RAINFALL, PONDING AND FLOOD IRRIGATION - THEIR IMPORTANCE TO RICE GROWING IN THE ADELAIDE RIVER AREA

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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.

SUSTAINABLE AGRICULTURE IN THE NORTHERN TERRITORY

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FLOOD IRRIGATION OF RICE IN THE ADELAIDE RIVER AREA

1. INTRODUCTION

It is now recognised that rainfall in the Top End is not as reliable as previously thought, for the purpose of dryland farming. (Mollah 1986) Cropping experience over the past few years has shown that dry periods during the growing season and early finishes to the wet season are major causes of poor crop performance or crop failure.

Sections 3.1 and 3.2 of this bulletin examine historical rainfall data from the main rice growing area. It presents some basic summaries of rainfall data which should help the reader to analyse the effect of rain, or lack of it, on rice yields. Particularly, for those in the industry or closely associated with it, it is possible to compare the few seasons of cropping experience to the previous seasons for which rainfall data is available. Section 3.3 presents the results of modelling soil moisture for different planting times and in the presence or absence of water control structures. This section presents some important conclusions for the rice industry. Chapters 4 and 5 examine the economics of irrigation and water control structures for rice growing.

1.1 Background of the Rice Industry

The rice industry in the NT re-emerged in the early 80's in the upper Adelaide River area following the demise of rice growing at Humpty Doo in the early 1960's. Table 1 shows the area, production and yield for the seasons since the industry restarted in the upper Adelaide River area.

Table 1: Production statistics for the rice industry 1983/84 - 1987/88

	Area (ha)	Production (tonnes)	Yield (t/ha)
1983/84	63	195	3.10
1984/85	190	350	1.84
1985/86	305	526	1.72
1986/87	294	133	0.45
1987/88	401	201	0.50

Only in the first year were average yields reasonable, though it should be noted that a significant proportion of the crop has been sown on a low input basis which would be expected to show marked variation in yield depending on seasonal conditions.

Although the above period of experience included some abnormally dry years it is apparent now that in most years dry periods can be expected which will stress crops during the growing season. Even contour banks or laser levelling of rice bays in conjunction with banking is not sufficient to remove the crop from the vagaries of the weather.

Given the severe effect of the weather in recent years on yields and the need of grain users for a stable source of grain supply it seems appropriate to investigate the economics of rice irrigation.

2. EFFECTS OF WATER STRESS ON RICE

The rice plant is able to grow and produce grain over a diverse range of environments, from flooded river deltas to upland areas. This range of environments is far larger than most other dryland grain crops can tolerate.

Throughout the world's rice growing areas there are a range of cultural practices under which the crop is grown. These can be broadly classified into the following:

- Deep Water; water height can be as high as six metres (requires special varieties of rice).
- Irrigated; water height (10-15cm) and time of flooding is controlled by the grower.
- Rainfed; water height and control is dependent on the amount of rainfall during the growing season and the presence or lack of water control structures.
- Upland; no flooding occurs and the crop is dependent on rainfall that falls during the growing season.

Despite the ability of the rice plant to grow over a large range of moisture environments, it is most suited to a flooded or saturated environment and is at a disadvantage in dry conditions compared to other grain crops. The rice plant possesses characters which place it in a distinct disadvantage under dry conditions, such as:

- Rice has a shallow root system. Its roots prefer to extract water from shallow soil depths and cannot efficiently extract water from greater soil depths despite the presence of roots. This is due to the high resistance to water flow in rice roots.

- There is little resistance to water flow out of the plant through the leaves. The plant is a poor conserver of water. As the soil can no longer provide sufficient moisture for the plant's needs, plant growth slows down rapidly. This also makes the crop susceptible to competing weed growth.

The effects of soil water deficits on rice are dependent on the severity of stress, duration of stress and at what point in the life cycle of the plant stress occurs. The life cycle of the rice plant can be conveniently split into four distinct phases. The effects of water stress on rice are best dealt with by referring to the various growth stages.

Emergence (from seeding to emergence of the seedling, duration approximately 5-7 days) Soil moisture stress following sowing of rice seed can be a problem if there is sufficient moisture at sowing to allow the germination process to begin, but insufficient moisture to allow the developing root system to contact moist soil. Seed germinating into a hot dry environment will rapidly dehydrate and die.

Vegetative (from emergence to formation of the reproductive apex i.e. panicle initiation, duration approximately 50-60 days) During this time the plant produces its tillers. Under favourable conditions, the rice crop develops rapidly by the development of new leaves and tillers. Moisture stress at this stage affects leaf expansion and development, reduces tiller numbers and retards crop growth generally. The end result is a sparse crop with poor canopy development. Yield potential is lowered directly by a reduction in the number of tillers able to produce panicles (heads) and indirectly by competition from weeds which readily proliferate under the dry conditions.

Reproductive (from panicle initiation to flowering i.e. just after panicle emergence, duration approximately 25-30 days) During this time the size of the panicle (head) is determined. Stress during this stage can severely effect yield. The most crucial stage is during pollen development, near the end of the phase. Stress at this stage renders the plant infertile. The reduction in potential yield will depend on the severity and length of the stress period.

Grain Filling (from flowering to maturity (for stockfeed rice 14% moisture), duration approximately 30 days) Shortly after fertilization of the florets (flowers) the grain begins to fill. Severe stress at this stage will result in pinched grains. However, mild water stress will not have a marked effect on yield, particularly if the plant has been grown under favourable conditions prior to this stage.

3. RAINFALL, SOIL MOISTURE AND CROP STRESS

3.1 Rainfall

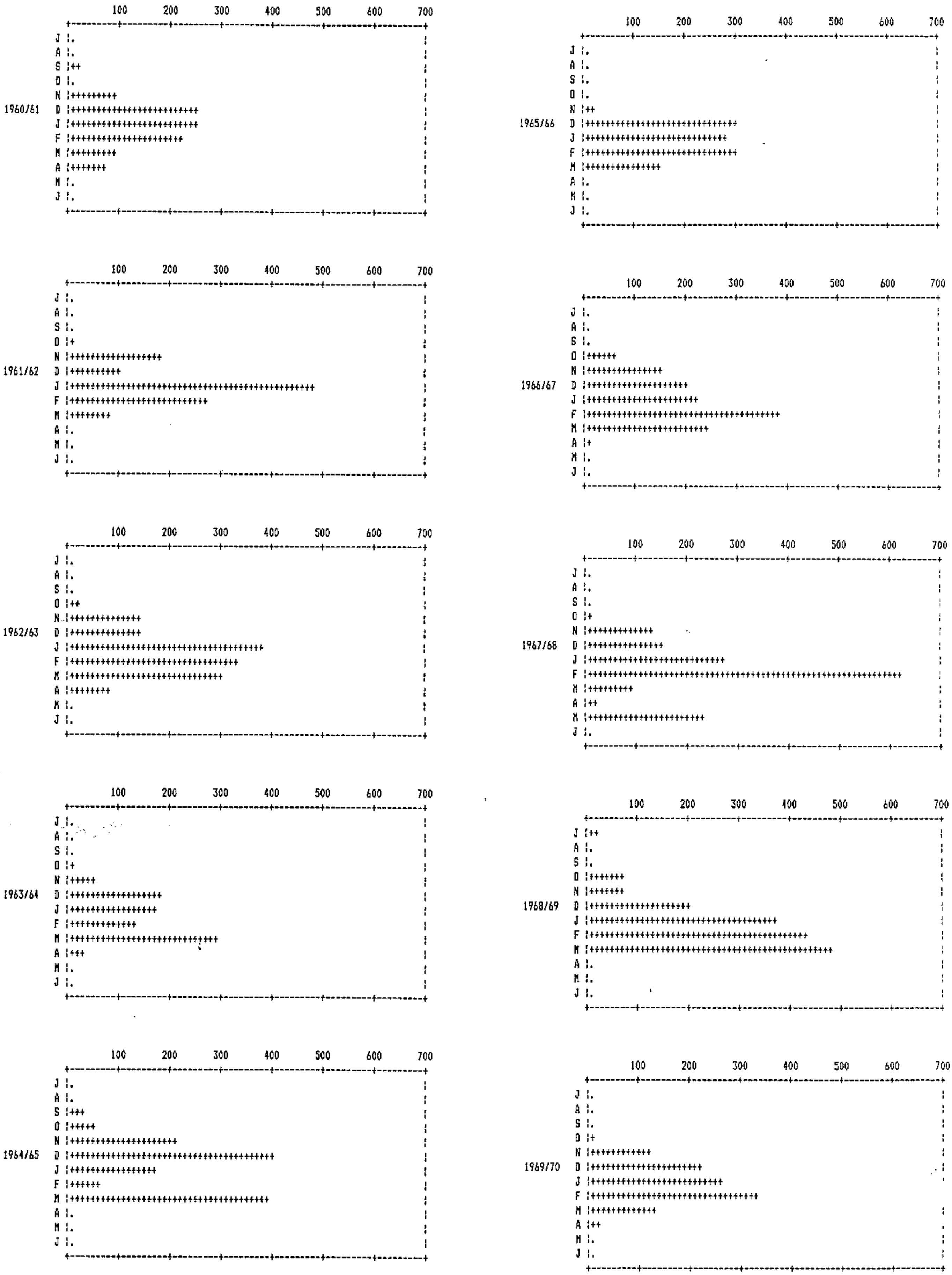
Rainfall data has been collected at Tortilla Flats Research Farm since 1960. This data has been transferred to a computer database which has enabled manipulation of the data to provide more readily usable information.

