	88.3	112.0	56.0	136.3	124.4	182.1	184.0	219.4	156.0	160.0	139.4

Table III.2.6 Daily Duration of Sunshine (hrs) at Mongu 1983

MON / DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.4	11.7	10.7	9.2	9.7	10.3	9.3	10.6	10.6	9.1	5.2	5.2
2	2.1	4.8	11.5	9.9	9.7	10.3	7.2	10.2	10.7	9.3	8.5	3.2
3	3.5	11.2	11.1	9.2	6.8	10.5	10.4	10.6	10.3	9.3	4.6	4.8
4	3.9	2.6	9.2	6.4	10.1	10.4	10.3	10.4	10.1	8.7	3.6	4.9
5	7.5	8.5	4.6	2.2	10.0	10.3	10.4	10.2	10.1	9.3	4.6	3.0
6	7.4	3.4	7.4	10.7	10.2	10.0	10.6	10.2	10.3	9.0	6.8	10.2
7	6.5	4.9	6.8	2.0	10.0	9.3	9.8	9.1	10.3	10.7	8.8	4.2
8	11.2	4.3	5.1	9.2	10.7	10.0	9.0	10.3	10.2	10.4	5.2	8.8
9	8.7	2.6	3.4	8.5	10.4	10.3	9.5	10.4	10.3	8.8	2.7	8.0
10	7.9	0.1	4.2	7.2	10.5	10.4	10.5	10.6	10.3	9.7	5.1	7.3
11	11.6	8.2	4.9	8.9	10.0	10.4	10.4	10.6	10.5	11.3	5.1	7.2
12	10.3	3.0	2.6	4.5	8.5	10.1	10.4	10.7	10.4	11.4	4.8	6.7
13	8.2	8.1	7.5	8.0	10.7	0.0	10.3	10.6	10.5	10.9	3.2	7.1
14	6.8	7.5	1.3	9.4	10.7	10.3	10.3	10.7	10.3	9.1	0.1	8.9
15	8.6	8.3	10.2	9.2	10.2	9.8	10.3	10.7	10.4	10.5	9.5	11.9
16	9.7	10.8	5.6	9.8	10.5	9.8	10.4	10.3	9.4	5.4	4.8	10.0
17	3.5	11.8	10.9	9.7	10.4	10.0	10.4	10.2	9.2	4.4	11.1	2.4
18	6.4	11.7	11.0	10.5	9.9	10.5	10.2	10.3	9.9	10.1	8.3	2.5
19	4.7	9.3	3.9	9.7	10.7	10.6	10.7	10.4	9.2	4.9	11.0	9.3
20	5.2	11.6	7.0	10.1	10.7	10.6	10.8	10.2	9.7	4.5	7.3	4.3
21	5.7	12.2	10.4	10.4	10.1	10.4	10.6	10.4	9.9	9.1	2.4	3.9
22	5.4	12.1	8.5	10.6	10.0	10.3	10.6	10.5	7.9	7.1	8.2	3.6
23	1.6	11.2	7.1	10.5	10.6	10.4	10.6	10.4	9.6	1.4	1.2	7.0
24	2.0	8.9	7.8	10.1	10.7	10.4	10.5	10.1	10.7	6.0	10.4	1.6
25	5.0	10.9	2.5	10.2	10.6	10.4	10.3	10.4	10.7	6.5	5.3	3.2
26	1.6	11.7	7.6	10.6	10.6	10.3	10.2	10.4	10.8	7.7	6.7	6.4
27	7.9	10.9	10.6	10.5	10.0	10.3	10.6	10.4	10.3	9.2	8.5	5.1
28	1.6	11.7	4.7	10.5	10.9	10.4	10.6	10.3	10.7	10.4	10.3	0.4
29	7.5		4.6	10.6	10.7	10.2	10.7	10.3	10.7	12.0	6.7	4.1
30	10.9		11.0	9.9	10.8	9.3	10.2	9.4	10.7	8.8	8.6	6.5
31	9.9		11.0		10.7		9.6	10.2		9.2		2.7
MEAN	6.2	8.4	7.2	8.9	10.2	9.9	10.2	10.3	10.2	8.5	6.3	5.6

Table III.2.7 Reference Crop Evapotranspiration for Mongu 1983

MON / DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.3	4.0	5.1	4.8	5.5	5.7	7.1	6.4	9.0	10.0	-	3.0
2	2.7	2.8	-	4.8	5.7	5.2	7.4	7.3	9.5	7.8	-	2.9
3	2.7	4.1	-	5.1	5.0	4.7	6.1	-	8.3	6.6	4.3	3.7
4	2.6	2.6	3.3	4.4	5.8	4.8	5.3	-	9.4	7.1	4.7	3.3
5	2.8	4.0	2.8	3.1	-	4.9	4.8	6.9	10.4	6.8	-	3.5
6	2.7	3.0	3.1	4.5	-	5.3	5.4	-	8.8	9.6	-	3.9
7	2.6	3.5	4.2	3.1	5.9	5.9	5.9	-	8.3	5.8	5.6	3.5
8	3.4	3.2	4.0	4.5	6.3	5.8	5.7	7.0	8.9	6.0	6.1	4.0
9	3.2	2.9	3.5	4.4	5.9	6.1	5.4	7.3	9.6	6.9	2.9	3.8
10	2.9	2.2	3.5	4.2	6.1	4.3	5.4	6.7	10.0	8.3	-	3.7
11	3.7	3.3	3.6	4.5	6.6	4.4	6.0	6.0	8.5	7.7	-	3.4
12	3.7	2.7	3.6	3.6	6.3	6.2	6.5	6.8	7.4	9.0	4.8	3.1
13	3.0	3.6	4.5	3.9	6.2	4.6	6.0	8.0	8.1	7.6	5.5	3.6
14	2.8	4.1	3.5	4.7	6.2	5.6	7.2	7.0	7.4	6.3	3.4	4.0
15	3.0	3.9	-	4.2	6.7	4.4	7.4	6.5	7.1	6.9	5.1	5.1
16	3.2	4.4	-	4.9	6.0	-	6.8	6.3	6.3	4.5	3.8	3.6
17	2.4	4.7	5.8	5.2	-	-	-	6.5	7.4	5.3	5.1	2.5
18	2.9	4.4	5.2	4.8	-	5.7	-	6.7	7.8	5.5	4.8	3.5
19	2.5	4.4	-	5.1	6.7	6.0	5.0	6.0	7.2	4.1	4.7	3.2
20	2.7	5.0	-	5.8	6.1	4.0	5.8	6.5	10.6	7.0	4.3	2.7
21	2.7	5.0	-	5.3	5.9	4.7	5.9	7.1	8.5	-	2.5	2.7
22	2.6	4.7	5.0	5.1	-	5.3	7.6	7.9	7.4	-	4.2	3.2
23	2.4	4.9	4.6	4.9	-	4.9	8.4	8.0	-	2.8	2.7	3.1
24	2.3	4.1	4.7	5.0	6.6	6.0	8.2	7.3	-	3.4	4.5	3.1
25	3.0	5.4	2.9	4.7	6.4	7.0	7.6	6.6	9.9	3.8	3.5	3.9
26	2.1	5.1	4.1	4.6	4.8	5.9	7.4	5.3	9.1	6.4	4.0	3.7
27	3.1	5.4	4.9	4.4	5.2	5.6	7.2	6.9	7.9	5.1	5.0	2.6
28	2.6	6.3	4.7	4.5	5.3	5.0	7.9	7.0	7.4	5.2	4.5	2.8
29	-		5.0	4.1	5.4	5.2	6.3	7.6	9.0	6.5	3.6	3.3
30	-		5.7	5.0	3.9	6.6	6.3	6.5	7.2	-	4.4	3.5
31	-		5.9		4.0		7.0	8.2				2.3
MEAN	2.8	4.1	4.3	4.6	5.8	5.4	6.5	6.9	8.4	6.4	4.3	3.4

Table III.2.8 Furrow Flow Rate, Furrow Intake Rate and Required Irrigation Time Depend on Furrow Irrigation Test

Slope	Furrow Flow Amount l/s	Furrow Flow Rate $t = \alpha \cdot L^{\beta}$	Furrow Intake Rate $I = K \cdot T^{n}$	Required Irrigation Time (min)
1/250	0.25	$t = 0.09 \cdot L^{1.43}$	$I = 29.7 \cdot T^{0.597}$	25.5
	0.50	$t = 0.11 \cdot L^{1.26}$	$I = 64.8 \cdot T^{0.746}$	13.7
	0.67	$t = 0.07 \cdot L^{1.28}$	$I = 101.7 \cdot T^{0.756}$	10.4
1/500	0.25	$t = 0.50 \cdot L^{0.93}$	$I = 29.7 \cdot T^{0.597}$	20.8
	0.50	$t = 0.60 \cdot L^{1.01}$	$I = 64.8 \cdot T^{0.746}$	13.4
	0.67	$t = 0.13 \cdot L^{1.28}$	$I = 101.7 \cdot T^{0.756}$	9.0

Table III.2.9 The Results of Yield Survey for the Paddy Rice Irrigation Trial

	Culm Length (cm)	No. of Panicles/m^2	Grain Yield (g/m^2)	G/S ratio
Continuous Irrigation Plot				
(1)	45.0	111	281	1.24
(2)	44.0	188	396	1.05
Average	44.5	149.5	339	1.15
4 days Intermittent Irrigation Plot				
(1)	40.7	179	315	1.15
(2)	38.7	226	400	1.23
Average	39.7	202.5	358	1.19
7 days Intermittent Irrigation Plot				
(1)	44.4	285	459	0.70
(2)	36.2	270	371	0.85
Average	40.3	277.5	415	0.78
Rain Fed Plot				
(1)	37.6	164	371	1.56
(2)	33.2	183	210	0.85
Average	35.4	173.5	291	1.21

where) G/S ratio is Grain/Straw ratio
The rain fed plot was benefiting from the seepage water out of the secondary irrigation canal.

Table III.2.10 Intake Rate and Accumulated Infiltration Volume

	Namushakende		Lealui					
	W-2		Black Soil Dressed Plot		Manure Dressed Plot		No Treatment Plot	
	End of Rainy Season	Dry Season	End of Rainy Season	Dry Season	End of Rainy Season	Dry Season	End of Rainy Season	Dry Season
Accumulated Infiltration Volume (mm) (Elapsed 60min.)	9.5	64.1	115.3	329.4	54.0	308.7	582.0	535.7
Initial Intake Rate (mm/hr)	31	244	241	852	121	584	1,059	861
Basic Intake Rate (mm/hr)	3	21	69	149	28	471	414	489

Table III.2.11 The Results of Yield Survey for the Interrow Spacing Examination Trial

	S-3-1	S-3-2	S-3-3	Average	Unit Yield
A (Interrow Spacing 80 cm)	51 g	49 g	35 g	45.0 g	1.8 ton/ha
B (Interrow Spacing 65 cm)	33 g	44 g	41 g	39.3 g	2.0 ton/ha
C (Interrow Spacing 50 cm)	26 g	30 g	35 g	30.3 g	2.0 ton/ha

where) Each value except unit yield is grain yield per plant.

Table III.2.12 The Results of Yield Survey for the Ridge Height Examination Trial

	S-2-3	S-2-4	S-2-8	Average	Unit Yield
A (Ridge Height 10 cm)	107 g	101 g	75 g	93.3 g	3.9 ton/ha
B (Ridge Height 15 cm)	121 g	63 g	96 g	93.3 g	3.9 ton/ha
C (Ridge Height 20 cm)	114 g	81 g	95 g	96.7 g	4.1 ton/ha
	M-5-1	M-5-2	M-5-3	Average	Unit Yield
A (Ridge Height 10 cm)	46 g	41 g	32 g	39.7 g	1.7 ton/ha
B (Ridge Height 15 cm)	47 g	49 g	57 g	51.0 g	2.1 ton/ha
C (Ridge Height 20 cm)	36 g	40 g	43 g	39.7 g	1.7 ton/ha

where) Each value except unit yield is grain yield per plant.