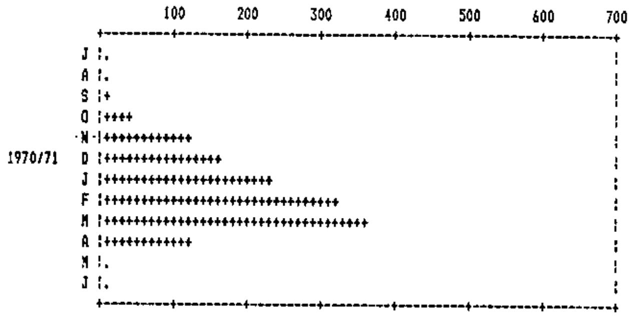
Table 2 shows a summary of monthly rainfall for the years 1960-61 to 1987-88 plus the maximum, minimum and average observations. Also included for the statistically minded are standard deviations and coefficients of variation. Figure 1 shows graphic representations of monthly rainfall in each year and average monthly rainfall. As a rough guide months with rainfall below potential evapo-transpiration (210-220 millimeters) would have moisture stress problems but these problems can also occur in higher rainfall months where there is poor rainfall distribution. Complete rainfall data for Tortilla Flats is presented in Appendix 1.

Table 2: Summary of monthly rainfall at Tortilla Flats Research Farm for the seasons 1960/61 to 1987/88

SEASON	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
60 / 61	0.0	0.0	25.9	6.6	95.3	253.0	254.3	221.0	94.2	76.5	0.0	0.0
61 / 62	0.0	0.0	0.8	17.3	188.5	100.8	483.9	277.4	86.9	2.0	0.0	0.0
62 / 63	0.0	0.0	0.0	21.1	141.5	147.8	388.4	336.0	302.5	84.1	0.0	0.5
63 / 64	0.0	0.0	0.0	16.8	58.9	181.9	177.0	138.4	297.4	34.3	4.8	8.4
64 / 65	0.0	0.0	36.1	55.4	219.5	403.4	170.7	69.6	393.4	0.0	3.8	2.8
65 / 66	0.0	0.0	0.0	1.5	25.4	302.3	280.2	309.1	153.7	2.5	0.0	2.5
66 / 67	0.0	0.0	3.0	62.0	150.4	209.8	226.6	382.0	241.8	11.7	0.0	0.0
67 / 68	0.0	0.0	0.0	12.2	137.4	151.4	270.3	629.4	93.2	26.4	237.2	0.0
68 / 69	23.9	0.0	1.3	74.4	72.6	205.7	379.5	430.8	484.6	0.0	0.0	0.0
69 / 70	2.3	0.0	0.0	19.8	124.7	220.2	269.7	333.2	134.4	20.8	0.0	0.0
70 / 71	0.0	0.0	13.2	40.4	120.9	163.3	231.4	322.1	367.8	124.7	0.0	0.0
71 / 72	0.0	2.5	28.2	70.1	138.4	326.6	160.0	219.7	344.7	169.4	0.0	0.0
72 / 73	0.0	0.0	5.1	9.7	90.9	141.0	361.2	255.8	331.2	59.2	0.0	76.2
73 / 74	0.0	0.0	28.4	40.4	220.2	204.2	452.9	310.4	390.4	114.3	15.2	0.0
74 / 75	0.0	3.0	40.6	69.9	118.6	254.5	348.7	432.6	299.7	27.7	0.0	0.0
75 / 76	0.0	1.0	0.6	203.3	127.5	295.1	244.7	317.8	507.9	26.4	0.0	0.0
76 / 77	0.0	0.0	0.0	50.0	79.6	146.0	269.6	310.4	507.6	29.2	6.6	0.0
77 / 78	0.0	0.0	0.0	10.9	95.0	217.0	209.3	347.3	144.4	46.3	7.2	0.0
78 / 79	11.2	0.0	3.8	82.0	203.3	69.2	338.4	216.6	251.8	50.6	17.0	0.0
79 / 80	0.0	0.0	0.0	123.8	27.2	213.4	315.0	497.4	139.7	153.1	0.0	0.0
80 / 81	0.0	25.0	0.0	5.2	123.9	182.9	271.5	330.4	325.3	0.0	0.0	0.0
81 / 82	0.0	0.0	128.4	26.8	210.4	237.2	417.8	213.2	99.5	12.0	0.0	0.0
82 / 83	0.0	1.2	28.0	0.0	55.2	228.2	169.0	123.1	310.5	102.0	0.0	0.0
83 / 84	0.0	0.0	0.0	49.3	141.9	125.1	443.0	464.7	333.6	46.0	0.0	0.0
84 / 85	0.0	1.5	48.3	0.5	42.5	104.0	355.5	166.5	94.5	212.0	0.0	0.0
85 / 86	0.0	0.0	3.0	28.1	94.4	107.0	501.0	169.0	117.0	228.0	10.0	0.0
86 / 87	0.0	0.0	51.0	151.1	118.5	79.1	312.4	373.5	48.8	15.0	39.0	0.0
87 / 88	0.0	0.0	3.0	12.5	131.9	162.6	189.6	201.8	185.1	50.6	0.0	0.0
MAXIMUM	23.9	25.0	128.4	203.3	220.2	403.4	501.0	629.4	507.9	228.0	237.2	76.2
MINIMUM	0.0	0.0	0.0	0.0	25.4	69.2	160.0	69.6	48.8	0.0	0.0	0.0
AVERAGE	1.3	1.2	16.0	45.0	119.8	194.0	303.3	300.0	252.9	61.6	12.2	3.2
STANDARD DEVIATION	4.9	4.7	27.5	48.4	54.6	78.1	99.1	123.7	137.7	64.6	44.9	14.4
COEFFICIENT OF VARIATION (%)	368	386	172	108	46	40	33	41	54	105	369	446

Figure 1: Graphic representation of monthly rainfall at Tortilla Flats Research Farm for the seasons 1960/61 to 1987/88 and average monthly rainfall

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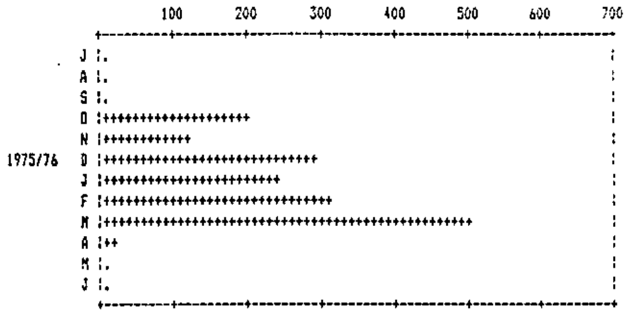
1970/71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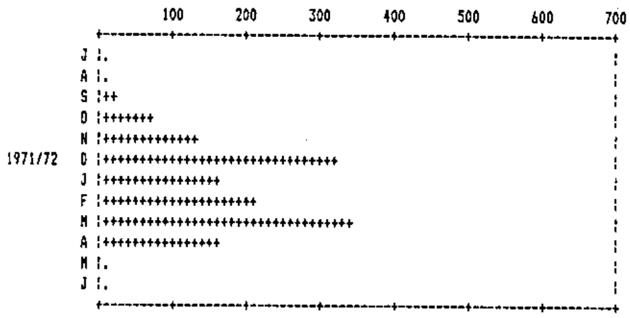
1975/76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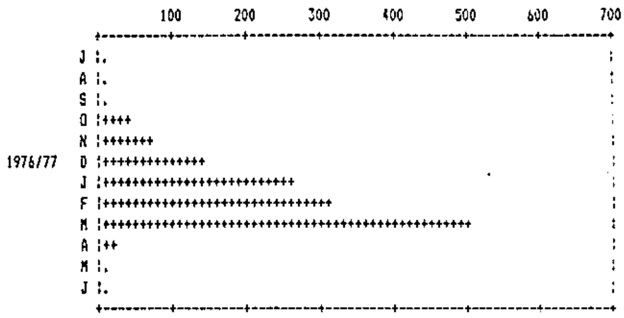
1971/72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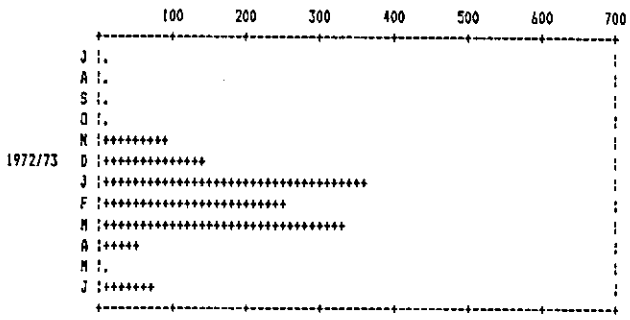
1976/77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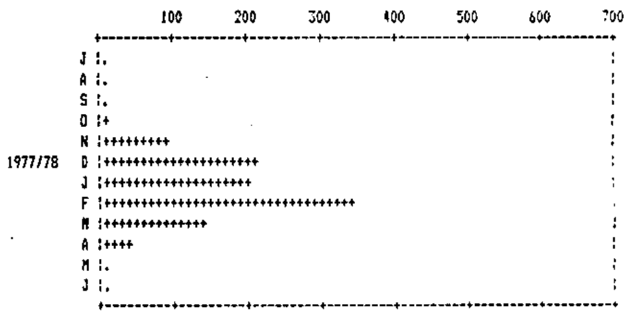
1972/73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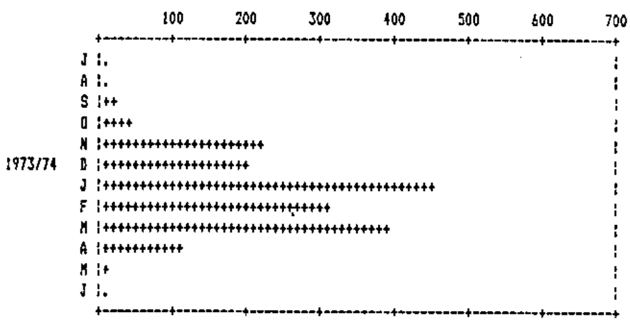
1977/78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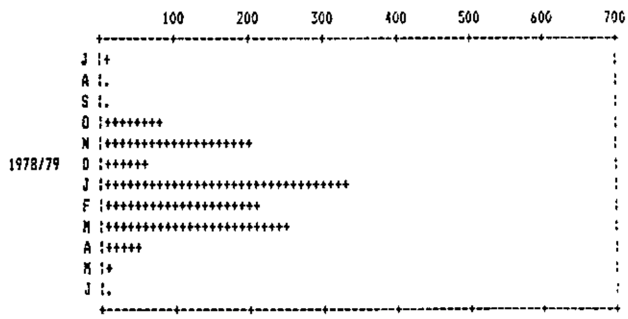
1973/74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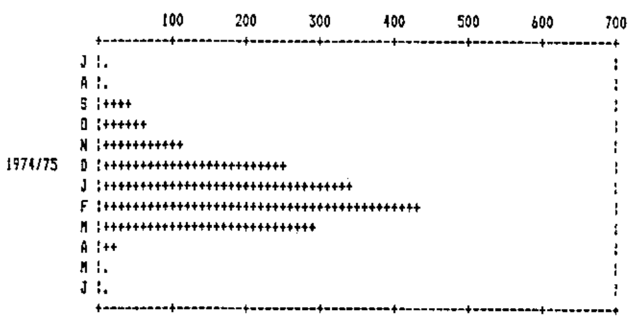
J A S O N D J F M A M J
1978/79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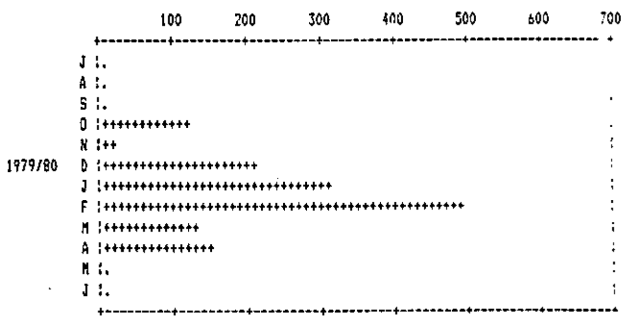
1974/75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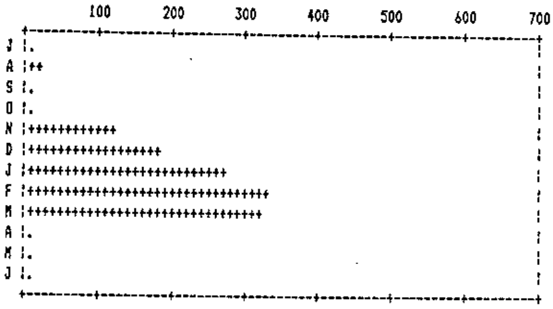
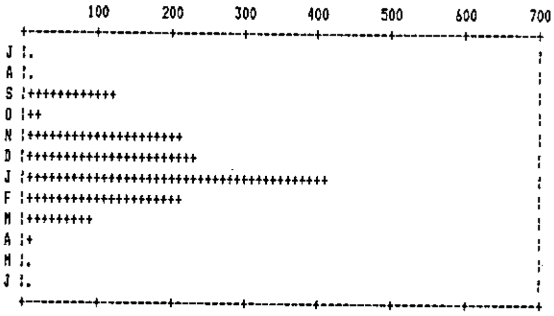
1979/80