Table III.2.13 The Results of Growth Observation for Ridge Height Examination Trial (Plant Height)

(Unit: cm)

	W-2-3			W-2-4			W-2-8			Average		
	A	B	C	C	A	B	B	C	A	A	B	C
11th - Sep.	17.8	16.8	22.9	14.9	15.8	15.6	22.6	21.6	22.0	18.6	18.3	19.8
30th - Sep.	54.2	58.4	67.9	52.2	57.3	55.1	63.4	56.2	60.4	58.5	57.3	62.2
30th - Oct.	135.1	160.5	165.6	139.5	154.9	150.9	131.3	142.5	125.2	138.4	147.6	149.2
13th - Dec.	134.3	155.6	148.5	148.5	157.5	152.1	136.6	141.8	135.3	142.4	148.1	147.8

	W-2-3			W-2-4			W-2-8			Average		
	A	B	C	C	A	B	B	C	A	A	B	C
11th - Sep.	17.8	19.1	22.0	23.7	21.4	22.3	22.1	22.6	22.1	20.4	21.4	22.8
30th - Sep.	44.9	45.3	47.6	54.1	47.1	48.6	48.0	47.0	48.9	47.0	47.3	49.8
30th - Oct.	108.4	106.6	108.0	117.8	110.1	106.2	112.2	111.1	112.8	110.4	108.3	112.3
13th - Dec.	136.8	121.9	124.6	128.0	130.5	139.2	139.5	129.8	126.1	131.1	133.5	127.5

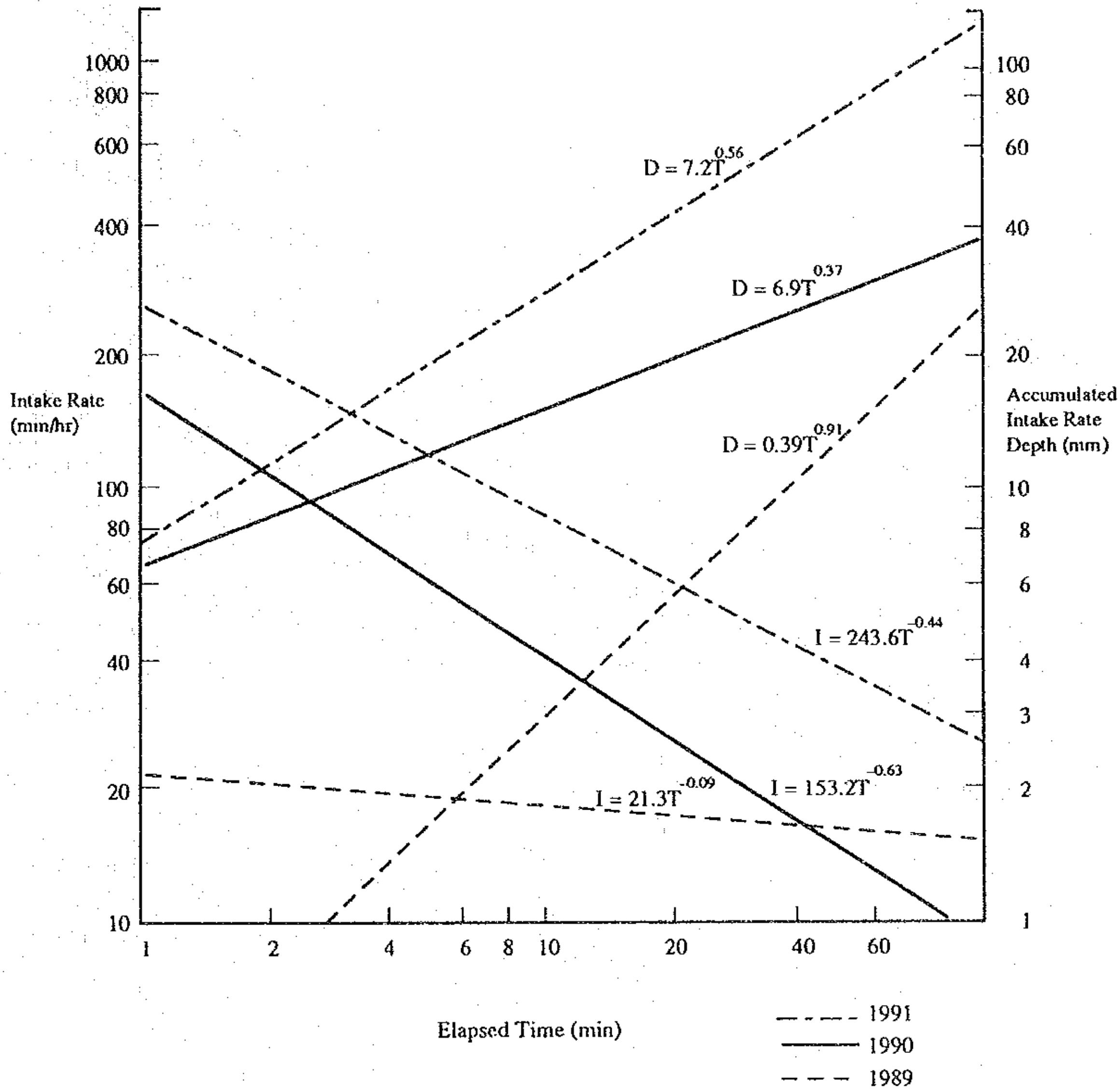


Figure III.2.6 Infiltration Curve for Namushakende

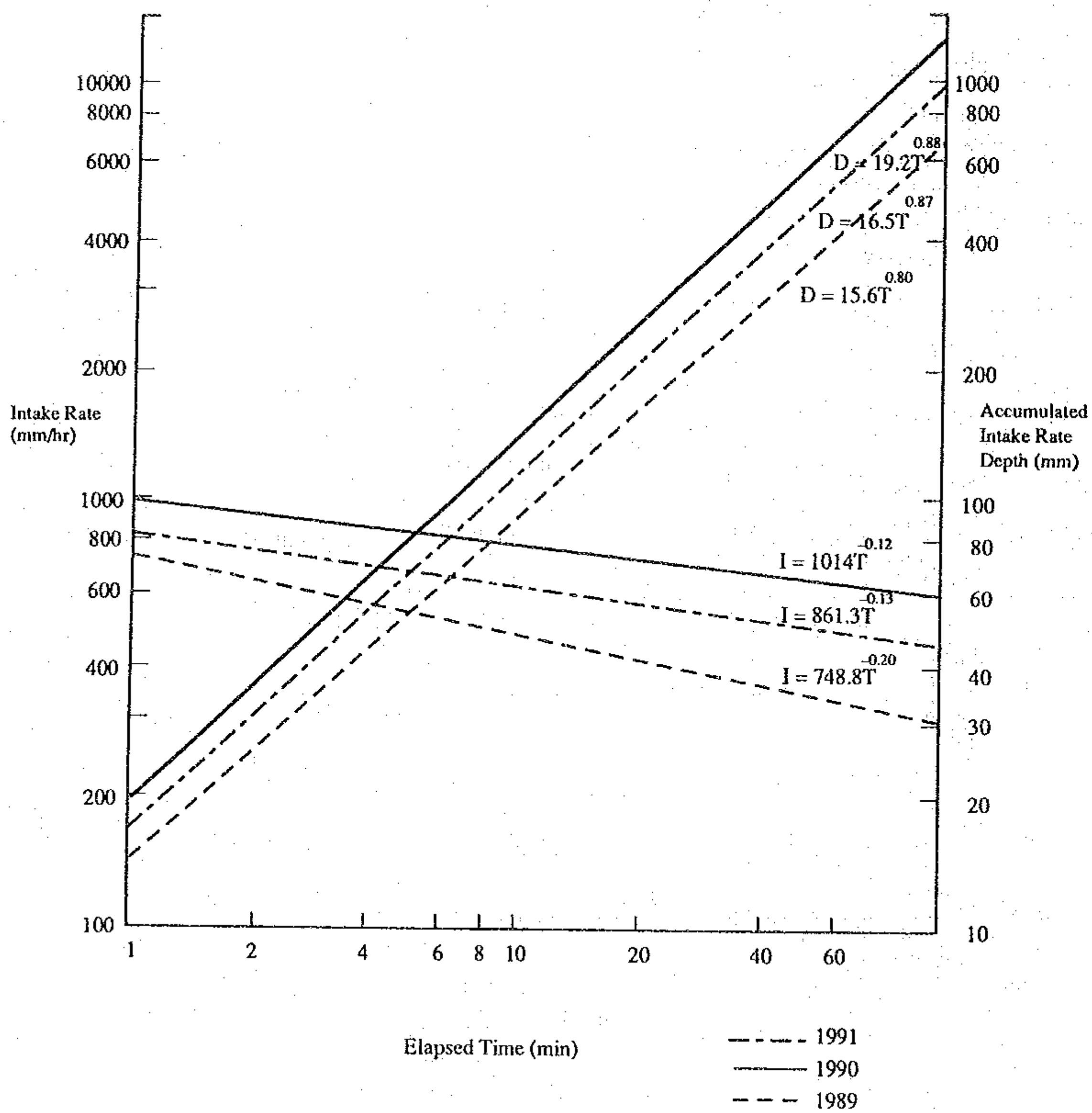
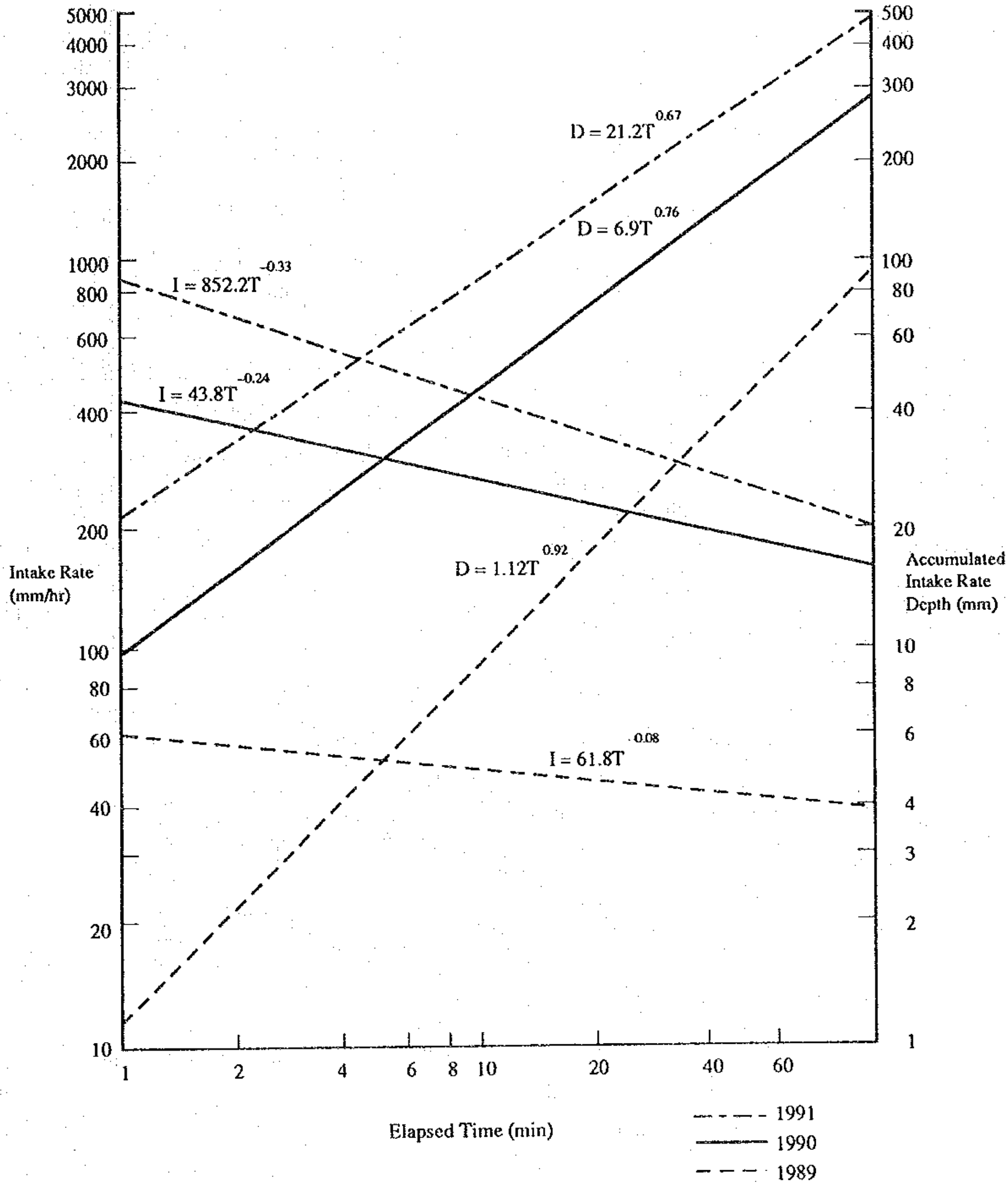