1980/81



1981/82



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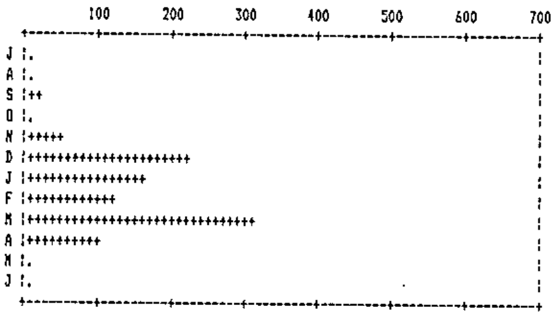

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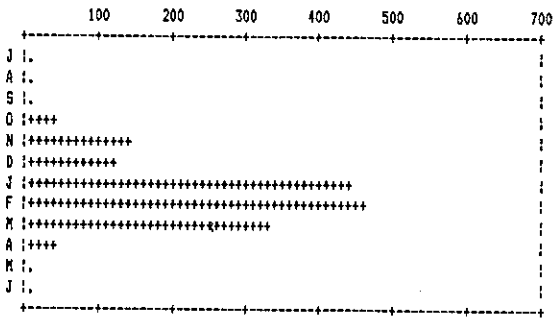

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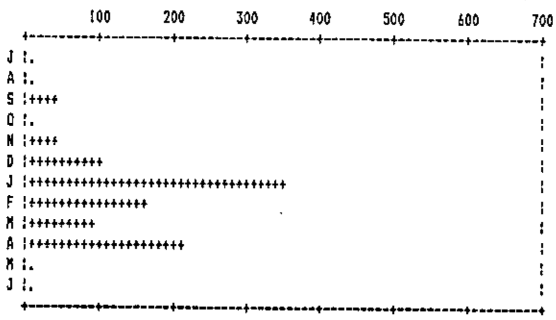

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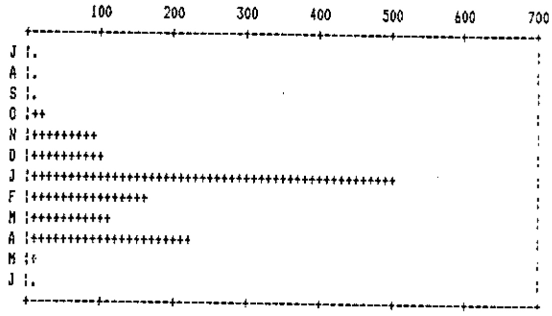
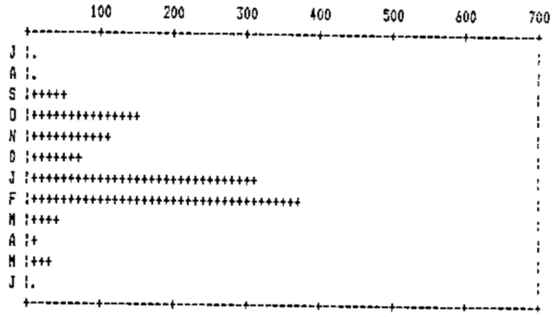
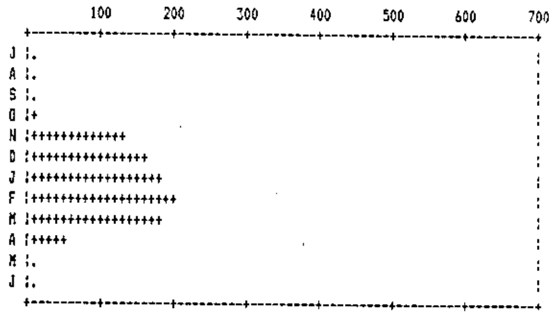


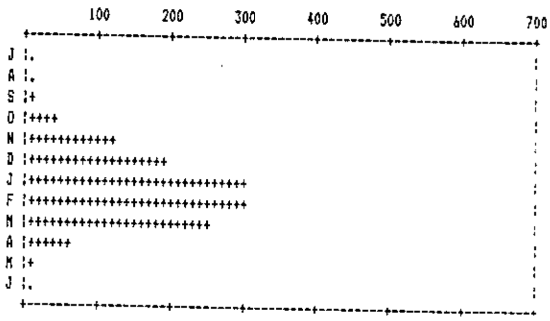
1986/87



1987/88



Average Rainfall 1960/61 - 1987/88



3.2 Rainfall Deciles

Another method to compare the variation of rainfall for a large number of years is to categorize rainfall into deciles. This basically means that rainfall (weekly, monthly, yearly, etc) is divided up into the bottom ten percent of observations (decile 1), the next ten percent of observations (decile 2) and so on until the top 10% of observations (decile 10). This method is most useful where there is a large number of observations, (say 100 or more) but is still useful where there are 28 observations such as at Tortilla Flats. The advantage of using deciles is that they give an indication of the probability of rainfall exceeding or being less than a particular amount (eg evapo-transpiration). They also show where a particular month of rainfall ranks in terms of its likelihood of being exceeded or not. Table 3 shows the monthly rainfall and the decile numbers for the years 1960-61 to 1987-88.

Decile numbers for May to September are not shown as no rainfall fell during these months in most years. In such situations decile numbers have no meaning.

If 210 mm is taken as being the minimum monthly rainfall required to avoid moisture stress problems (and this is a rough rule, especially where there are no water control structures) then Table 2 shows that the probability of exceeding this level is:

43% in December
77% in January
77% in February
57% in March
10% in April

On the face of it, January and February appear fairly reliable but the end of the rice cropping season is not quite so good. From a cropping point of view, monthly deciles still have some flaws because they do not indicate distribution of rainfall. A good month of rainfall with a high decile number may have had most of the rainfall at the beginning or end of the month but very little at other times.

Table 3: Decile numbers and monthly rainfall for the seasons 1960/61 to 1987/88

DECILE NUMBERS FOR THE YEARS 1960/61 TO 1987/88

DECILE NO.	1		2			3			4			5			6			7			8			9			10	
OCTOBER																												
Year	82/83	84/85	65/66	80/81	60/61	72/73	77/78	67/68	87/88	63/64	61/62	69/70	62/63	81/82	85/86	70/71	73/74	83/84	76/77	64/65	66/67	74/75	71/72	68/69	78/79	79/80	86/87	75/76
Rainfall(mm)	0	1	2	5	7	10	11	12	13	17	17	20	21	27	28	40	40	49	50	55	62	70	70	74	82	124	151	203
NOVEMBER																												
Year	65/66	79/80	84/85	82/83	63/64	68/69	76/77	72/73	85/86	77/78	60/61	86/87	74/75	70/71	80/81	69/70	75/76	87/88	67/68	71/72	62/63	83/84	66/67	61/62	78/79	81/82	64/65	73/74
Rainfall(mm)	25	27	43	55	59	73	80	91	94	95	95	119	119	121	124	125	128	132	137	138	141	142	150	188	203	210	219	220
DECEMBER																												
Year	78/79	86/87	61/62	84/85	85/86	83/84	72/73	76/77	62/63	67/68	87/88	70/71	63/64	80/81	73/74	68/69	66/67	79/80	77/78	69/70	82/83	81/82	60/61	74/75	75/76	65/66	71/72	64/65
Rainfall(mm)	69	79	101	104	107	125	141	146	148	151	163	163	182	183	204	206	210	213	217	220	228	237	253	255	295	302	327	403
JANUARY																												
Year	71/72	82/83	64/65	63/64	87/88	77/78	66/67	70/71	75/76	60/61	76/77	69/70	67/68	80/81	65/66	86/87	79/80	78/79	74/75	84/85	72/73	68/69	62/63	81/82	83/84	73/74	61/62	85/86
Rainfall(mm)	160	169	171	177	190	209	227	231	245	254	270	270	270	272	280	312	315	338	349	356	361	379	388	418	443	453	484	501
FEBRUARY																												
Year	64/65	82/83	63/64	84/85	85/86	87/88	81/82	78/79	71/72	60/61	72/73	61/62	65/66	73/74	76/77	75/76	70/71	80/81	69/70	62/63	77/78	86/87	66/67	68/69	74/75	83/84	79/80	67/68
Rainfall(mm)	70	123	138	167	169	202	213	217	220	221	256	277	309	310	310	318	322	330	333	336	347	374	382	431	433	465	497	629
MARCH																												
Year	86/87	61/62	67/68	60/61	84/85	81/82	85/86	69/70	79/80	77/78	65/66	87/88	66/67	78/79	63/64	74/75	62/63	82/83	80/81	72/73	83/84	71/72	70/71	73/74	64/65	68/69	76/77	75/76
Rainfall(mm)	49	87	93	94	95	99	117	134	140	144	154	185	242	252	297	300	303	311	325	331	334	345	368	390	393	485	508	508
APRIL																												
Year	80/81	68/69	64/65	61/62	65/66	66/67	81/82	86/87	69/70	75/76	67/68	74/75	76/77	63/64	83/84	77/78	78/79	87/88	72/73	60/61	62/63	82/83	73/74	70/71	79/80	71/72	84/85	85/86
Rainfall(mm)	0	0	0	2	3	12	12	15	21	26	26	28	29	34	46	46	51	51	59	76	84	102	114	125	153	169	212	228

	60/61	61/62	62/63	63/64	64/65	65/66	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88
OCTOBER	2	4	5	4	7	2	8	3	9	5	6	8	3	6	8	10	7	3	9	9	2	5	1	7	1	6	10	4
NOVEMBER	4	9	8	2	10	1	8	7	3	6	5	7	3	10	5	6	3	4	9	1	6	9	2	8	2	4	5	7
DECEMBER	8	2	4	5	10	9	6	4	6	7	5	10	3	6	9	9	3	7	1	7	5	8	8	3	2	2	1	4
JANUARY	4	10	8	2	2	6	3	5	8	5	3	1	8	9	7	4	4	3	7	6	5	9	1	9	7	10	6	2
FEBRUARY	4	5	7	2	1	5	8	10	9	7	6	4	4	5	9	6	6	8	3	10	7	3	1	9	2	2	8	3
MARCH	2	1	6	6	9	4	5	2	9	3	8	8	7	9	6	10	10	4	5	4	7	3	7	8	2	3	1	5
APRIL	7	2	8	5	2	2	3	4	1	4	9	9	7	8	5	4	5	6	6	9	1	3	8	6	10	10	3	7

3.3 Soil Moisture Simulation

The ideal way to interpret the effect of rainfall and other meteorological factors on crops is to develop and validate a computer program which will relate all of the relevant factors to crop yields. This sort of analysis has been done elsewhere but requires considerable resources. An alternative method (water balance) used here models soil moisture to determine periods of crop stress.

These basic assumptions incorporated into the model are:

- The soil profile is 30cm deep and holds 60mm of available water.
- Moisture stress is assumed to occur once available soil moisture drops below 20mm for a fully exploited soil profile.
- Moisture stress occurs at higher levels of soil moisture availability when the roots of the rice plants are only partially exploiting the soil profile.
- The average pan evaporation during the growing season is just over 5mm per day.
- The crop factor for most of the growing season is 1.4 giving evapotranspiration rates of just over 7mm per day.
- Ponding allows up to 100 millimetres of water to be ponded from day 30 giving total available moisture storage in and above the soil profile of 160mm. Between day 10 and day 30 intermediate amounts are allowed to be ponded.
- There is no allowance for run-on of water which occurs in certain floodplain situations.

Theoretically, the model gives a good representation of soil moisture during most of the cropping cycle. The main weakness is in the first three weeks of crop growth when we do not fully understand the ability of a rice plant's roots to extract moisture from the soil, movement of moisture in the soil and evaporation from the soil surface. In any case set backs from moisture stress during this period (assuming no major loss of plant density) are considered less important than stress later in the crop cycle.

Nevertheless, construction of the model and using it for analysis has provided some useful insights for the rice cropping industry. Six scenarios are reported in this study. They include ponding of water to 100mm and no ponding, for three sowing dates (December 15, January 1 and January 20). Figures 2 and 3 show the six scenarios together for easy comparison. The scenarios are reproduced in a larger scale in Appendix 2.

These figures show that earlier sowing decreases the probability of stress at the end of the season markedly but at the expense of some increased stress earlier in the season. Ponding has a marked effect in reducing stress particularly in the reproductive and grain filling stages. The exception to this is for the January 20 sowing where ponding substantially reduced stress in the reproductive stage but there was still not enough moisture in most seasons for grain filling.

The diagrams show the variability in rainfall from season to season particularly the long dry spells within the growing season. The diagrams also show a characteristic that in dry seasons, falls of rain during dry spells are often small thus only breaking the period of stress for a few days. In such situations ponding on its own provides no advantage. The benefits of ponding come in periods when falls of around 50mm or more occur within a few days of each other and the excess rain would otherwise have run off.

Figure 2: Stress periods (——) during the growing season for rice shown on three dates without ponding