Figure III.2.7 Infiltration Curve for the No Treatment Plot in Lealui



Figire III.2.8 Infiltration Curve for the Black Soil Dressed Plot in Lealui

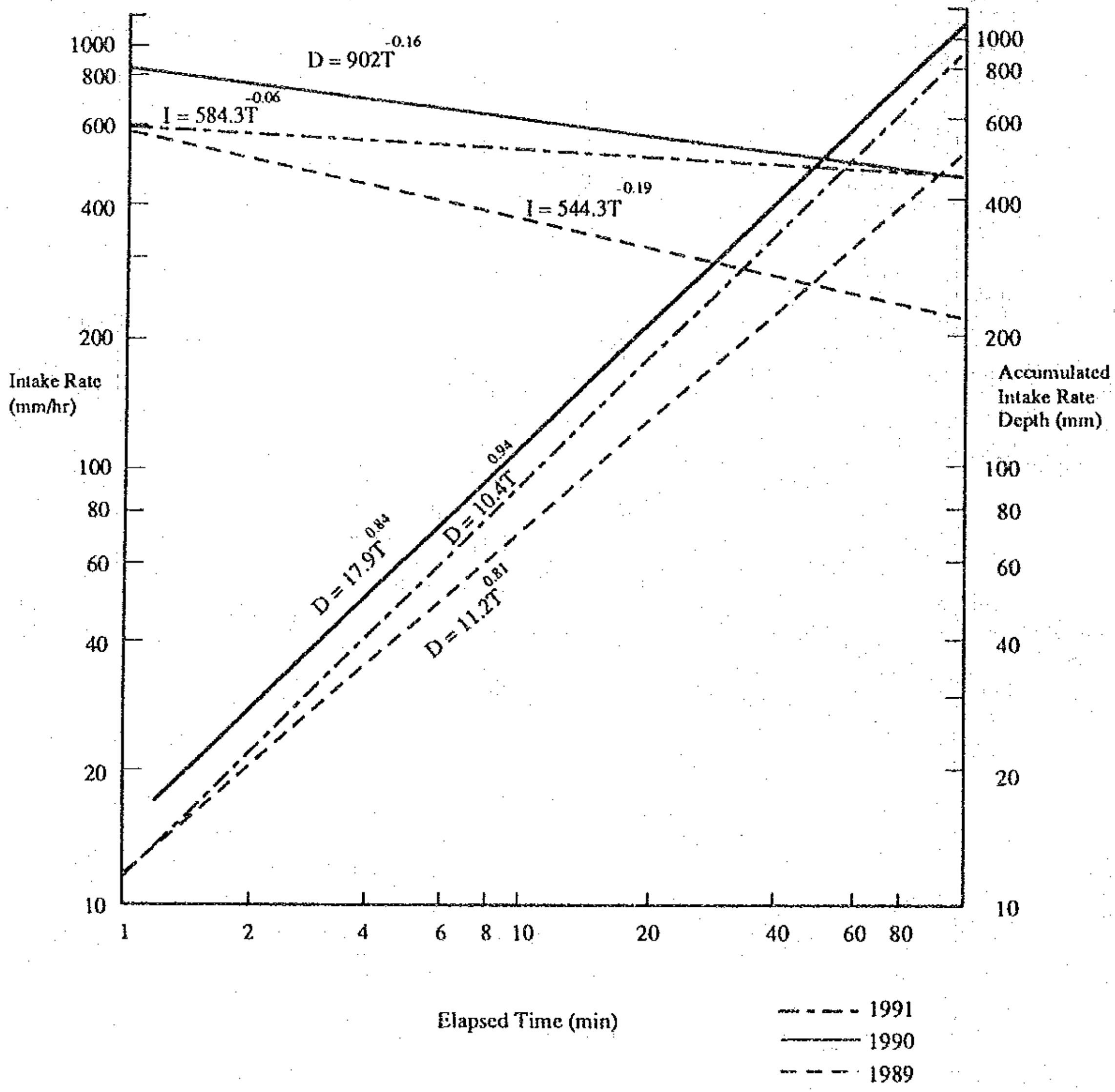


Figure III.2.9 Curve for the Cattle Manure Dressed Plot in Lealui

III.3 Farm Land Consolidation Guideline

III.3.1 Exceedance - Probability of Little Zambezi Water Levels

(1) Water level records of Little Zambezi at Matongo

Water level records of Little Zambezi at Matongo for 21 years from 1971/72 to 1991/92 are given in the Table III.4.1. These date were collected from the Department of Water Affairs at Mongu during the period of the AVS.

All the values in the Table III.4.1 were converted in meters from the original data presented in feet from the staff gauge readings. Finally, the corresponding water levels values above sea level were obtained by adding a correction height of 1,007.38 m gotten from the leveling survey. (Connection of the staff gauge readings to the national B.M.).

(2) Exceedance - Probability of Little Zambezi water levels

By using the values of annual maximum water levels of the Little Zambezi at Motongo, the probability of exceedance was computed by the Hazen method.

Results of the computation are shown in the Table III.3.1.