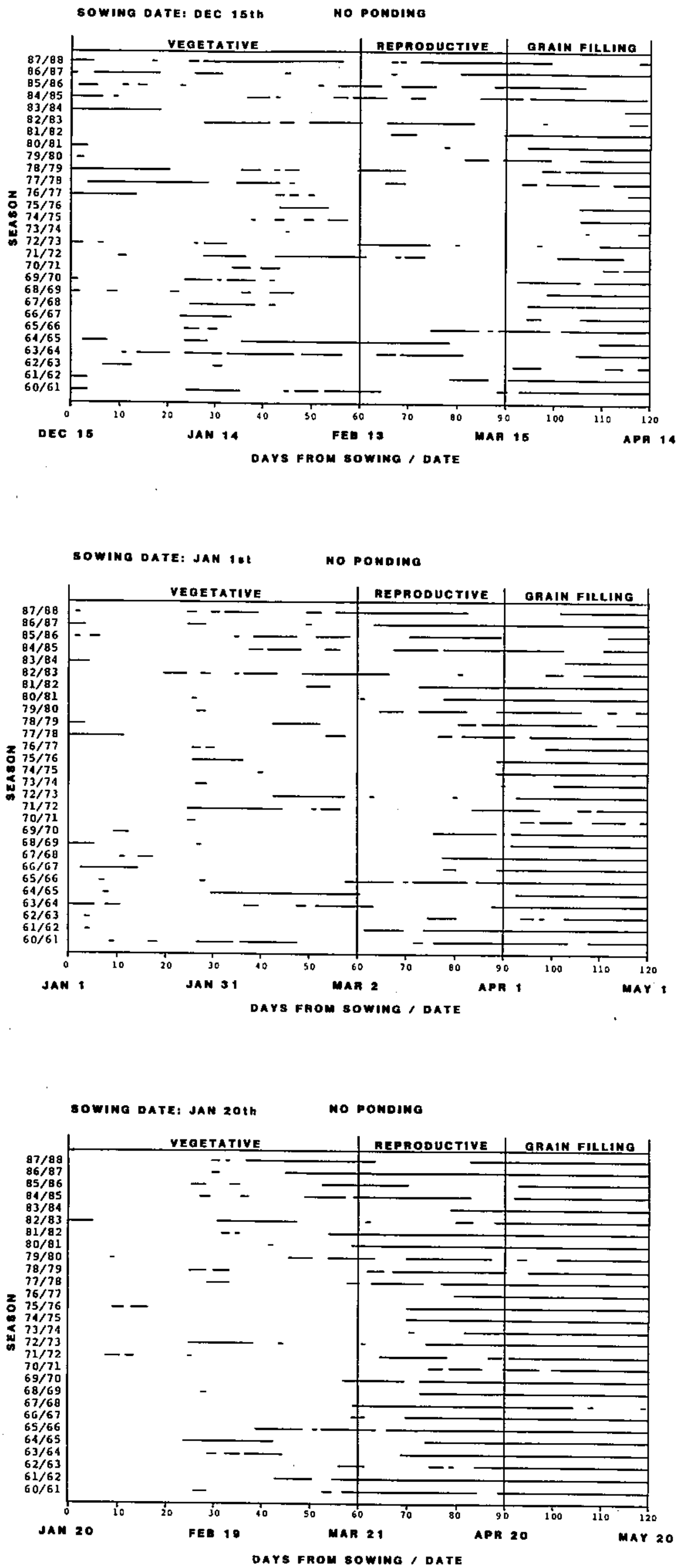
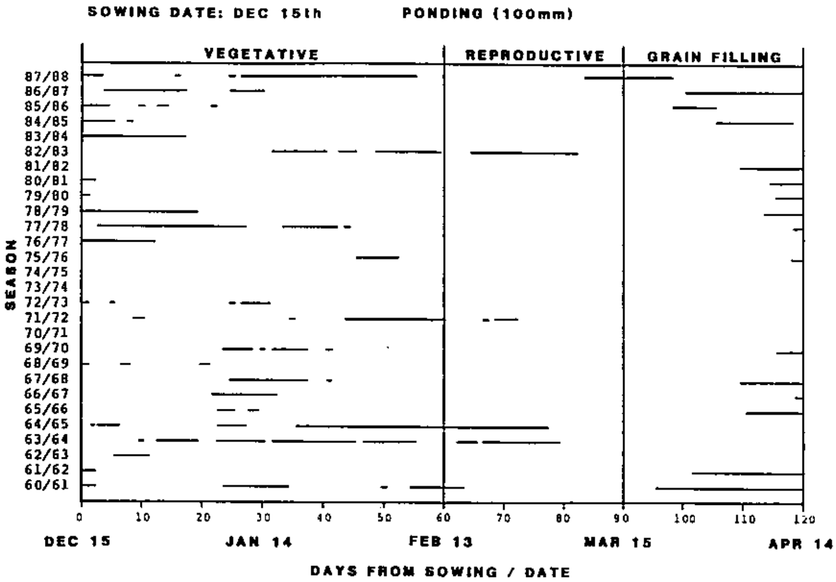
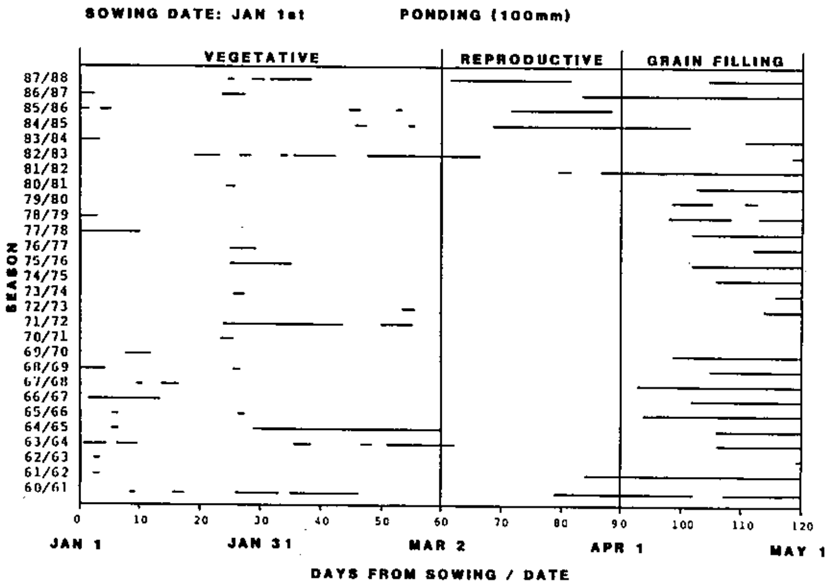
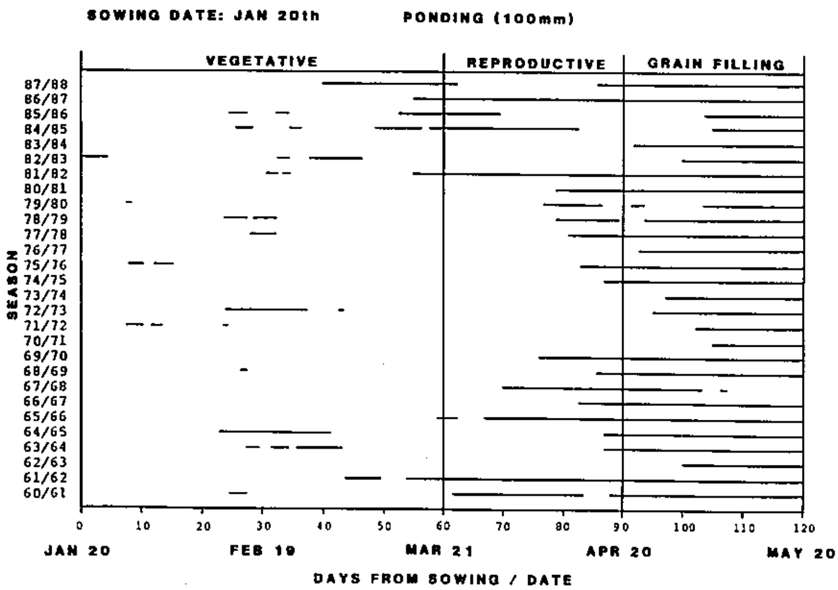


Figure 3: Stress periods (——) during the growing season for rice sown on three dates with ponding







An important point shown in the diagrams is that the 1983-84 season which is the first commercial season in the Upper Adelaide River area and the only season in which good average yields occurred, was the best season in the whole 28 year period for an unponded situation. This has probably coloured the industry's expectations, and as a result attitudes to water control structures, harvesting of water and irrigation.

Tables 4 and 5 reinforce the interpretation of figures 2 and 3. That is, earlier sowing dates reduce moisture stress at the end of the season while increasing moisture stress to a lesser extent at the beginning of the season. Also, ponding reduced stress markedly in the reproductive and grain filling stage but had a lesser effect in the vegetative stage.

Table 4: Percentage of years in which stress in each growth phase would severely affect rice yields.

	Vegetative	Reproductive	Grain Filling
Dec. 15			
No Ponding	43	25	54
Ponding	39	14	14
Jan. 1			
No Ponding	29	54	89
Ponding	18	21	36
Jan. 20			
No Ponding	25	86	100
Ponding	18	43	75

Table 5: Stress days as a percentage of total days for each growth phase for the years 1960/61 to 1987/88.

	Vegetative	Reproductive	Grain Filling
Dec. 15			
No Ponding	27	22	60
Ponding	22	8	18
Jan. 1			
No Ponding	18	36	86
Ponding	13	11	51
Jan. 20			
No Ponding	16	69	97
Ponding	10	35	86

4. IRRIGATION OF RICE

Irrigation is seen as a possible answer to variable crop yields in the Top End but high capital cost is a major obstacle.

Flood irrigation of rice, however, shows promise in certain situations compared to irrigation of other crops. The reasons for this are:

- lower capital costs for flood irrigation compared to centre pivots (which appear to be the best alternative on sandy and loamy soils)

- lower pumping costs in situations where water is lifted low heads

- lower pumping costs because water does not have to be pressurized for delivery through irrigation sprays or sprinklers

- impervious sub-soils on floodplains which almost stop moisture loss via percolation

- after emergence rice will grow in flooded conditions which enables up to 160mm of available water to be stored "in the field".

The main irrigation option considered here is pumping with a flood-lift pump from a river or billabong. Another possibility would be harvesting run-off from a nearby water course or areas adjacent to the rice paddies (eg the "keyline" method). If the latter alternative can supply gravity fed water then it would be the cheaper method.

4.1 Benefits of Rice Irrigation

Irrigation of rice would enable:

1. Sowing at the optimal time (assuming rainfall does not make conditions too wet) or sowing over a longer period than rainfed conditions would allow, enabling a larger area to be sown for a given plant (machinery) size.

2. Reduced moisture stress from mid-season droughts (which affect tillering, panicle development and/or flowering).

3. Reduced moisture stress from late-season droughts (which affects grain filling).

4. Irrigation of crops after harvesting to produce a ratoon crop for hay or possibly grain.

5. Better utilization of nitrogen fertilizers by reducing losses via volatilization.

4.2 Capital Costs

The capital items include:

- pump
- diesel motor or electric motor plus cost of connecting electricity
- structures to support and house the pump and motor
- delivery channels
- laser levelling and banking of rice bays

Capital costs will vary considerably depending on the particular situation. The area to be irrigated is a major determinant of pump and motor size and hence costs. The cost of structures to support and house the pump and motor will depend on the latter's size and the engineering requirements of the pumping site. The length and cost of delivery channels will depend on area irrigated, physical layout of rice bays, topography, soil type and construction method. The cost of laser levelling will depend on slope for land, size of rice bays and soil type.

Laser levelling and banking are necessary to produce the best results from ponding water under rainfed conditions so may be in place already.

4.3 Operating Costs

The major operating costs are fuel & lubricants, repairs & maintenance to the pump and motor, and repairs & maintenance to delivery channels. Fuel cost will depend on the area irrigated, water losses in delivery channels, number of irrigations per year and the vertical distance water has to be lifted to delivery channels.

The least obvious of these factors is water losses. Channels crossing levee or other sandy/loamy soils could lose up to one third of pumped water through percolation.

An interesting aspect in the following example is that repair and maintenance can cost more than the cost of fuel.

5. THE EXAMPLE

The following example has been formulated from experience in the Adelaide River area to illustrate the benefits and costs of irrigating rice.

The physical specifications for the example are:

Pump - type: centrifugal - floodlift
- capacity: 300 litres/sec.

Motor - type: diesel
- power rating 52kw
- fuel consumption 13.5 litres/hr.

Delivery Channels - length 1 kilometre.

Irrigations - no. per season: 4
- mm. per irrigation: 100 millimetres.

Percentage loss of water between pump and rice bays: 25%.

Capital Costs

Pump	$21 500
Diesel Motor	10 000
Shed, foundations & fuel tank	3 000
Delivery channels	2 000
Laser levelling 40ha, 2hrs/ha @$40/hr	$ 3 200
	$39 700

A lower cost is possible if owner and family labour is solely used and only materials are purchased or if secondhand machinery is purchased.

Irrigation Operating Costs: (per hectare)

Fuel 1.25 hr/ha @ 13.5 l/hr @ 30 c/l x 4 applications	20.25
Lubricants @ 5% of fuel cost	1.01
R&M pump and motor @ 3% pa	23.63
R&M delivery channels	5.00
	$49.89 / ha

If we assume that fuel & lubricant costs plus 50% of repairs and maintenance costs vary directly with the number of irrigations then the formula for irrigation costs is $21.26/ha plus $7.16/ha/irrigation.

Table 6: Gross margin budget for rice - 1988

Enterprise Name: RICE

Region: Upper Adelaide River
Date: September 1988

						$/ha
INCOME						
Yield	3.5	t/ha	@	$185.00	/tonne	647.50
Other income: fertilizer subsidy						
	175	kg/ha	@	$95.00	/tonne	16.63
A. TOTAL INCOME						664.13
VARIABLE COSTS						$/ha
Land Preparation						
1 laser levelling	1	ha/hr	@	$39.20	/hr	13.07
(assume one third of area is levelled each year)						
2 ploughings	0.95	ha/hr	@	$10.22	/hr	21.64
bank maintenance						9.05
Sowing						
seed:	100	kg/ha	@	$200.00	/tonne	20.00
sowing operation:	1.08	/ha	@	$9.32	/hr	8.63
Fertilizers						
101 kg/ha of urea			@	$431.00	/tonne	43.53
75 kg/ha of DAP + 2.5%Zn + 10%S			@	$622.00	/tonne	46.65
Application:						
urea	1.26	ha/hr	@	$9.32	/hr	7.39
(urea is drilled by combine, DAP is sown with seed)						
Weed Control						
6.0 L/ha of Stam			@	$6.50	/L	39.00
2.0 L/ha of Saturn			@	$11.50	/L	23.00
(for control of barnyard grass)						
aerial application:			@	$17.00	/ha	17.00
Pest Control						
ammunition (for birds)			@	$9.00	/ha	9.00
Harvesting						
contract harvester:	6.0	t/ha	@	$220.00	/hr	128.33
Marketing						
cartage to depot:	3.5	t/ha	@	$15.00	/tonne	52.50
B. TOTAL VARIABLE COSTS						438.79
C. GROSS MARGIN (A - B) PER HECTARE						225.34

5.1 Cost and Returns from Irrigation

The benefits from irrigation are higher grain yield from the main crop and a higher hay yield and hay price from the ratoon crop. There is also the possible alternative of producing a ratoon grain crop plus hay but this option is not considered in the example budgets.

In terms of the grain crop alone a yield increase of less than half a tonne is required to cover the variable costs of irrigating. To assess the cost and returns from irrigation the 1988 gross margin budget for rice has been used as a basis. The budget shown in Table 6 is one in a series of crop gross margin budgets which are updated annually. This budget provides the basis for calculating the budgets summarised in Tables 7 and 8. The gross margin budget in Table 6 does not include income and variable costs for hay making which are quite important to rice growers.

Table 7 shows income, variable costs and gross margins for grain and hay production for four yield scenarios under rainfed conditions. This table illustrates the importance of hay production on rice farms.

Table 8 shows a summary of gross margin information for an irrigated rice crop and calculates the benefit from irrigation under four rainfed yield scenarios. The annual benefit from irrigation under most rainfed scenarios is substantial relative to the value of irrigation capital.

Table 7: Gross Margins for four rainfed yield scenarios

Grain				
Yield (t/ha)	1.0	2.0	3.0	4.0
Gross Income (+ fertilizer freight rebate)	201.63	386.63	571.63	756.63
Variable Costs	309.62	361.29	412.96	464.63
Gross Margin (grain only)	-107.99	25.34	158.67	292.00
Hay				
No. of Bales	115	150	190	230
Gross Income	345.00	450.00	570.00	690.00
Variable Costs	143.75	187.50	237.50	287.50
Gross margin (hay only)	201.25	262.50	332.50	402.50
Grain and Hay				
Gross Margin	93.26	287.84	491.17	694.50

Note: (1) On-farm hay price for rice straw is $3/bale.

(2) Bale weight is 20kg.

(3) No allowance is made for labour.

Table 8: Summary of gross margin information to calculate the benefit from irrigation under four rainfall yield scenarios

	Yield Scenario (t/ha)			
Rainfed Yield	1.0	2.0	3.0	4.0
Irrigated Yield	4.0	4.0	4.0	4.0
<u>Irrigated Crop</u>				
number of irrigations (100mm each)	4	3	2	1
Grain Income	756.63	756.63	756.63	756.63
Hay Income	980.00	980.00	980.00	980.00
	1736.63	1736.63	1736.63	1736.63
Variable Costs				
- grain	464.63	464.63	464.63	464.63
- hay	350.00	350.00	350.00	350.00
- irrigation	49.04	41.45	33.86	26.27
	864.52	857.36	850.20	843.04
Gross Margin (irrigated)	872.11	879.27	886.43	893.59
Gross Margin (rainfed) (from Table 7)	93.26	287.84	491.17	694.50
Benefit from Irrigation ($/ha)	778.85	591.43	395.26	199.09
($/40ha)	31 154	23 657	15 810	7 964

Note:
(1) Hay yield from irrigated ratoon crop is 280 bales/hectare.

(2) On-farm price for rice hay is $3.50/bale.

(3) Bale weight is 20kg.

(4) No allowance is made for labour.

5.2 Rate of Return on Irrigation Capital

The end product of the preceding analysis is an answer on how profitable is investment in irrigation structures and equipment. Table 9 shows calculations of the annual rate of return to capital before any allowance for labour. The profitability is quite high at all yield levels though it should be noted that at low rainfed yields, rice cropping would not be a profitable enterprise.

If greater areas could be irrigated from the one pump or second hand equipment can be purchased then the annual rate of return would be even greater. Also, higher irrigated yields are achievable with good management.

The rate of return to capital is real (ie before inflation). If the inflation rate is added to the real rate of return then the new (nominal) rate of return is comparable to interest rates offered by financial institutions.

Table 9: Annual rate of return to capital for four yield scenarios.

Grain Yield - rainfed	1.0	2.0	3.0	4.0
Increased Gross Margin for 40 hectares	31 154	23 657	15 810	7 964
Depreciation	2 760	2 760	2 760	2 760
Net Annual Return	28 394	20 897	13 050	5 204
Annual Return to Capital (%)	81	59	37	15

6. WHOLE FARM PROFITABILITY

While supplementary irrigation appears to be a profitable investment on an existing farm the question arises, would irrigated rice be profitable as a farming system. To some extent this would depend on the other components of the system (ie cattle and buffalo enterprises, other crops etc). The following analysis concentrates on rice growing by apportioning capital and overhead costs to other enterprises. The annual return to capital of 14% is good by the standard of Australian agriculture.

"Capital" Item	Value	% attributed to rice	Rice Capital
	$	$	$
Land (unimproved)	300 000	50	150 000
Clearing (100 hectares @ $200/ha)	20 000	100	20 000
Machinery (new)	100 000		
(average value)	80 000	90	72 000
Irrigation Structures and Equipment	40 000	1 100	40 000
			$282 000

Income	80 hectares x $1 736.63/ha	=	$138 930
Variable Costs (3 irrigations)	80 hectares x $857.36/ha	=	$ 68 589
Overhead Costs	- labour 60% x $20 000		$ 12 000
	- other 75% x $10 000		$ 7 500
Depreciation	- machinery 12%		$ 8 640
	- depreciable irrigation capital $34 500 @ 8%		$ 2 760
Net Annual Return			$ 39 441

Annual Return to Capital = 14.0%

7. CONCLUSIONS

The preceding analysis in conjunction with the history of the rice industry since the early 80's indicates that water control structures for ponding are the minimum improvements required for viable rice growing in the NT. Flood irrigation from rivers or billabongs is quite profitable for reasonable size areas (40 hectares or more) and extremely profitable if the machinery is purchased secondhand.

Flood irrigation should be regarded as the recommended practice where it is technically feasible, unless a cheaper alternative to supply water is available. Water harvesting (ie the keyline approach) or building rice bays on sites where water flows across the floodplains, would be favourable alternatives though would not provide the same security as flood irrigation.

Recommendations for sowing dates are only given for situations where ponding is the minimum amount of water control, as sowing cannot be recommended in situations without ponding (assuming no other compensating factors).

Late December to early January is the preferred sowing time if seasonal conditions permit. This is on average earlier than the present industry norm. Sowing in mid-December should be considered if conditions are suitable or flood irrigation is available. Late January (after 15 January) is definitely not recommended.

These recommendations should be seriously considered when formulating future Government support to the rice industry.