Table III.3.1 Computation Results of Exceedance - Probability of Little Zambezi Water Levels at Matongo

Ranking	Year	Max. Water Levels (m)	Probability (%)	Return Period (years)
1	1978	1,104.57	2.5	40.0
2	1979	1,014.55	7.5	13.3
3	1975	1,014.36	12.5	8.0
4	1976	1,014.27	17.5	5.7
5	1989	1,014.14	22.5	4.4
6	1980	1,014.09	27.5	3.6
7	1981	1,014.06	32.5	3.1
8	1977	1,013.86	37.5	2.7
9	1986	1,013.82	42.5	2.4
10	1988	1,013.79	47.5	2.1
11	1987	1,013.69	52.5	1.9
12	1974	1,013.64	57.5	1.7
13	1991	1,013.60	62.5	1.6
14	1985	1,013.54	67.5	1.5
15	1984	1,013.39	72.5	1.4
16	1982	1,013.18	77.5	1.3
17	1990	1,012.85	82.5	1.2
18	1973	1,012.84	87.5	1.1
19	1983	1,012.81	92.5	1.1
20	1992	1,012.57	97.5	1.0

III.3.2 Analysis of Creep Length for the Peripheral Road

(1) General

When running water is blocked by an impervious wall of an embankment constructed on permeable ground, the difference of water head across the wall (ΔH) can act to move soil of minimum grain size as the water permeates through the ground. This can create voids in the ground, leading to the destruction of the foundation. This action is called "piping".

To prevent this phenomenon, a safe creep length must be ensured under the foundation of the embankment.

The creep length to be ensured must be the larger of the values calculated by the following two methods.

i) Bligh's method

$$L \geqq C \cdot \Delta H$$

where L : length of creep length measured along the foundation face of the embankment. (which may differ from the actual percolation path) (m).

C : coefficient which varies depending on the type of the foundation ground. (Table III.3.2)

ΔH : maximum head difference at upstream and downstream sides. (m)

ii) Lane's method

Lane defined the effect of the horizontal creep length as 1/3 of the vertical creep length, and established the weighted creep length by dividing the total of vertical and horizontal creep length by the difference between water heads, and defined the ratio as shown in Table III.3.2.

$$L' \geqq C' \cdot \Delta H$$

where L' : length of weighted creep length (m),

$L' = \sum lv + 1/3 \sum lh$

lv : creep length of vertical direction (inclination of more than 45 degrees)

lh : creep length of horizontal direction (inclination below 45 degrees)

C' : coefficient which varies with the type of ground (Table III.3.2)

ΔH : maximum difference between water heads (m)

Table III.3.2 Coefficients of Bligh and Lane's Methods

Foundation	Bligh's coefficient (c)	Lane's coefficient (c')
Silty and or clay	18	8.5
Fine sand	15	7.0
Medium sand	–	6.0
Coarse sand	12	5.0
Gravel	–	4.0
Coarse gravel	–	3.5
Sandy gravel	9	–
Cobble stone with gravel	–	3.0
Rocks with cobble stone and gravel	–	2.5
Rocks with gravel and sand	4 ~ 6	–
Soft clay	–	3.0
Medium clay	–	2.0
Heavy clay	–	1.8
Hard clay	–	1.6

(2) Creep length and necessary depth of cut-off wall

To ensure a creep length longer than L or L' obtained from the above two calculations, a cut-off wall is normally provided into the foundation ground.

1) Creep length

i) Bligh's method

$C \cdot \Delta H = 13.5 \times 0.8 = 10.8$ m

(C = 13.5 : medium sand)

L = 10.2 m < $C \cdot \Delta H$ .... out

ii) Lane's method

$$C' \cdot \Delta H = 6.0 \times 0.8 = 4.8 \text{ m}$$
$$(C' = 6.0 \text{ : medium sand})$$
$$L' = 10.2 \text{ m} \times 1/3 = 3.4 \text{ m} < C' \cdot \Delta H \text{ .... out}$$

Therefore, a cut-off wall is required.

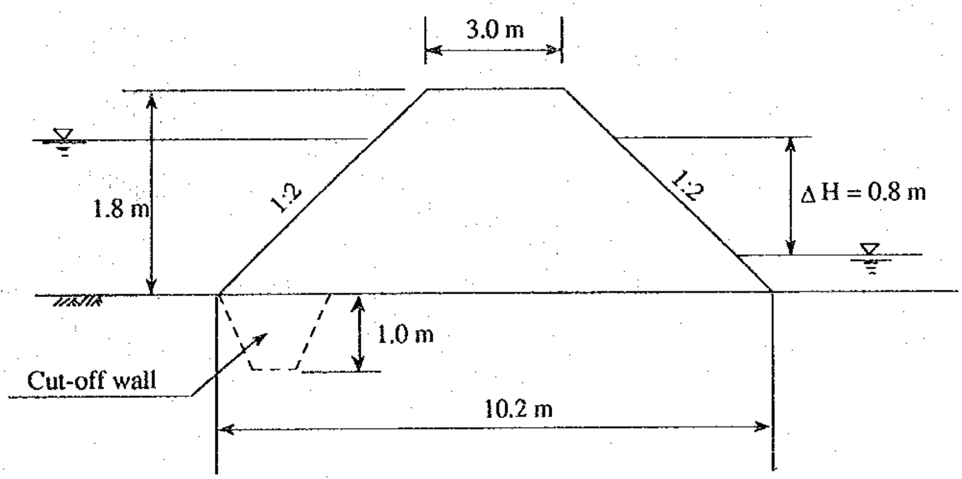
2) Depth of cut-off wall

According to the above results, a necessary depth of cut-off wall is decided by the Lane's method. The shortage of creep length is 1.4 m (4.8 m - 3.4 m).

Therefore, 1.0 m depth of cut-off wall made with impervious material such as clayey soil is recommendable.

As a result, the value of creep length will be as follows:

$$L' = 10.2 \times 1/3 + 1.0 \times 2 = 5.4 \text{ m} > C' \cdot \Delta H \text{ .... OK}$$



III.3.3 Hydraulic Design of Canals

(1) Hydraulic analysis of typical irrigation canals

Water depths and flow velocities of typical irrigation canals which are presented in the guideline were computed by using the Manning's formula, and heights of canal embankments were given considering these water depths and freeboard.