Appendix 1: Daily rainfall at Tortilla Flats Research Farm for the seasons 1960/61 to 1987/88 in millimetres

STATION: TORTILLA FLATS RESEARCH FARM

DAY NO.	MONTHDAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
1	JULY 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	AUG 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0
52	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

STATION: TORTILLA FLATS RESEARCH PARK

DAY NO.	MONTH DAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 -87	87 88
57	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0
58	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	SEPT 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
66	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
67	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0
69	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	11	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	12	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
76	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0
77	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	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
78	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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
79	17	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
80	18	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0
81	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
82	20	0.0	0.0	0.0	0.0	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
83	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
84	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0
86	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0
87	25	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	22.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
88	26	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	0.0	0.0	0.0	2.5	0.0	0.0	0.0	1.0	0.0	0.0	58.0	0.0	0.0	0.0	0.0	0.0	0.0
89	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90	28	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.0	0.0	0.0	0.8	0.0	0.0	3.0
91	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5	0.0
92	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0
93	OCT 1	0.0	0.0	0.0	0.0	0.0	0.0	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.6	0.0	0.0	0.0	31.8	0.0	18.4	0.0	0.0	0.0	0.0	3.5	0.0
94	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.0	0.0
95	3	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	6.1	0.0	0.0	0.0	0.0	0.0	40.6	1.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0
96	4	0.0	0.0	0.0	0.0	0.0	0.0	37.1	0.0	23.9	0.0	0.0	0.0	0.0	0.0	0.0	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
97	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.3	0.5	0.8	0.0	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
98	6	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
99	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	15.7	27.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	5.3	0.0	0.0	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
102	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	10.7	0.0	0.0	1.0	0.0	15.8	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	11	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
104	12	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0	0.0
105	13	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	0.0	13.1	0.0	0.0
106	14	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	0.0	1.6	0.0	0.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0
107	15	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	25.7	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0
108	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	62.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
109	17	0.0	0.0	11.9	0.0	6.6	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0
110	18	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

STATION: TORTUGA FLATS RESEARCH FARM

DAY NO.	MONTH	DAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
111		19	0.0	0.0	0.0	0.0	22.9	0.0	0.0	0.4	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
112		20	0.0	1.0	0.0	0.0	5.3	1.0	9.9	0.0	0.0	18.8	1.5	48.0	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	24.0	3.5
113		21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0
114		22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	25.8	0.0	17.2	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	3.0
115		23	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
116		24	0.0	15.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
117		25	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
118		26	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	6.0	0.0
119		27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	10.9	0.0	0.0	0.0	3.6	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
120		28	0.0	0.0	1.0	6.4	0.0	0.0	0.3	0.0	0.0	0.0	0.0	1.8	3.3	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
121		29	1.8	0.0	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0
122		30	0.0	0.3	0.0	1.3	15.2	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	23.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	6.0
123		31	0.0	0.0	1.5	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.0	0.0	6.0	28.8	0.0	0.0	0.0	0.0	0.0	0.0	15.0	2.0	0.0
124	NOV	1	1.8	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	43.4	0.0	0.0	0.0	0.0	28.4	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	43.0
125		2	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.9	0.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6
126		3	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.5	29.7	0.0	0.0	0.0	0.0	14.0	19.0	0.0	1.4	26.6	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	2.0
127		4	0.0	25.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0
128		5	0.0	2.5	6.4	0.0	14.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	17.8	0.0	0.0	0.0	0.0	6.8	0.0	0.0	9.8	25.2	0.0	0.0	0.0	0.0
129		6	0.0	0.0	0.0	4.6	6.9	0.0	0.0	19.1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	6.4	0.0	0.0	10.2	0.0	7.2	0.0	0.2	5.2	0.0	2.0	0.0	0.0
130		7	0.0	11.2	0.3	0.0	0.0	0.0	0.0	22.1	0.0	4.1	35.8	0.5	0.0	0.5	0.0	0.4	0.0	6.2	0.0	0.0	1.0	0.0	0.0	13.5	0.0	0.0	0.0	0.0
131		8	0.0	7.6	2.5	0.0	0.0	0.0	0.0	14.5	0.0	0.0	0.0	19.3	0.0	19.6	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
132		9	0.0	0.0	1.0	17.3	0.0	5.1	0.0	1.3	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	2.0	7.0	23.0
133		10	0.0	0.0	15.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	12.2	16.5	13.2	38.9	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	8.0	17.6
134		11	0.0	4.3	8.6	0.5	16.8	6.6	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	2.0	0.0	25.4	0.0	10.2	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
135		12	0.0	10.4	0.0	0.0	0.0	0.0	33.0	0.0	0.0	0.0	17.0	0.0	0.0	7.9	30.5	0.0	7.8	0.0	0.0	0.0	3.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0
136		13	0.0	2.5	0.0	0.0	0.0	0.0	0.0	17.8	1.0	0.0	0.0	0.0	14.7	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	15.0	0.0	10.5
137		14	0.0	0.0	0.0	2.5	9.1	0.0	56.4	0.0	0.0	1.0	0.0	0.0	2.3	1.0	19.1	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	13.0	0.0	0.0	0.0	0.0
138		15	7.6	0.0	0.5	0.0	12.7	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	3.0	0.0	2.0	0.0
139		16	0.5	26.4	0.0	7.1	0.0	0.0	0.0	1.3	7.9	46.5	23.9	0.0	0.0	26.9	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
140		17	60.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.4	0.0	0.0	0.0	3.0	9.8	0.0	5.2	0.0	55.0	0.0	26.4	17.0	0.0	0.0	0.0	0.6
141		18	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	3.8	1.0	0.0	0.0	0.0	0.0	2.2	34.4	0.0	0.0	0.0	42.0	0.0	1.5
142		19	9.7	10.7	6.1	0.0	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0	0.0	0.0	4.0	0.0	49.5	1.5
143		20	10.9	0.0	0.0	0.0	6.9	6.1	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
144		21	0.0	0.0	0.0	15.5	7.6	0.0	18.3	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.3	0.0	2.6	1.6	56.7	0.0	0.0	57.2	0.0	5.0	16.0	0.0	0.0	0.0
145		22	0.0	0.0	15.2	0.5	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.1	0.0	0.0	0.0	15.4	3.8	0.0	0.0	0.0	14.8	37.0	0.0	3.0	0.0	0.0
146		23	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.8	4.3	37.3	16.0	0.0	0.0	0.0	0.0	65.0	0.0	0.0	0.0	0.0	7.0	0.0	1.0	0.0	25.0
147		24	0.0	0.8	0.5	0.0	54.1	0.0	2.3	0.0	40.4	0.0	0.3	0.0	1.5	0.0	0.0	26.4	11.6	11.6	3.2	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0
148		25	0.0	72.1	0.0	0.0	17.5	0.0	3.6	0.0	0.0	0.0	7.6	0.0	4.1	0.0	0.8	10.2	0.0	1.2	0.0	0.0	13.6	18.2	0.0	0.0	0.0	0.0	0.0	0.0
149		26	0.0	0.0	81.0	0.0	0.5	0.0	0.0	0.0	9.1	0.0	0.0	20.8	2.0	40.9	0.0	1.8	0.0	0.0	0.0	10.0	34.6	14.0	0.0	0.0	8.5	8.0	15.0	0.0
150		27	0.0	0.0	3.8	0.0	22.4	0.0	13.0	3.3	0.0	0.0	1.0	0.0	0.0	0.0	0.0	13.8	0.0	0.0	17.6	10.4	0.0	0.0	0.0	0.0	0.0	0.0	32.0	0.0
151		28	0.0	7.9	0.0	0.0	31.0	0.0	13.2	0.0	7.1	0.0	2.3	0.0	10.4	0.0	0.0	0.5	0.0	25.2	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
152		29	0.5	0.3	0.0	0.0	5.1	1.3	0.0	16.5	0.0	0.0	9.7	0.0	5.3	0.0	0.0	5.4	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
153		30	0.0	6.4	0.0	8.6	0.3	0.5	0.0	40.6	0.0	0.0	0.0	5.6	0.0	3.6	0.0	25.0	0.0	27.4	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	4.6
154	DEC	1	7.9	6.9	10.9	0.0	0.0	1.5	2.8	0.0	11.9	0.0	21.8	22.9	0.0	1.0	0.5	10.0	0.0	18.0	13.2	0.0	12.0	0.0	0.0	15.0	0.0	0.0	0.0	20.0
155		2	1.8	0.0	0.0	0.0	1.8	13.0	2.3	7.6	34.0	0.0	54.4	0.3	0.0	0.0	3.6	0.8	2.4	0.0	0.0	0.0	7.3	0.0	0.0	63.0	0.0	0.0	0.0	0.0
156		3	0.0	0.0	38.1	78.5	121.4	4.3	0.0	0.0	1.5	0.0	0.5	0.0	0.0	0.0	17.3	0.0	0.0	0.0	0.0	0.0	0.0	36.0	8.0	24.1	0.0	0.0	19.0	0.8
157		4	0.0	0.0	0.0	0.0	163.6	0.0	0.0	18.8	11.7	0.0	0.0	7.6	0.0	0.0	62.2	52.0	6.8	0.0	3.0	28.2	3.4	0.0	50.0	0.0	0.0	0.0	9.0	0.0
158		5	0.0	0.0	0.0	22.1	0.3	0.0	0.0	0.0	0.5	0.0	0.0	10.4	0.0	0.0	5.3	0.0	3.4	37.6	0.0	8.8	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
159		6	4.6	0.0	3.6	2.5	0.0	4.6	2.8	3.6	0.0	0.0	0.0	3.3	3.0	1.0	0.0	17.6	0.0	17.4	12.4	0.0	0.0	0.0	0.0	4.0	3.5	0.0	6.0	0.0
160		7	0.0	2.8	0.0	3.6	0.0	0.0	15.2	23.1	0.0	0.0	16.3	1.5	0.0	40.9	8.6	0.0	0.4	35.0	0.6	0.0	0.0	8.0	4.6	0.0	10.0	45.0	0.0	0.0
161		8	8.4	0.0	0.0	0.0	0.0	2.5	1.5	0.3	0.0	4.1	6.9	1.5	0.8	0.0	0.0	13.8	0.0	0.0	0.8	21.0	0.0	53.0	3.4	0.0	0.0	0.0	12.0	0.0
162		9	0.0	5.3	0.0	0.0	19.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	6.8	87.0	0.0	0.0	15.0	0.0	45.4	0.0	7.5	6.0	13.5	0.0
163		10	0.0	1.5	0.0	0.0	0.0	54.1	0.0	0.0	6.6	0.0	7.6	2.3	0.0	0.3	16.5	0.0	0.0	0.0	0.0	28.0	13.2	0.0	0.0	0.0	0.0	18.0	0.0	6.0
164		11	34.3	0.0	0.0	8.6	3.6	21.8	0.0	24.6	0.0	0.0	0.0	0.0	32.5	0.0	0.5	20.4	1.0	0.0	8.6	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
165		12	0.0	0.0	8.6	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0	10.6	0.0	22.0	0.0	0.0	0.0	9.0	0.0	0.0	5.0	0.0	0.0	0.0