The results of hydraulic computation as well as main design dimensions of the canals are shown in Table III.3.3.

(2) Hydraulic design of general canals

Table III.3.4 (1), III.3.4 (2) and Table III.3.4 (3) show the relationship of bed gradient and flow velocity based on the canal bed width, given a typical canal side slopes.

Table III.3.3 Hydraulic and Structural Dimensions of Typical Irrigation Canals

	Q (m^3/s)	I	b1 (m)	b2 (m)	d (m)	$V = 1/n \cdot R^{2/3} \cdot I^{1/2}$ (m/s)				Fb (m)	H' (m)	H (m)	B (m)	Remarks
						A (m^2)	P (m)	R (m)	V (m/s)					
①	0.087	1/1000	0.40	1.33	0.31	0.268	1.518	0.177	0.33	0.30	0.61	0.7	2.50	Irrigation area: 50 ha
②	0.069	"	0.30	1.20	0.30	0.225	1.382	0.163	0.31	0.30	0.60	0.6	2.10	40 ha
③	0.052	1/500	0.25	0.94	0.23	0.137	1.079	0.127	0.38	0.30	0.53	0.6	2.05	30 ha
④	0.035	"	0.20	0.80	0.20	0.100	0.921	0.109	0.34	0.30	0.50	0.5	1.70	20 ha
⑤	0.017	"	0.15	0.60	0.15	0.056	0.691	0.081	0.28	0.30	0.45	0.5	1.65	10 ha

Note: 1) Roughness coefficient; n = 0.030

2) A; Cross-section area (m^2), P; Wetted perimeter (m)
R; Hydraulic radius (m) = A/P
I; Canal bed slope
Fb; Freeboard (m) ≧ 0.30 m

3) $Q = A \cdot V$ (m^3/s)

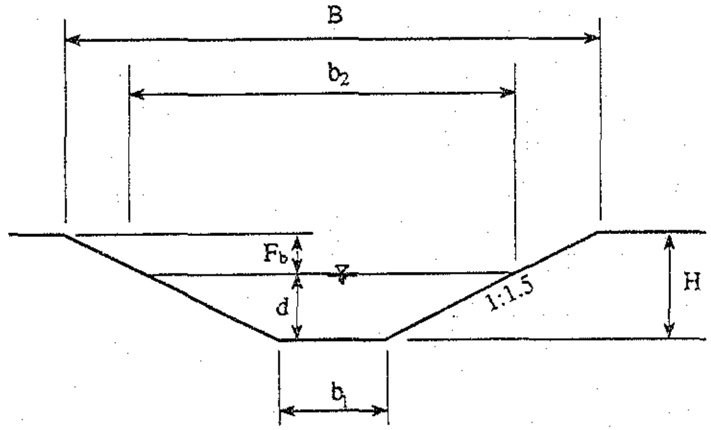


Table III.3.4 (1) Hydraulic Design of Canal by Mannings Mean Flow Velocity Formula (1/3)

Side Slope : S = 1 : 1
Coefficient of Roughness : N = 0.03

Bed Width	I :	1/100	1/200	1/300	1/400	1/500	1/600	1/700	1/800	1/900	1/1000
0.15	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	V :	0.71	0.50	0.41	0.35	0.32	0.29	0.27	0.25	0.24	0.22
	Q :	0.050	0.035	0.029	0.025	0.022	0.020	0.019	0.018	0.017	0.016
0.20	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	V :	0.74	0.52	0.43	0.37	0.33	0.30	0.28	0.26	0.25	0.23
	Q :	0.059	0.042	0.034	0.030	0.026	0.024	0.022	0.021	0.020	0.019
0.25	D :	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	V :	0.86	0.61	0.50	0.43	0.38	0.35	0.32	0.30	0.29	0.27
	Q :	0.107	0.076	0.062	0.054	0.048	0.044	0.041	0.038	0.036	0.034
0.30	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	V :	0.97	0.69	0.56	0.48	0.43	0.40	0.37	0.34	0.32	0.31
	Q :	0.174	0.123	0.101	0.087	0.078	0.071	0.066	0.062	0.058	0.055
0.40	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	V :	1.02	0.72	0.59	0.51	0.45	0.42	0.38	0.36	0.34	0.32
	Q :	0.213	0.151	0.123	0.107	0.095	0.087	0.081	0.075	0.071	0.067
0.50	D :	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	V :	1.14	0.81	0.66	0.57	0.51	0.47	0.43	0.40	0.38	0.36
	Q :	0.339	0.240	0.196	0.169	0.152	0.138	0.128	0.120	0.113	0.107
0.60	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	V :	1.26	0.89	0.73	0.63	0.56	0.51	0.47	0.44	0.42	0.40
	Q :	0.502	0.355	0.290	0.251	0.225	0.205	0.190	0.177	0.167	0.159
0.70	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	V :	1.29	0.91	0.74	0.64	0.58	0.53	0.49	0.46	0.43	0.41
	Q :	0.567	0.401	0.327	0.283	0.253	0.231	0.214	0.200	0.189	0.179
0.80	D :	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	V :	1.40	0.99	0.81	0.70	0.63	0.57	0.53	0.49	0.47	0.44
	Q :	0.786	0.556	0.454	0.393	0.351	0.321	0.297	0.278	0.262	0.249
0.90	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	V :	1.50	1.06	0.87	0.75	0.67	0.61	0.57	0.53	0.50	0.48
	Q :	1.051	0.743	0.607	0.526	0.470	0.429	0.397	0.372	0.350	0.332
1.00	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	V :	1.53	1.08	0.88	0.76	0.68	0.62	0.58	0.54	0.51	0.48
	Q :	1.147	0.811	0.662	0.573	0.513	0.468	0.433	0.405	0.382	0.363

D : Water depth (m)
V : Mean velocity (m/sec)
Q : Discharge (m3/sec)

V = 0.3 ~ 0.6 m/s

Table III.3.4 (2) Hydraulic Design of Canal by Mannings Mean Flow Velocity Formula (2/3)

Side Slope : S = 1. 5
Coefficient of Roughness : N = 0.03

Bed Width	I :	1/100	1/200	1/300	1/400	1/500	1/600	1/700	1/800	1/900	1/1000
	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.15	V :	0.73	0.52	0.42	0.37	0.33	0.30	0.28	0.26	0.25	0.23
	Q :	0.066	0.047	0.038	0.033	0.030	0.027	0.025	0.023	0.022	0.021
	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.20	V :	0.76	0.54	0.44	0.38	0.34	0.31	0.29	0.27	0.25	0.24
	Q :	0.076	0.054	0.044	0.038	0.034	0.031	0.029	0.027	0.025	0.024
	D :	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
0.25	V :	0.88	0.62	0.51	0.44	0.39	0.36	0.33	0.31	0.29	0.28
	Q :	0.138	0.097	0.079	0.069	0.062	0.056	0.052	0.049	0.046	0.043
	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.30	V :	0.99	0.70	0.57	0.50	0.45	0.41	0.38	0.35	0.33	0.31
	Q :	0.224	0.158	0.129	0.112	0.100	0.091	0.085	0.079	0.075	0.071
	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.40	V :	1.03	0.73	0.60	0.52	0.46	0.42	0.39	0.37	0.34	0.33
	Q :	0.263	0.186	0.152	0.131	0.118	0.107	0.099	0.093	0.088	0.083
	D :	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
0.50	V :	1.15	0.82	0.67	0.58	0.52	0.47	0.44	0.41	0.39	0.37
	Q :	0.414	0.293	0.239	0.207	0.185	0.169	0.156	0.146	0.138	0.131
	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.60	V :	1.27	0.90	0.73	0.64	0.57	0.52	0.48	0.45	0.42	0.40
	Q :	0.609	0.431	0.352	0.305	0.273	0.249	0.230	0.215	0.203	0.193
	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.70	V :	1.30	0.92	0.75	0.65	0.58	0.53	0.49	0.46	0.43	0.41
	Q :	0.674	0.477	0.389	0.337	0.302	0.275	0.255	0.238	0.225	0.213
	D :	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
0.80	V :	1.41	0.99	0.81	0.70	0.63	0.57	0.53	0.50	0.47	0.45
	Q :	0.933	0.660	0.539	0.467	0.417	0.381	0.353	0.330	0.311	0.295
	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.90	V :	1.51	1.07	0.87	0.76	0.68	0.62	0.57	0.53	0.50	0.48
	Q :	1.247	0.882	0.720	0.623	0.558	0.509	0.471	0.441	0.416	0.394
	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1.00	V :	1.53	1.09	0.89	0.77	0.69	0.63	0.58	0.54	0.51	0.49
	Q :	1.342	0.949	0.775	0.671	0.600	0.548	0.507	0.475	0.447	0.424

D : Water depth (m)
V : Mean velocity (m/sec)
Q : Discharge (m3/sec)

V = 0.3 ~ 0.6 m/s

Table III.3.4 (3) Hydraulic Design of Canal by Mannings Mean Flow Velocity Formula (3/3)

Side Slope : S = 1 : 2
Coefficient of Roughness : N = 0.03

Bed Width	I :	1/100	1/200	1/300	1/400	1/500	1/600	1/700	1/800	1/900	1/1000
0.15	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	V :	0.74	0.53	0.43	0.37	0.33	0.30	0.28	0.26	0.25	0.24
	Q :	0.082	0.058	0.047	0.041	0.037	0.033	0.031	0.029	0.027	0.026
0.20	D :	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	V :	0.76	0.54	0.44	0.38	0.34	0.31	0.29	0.27	0.26	0.24
	Q :	0.092	0.065	0.053	0.046	0.041	0.037	0.035	0.032	0.031	0.029
0.25	D :	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	V :	0.89	0.63	0.51	0.44	0.40	0.36	0.34	0.31	0.30	0.28
	Q :	0.166	0.117	0.096	0.083	0.074	0.068	0.063	0.059	0.055	0.053
0.30	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	V :	1.00	0.71	0.58	0.50	0.45	0.41	0.38	0.35	0.33	0.32
	Q :	0.270	0.191	0.156	0.135	0.121	0.110	0.102	0.096	0.090	0.085
0.40	D :	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	V :	1.03	0.73	0.60	0.52	0.46	0.42	0.39	0.37	0.34	0.33
	Q :	0.310	0.219	0.179	0.155	0.138	0.126	0.117	0.109	0.103	0.098
0.50	D :	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	V :	1.15	0.82	0.67	0.58	0.52	0.47	0.44	0.41	0.38	0.37
	Q :	0.484	0.342	0.280	0.242	0.217	0.198	0.183	0.171	0.161	0.153
0.60	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	V :	1.27	0.90	0.73	0.63	0.57	0.52	0.48	0.45	0.42	0.40
	Q :	0.710	0.502	0.410	0.355	0.317	0.290	0.268	0.251	0.237	0.224
0.70	D :	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	V :	1.29	0.91	0.75	0.65	0.58	0.53	0.49	0.46	0.43	0.41
	Q :	0.775	0.548	0.447	0.387	0.346	0.316	0.293	0.274	0.258	0.245
0.80	D :	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	V :	1.40	0.99	0.81	0.70	0.63	0.57	0.53	0.50	0.47	0.44
	Q :	1.071	0.757	0.618	0.535	0.479	0.437	0.405	0.376	0.357	0.339
0.90	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	V :	1.50	1.06	0.87	0.75	0.67	0.61	0.57	0.53	0.50	0.48
	Q :	1.428	1.010	0.825	0.714	0.639	0.583	0.540	0.505	0.476	0.452
1.00	D :	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	V :	1.52	1.08	0.88	0.76	0.68	0.62	0.58	0.54	0.51	0.48
	Q :	1.524	1.077	0.880	0.762	0.681	0.622	0.576	0.539	0.508	0.482

D : Water depth (m)
V : Mean velocity (m/sec)
Q : Discharge (m3/sec)

V = 0.3 ~ 0.6 m/s