STATION: TORTILLA FLATS RESEARCH FARM

DAY NO.	MONTHDAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
166	13	0.0	0.0	0.0	2.0	0.0	4.6	6.9	0.0	0.0	32.0	0.0	53.3	0.0	0.3	14.7	0.0	6.4	0.0	0.0	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0
167	14	0.0	40.4	0.0	0.0	0.0	0.0	27.7	0.0	0.0	0.0	0.0	0.0	0.0	17.8	1.3	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
168	15	0.0	0.0	40.4	4.3	0.0	0.0	57.4	9.9	0.0	8.4	0.0	0.0	0.0	0.0	0.0	10.2	0.4	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
169	16	0.0	0.0	0.0	0.0	0.0	0.5	22.9	0.0	0.0	24.9	21.6	37.1	5.8	0.0	0.0	31.0	0.4	0.0	0.0	0.0	0.0	39.0	4.3	7.0	2.0	0.0	12.6	4.0
170	17	1.8	1.0	0.0	0.0	0.0	0.0	40.4	0.0	15.0	0.5	0.0	114.0	18.5	0.0	0.0	0.0	5.4	0.0	0.0	55.8	1.8	0.0	12.0	0.0	0.0	0.0	0.0	29.0
171	18	18.3	15.2	0.0	0.0	0.0	26.7	0.0	1.0	0.0	0.5	0.0	0.0	1.3	28.2	0.0	2.2	0.0	0.0	0.0	0.0	48.1	0.0	0.0	0.0	0.0	0.0	4.0	0.0
172	19	57.2	0.0	0.0	55.9	0.9	4.8	0.0	0.0	1.5	1.3	0.0	0.0	0.0	0.0	15.0	0.2	0.0	0.0	0.0	0.0	25.1	0.0	0.0	0.0	4.0	4.0	0.0	29.0
173	20	1.8	3.8	0.0	0.0	0.0	7.4	1.3	0.8	4.8	1.5	10.7	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	17.0	0.0	25.0
174	21	4.3	0.0	0.0	0.0	0.0	0.0	0.0	26.7	0.0	5.8	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	4.8	0.0	8.8	9.0	23.5	0.0	43.0	0.0	0.0	21.0
175	22	6.4	0.0	0.0	0.0	21.3	0.0	13.7	0.0	0.0	61.7	0.0	1.3	0.0	0.0	1.3	20.6	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	23.8
176	23	5.6	0.0	0.0	0.5	13.7	0.0	3.3	0.0	2.0	1.3	1.5	1.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
177	24	10.2	8.6	0.0	0.0	0.0	0.0	0.0	13.2	68.8	31.5	6.9	0.0	0.0	33.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	3.0	0.0
178	25	20.3	0.0	2.5	0.0	6.9	6.4	10.4	0.0	8.9	17.5	0.0	0.0	0.0	0.0	5.1	0.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
179	26	0.0	0.0	0.0	0.0	12.2	8.1	0.0	0.0	38.4	0.0	0.0	0.0	0.0	0.0	33.0	14.0	0.0	0.0	0.0	0.0	1.2	47.0	46.0	5.0	0.0	0.0	0.0	0.0
180	27	0.0	2.3	39.9	0.0	9.4	0.8	0.0	0.0	0.0	0.0	0.0	24.9	0.0	0.0	10.2	14.4	2.0	0.0	9.6	52.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0
181	28	7.6	5.1	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	4.6	31.0	0.0	55.5	74.0	0.0	9.2	3.0	0.0	0.0	3.0	0.0	8.0	0.0	0.0	0.0
182	29	0.0	0.0	0.0	1.3	20.3	77.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	27.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
183	30	0.0	3.8	3.8	2.5	0.3	60.5	0.0	17.5	0.0	0.0	0.0	0.0	30.2	41.1	0.0	0.0	0.0	0.0	7.0	10.0	0.0	20.0	0.0	0.0	0.0	17.0	0.0	0.0
184	31	62.7	4.1	0.0	0.0	9.7	1.3	0.0	0.0	0.0	29.2	15.2	45.2	25.9	0.8	53.3	0.0	0.0	0.0	0.0	0.0	4.0	0.0	18.0	0.0	10.0	0.0	0.0	0.0
185 JAN	1	107.2	1.0	0.0	0.5	7.4	1.8	6.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.8	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	1.0	0.0	12.4
186	2	0.0	0.0	0.0	3.3	15.5	0.0	0.0	16.0	0.0	0.0	0.0	0.0	42.7	0.0	25.4	71.6	1.0	0.0	0.0	3.0	0.0	27.0	13.0	35.0	8.0	0.0	26.0	0.0
187	3	4.6	0.0	0.0	4.8	0.3	2.0	0.0	0.0	0.0	24.9	0.0	10.7	8.4	99.1	0.0	0.0	11.6	24.2	20.0	26.3	0.0	0.0	10.0	0.0	0.0	6.0	0.0	42.0
188	4	0.0	1.5	0.0	3.6	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	29.2	6.7	0.8	0.0	56.2	8.8	0.0	0.0	0.0	0.0	4.0	0.0	18.0	15.2
189	5	0.0	18.3	27.4	8.4	0.0	0.0	4.6	11.2	0.0	0.0	3.0	55.6	0.0	0.0	22.6	1.0	12.2	0.0	2.0	0.0	6.4	0.0	41.0	22.0	0.0	0.0	8.0	0.4
190	6	0.0	41.1	3.6	6.4	0.0	0.0	0.0	0.5	60.2	0.0	1.8	0.0	13.0	0.0	0.8	1.0	30.6	0.0	0.0	0.0	0.0	0.0	5.0	9.0	0.0	0.0	0.0	0.0
191	7	0.0	4.3	28.2	0.0	0.0	0.0	0.0	0.0	15.2	0.0	22.9	0.0	0.0	33.5	0.0	13.2	0.6	4.0	0.0	37.0	47.0	13.0	0.0	0.0	32.0	53.0	5.0	5.0
192	8	0.0	29.7	8.6	0.5	0.0	7.1	2.5	0.0	21.8	0.0	0.0	0.0	0.3	6.4	0.0	2.6	15.4	0.0	38.2	0.0	2.2	0.0	0.0	0.0	38.0	14.0	0.0	0.0
193	9	0.0	0.8	0.0	1.8	7.4	1.8	0.0	0.0	40.4	0.0	22.9	7.1	1.0	29.2	1.3	4.0	0.0	0.0	17.6	8.1	27.1	6.1	0.0	35.0	2.5	0.0	0.0	0.0
194	10	7.9	7.1	0.0	2.8	8.6	30.0	0.0	0.0	10.9	0.0	60.2	0.0	13.5	18.3	78.0	0.0	0.0	11.0	0.0	0.0	0.0	18.0	0.0	5.0	0.0	43.0	0.0	16.2
195	11	2.3	9.7	0.0	4.3	10.4	0.0	2.8	0.0	0.0	0.0	0.0	0.0	1.8	0.5	23.1	11.4	21.8	4.0	41.6	52.2	0.0	16.0	0.0	4.0	12.0	0.0	16.0	1.6
196	12	0.0	1.8	1.8	0.5	50.0	0.5	0.0	1.8	84.3	0.0	0.0	0.0	0.0	0.0	18.3	21.6	4.0	33.0	2.0	0.0	13.0	0.0	0.0	0.0	0.0	38.0	6.0	2.0
197	13	0.0	8.4	1.0	0.0	0.0	0.0	1.5	0.0	10.4	34.3	0.0	0.0	3.3	0.0	3.8	16.0	10.2	9.0	0.0	0.0	0.0	15.0	0.0	42.0	0.0	0.0	3.0	0.0
198	14	0.0	3.8	0.0	12.7	0.0	22.6	0.0	0.0	0.0	0.0	0.5	7.1	4.6	11.7	56.6	16.0	0.0	10.0	0.0	22.1	26.0	10.0	10.0	0.0	9.0	12.0	13.0	0.0
199	15	0.0	18.8	18.5	26.4	0.0	11.2	17.5	0.0	0.0	11.9	0.0	9.4	2.8	23.4	0.5	8.6	0.0	12.0	0.0	2.2	0.2	14.0	0.0	0.0	11.0	4.0	24.4	0.0
200	16	0.0	27.9	9.9	0.0	0.0	20.1	4.3	0.0	3.6	0.0	10.2	2.0	30.5	30.7	0.0	0.8	51.4	0.0	12.4	0.0	0.0	138.0	0.0	0.0	4.0	14.0	25.0	20.0
201	17	0.0	0.0	25.4	0.0	11.4	26.2	31.8	0.0	0.0	0.0	0.0	0.0	76.5	21.1	1.3	0.6	0.0	3.1	2.8	2.3	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0
202	18	0.3	0.3	1.3	0.0	0.0	23.4	2.5	19.6	0.0	0.0	7.6	1.8	0.0	35.3	4.1	0.0	41.2	1.2	0.0	32.5	0.0	18.0	0.0	0.0	5.0	20.0	0.0	8.0
203	19	28.4	26.9	14.7	0.8	0.0	5.3	18.5	3.8	0.0	0.0	0.0	0.0	0.0	25.4	0.0	49.6	0.0	3.0	0.0	0.0	39.0	0.0	0.0	7.0	0.0	0.0	46.0	0.0
204	20	40.9	72.1	2.8	24.1	0.0	43.9	2.8	18.5	0.0	0.0	9.7	53.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	15.0	0.0	0.0	0.0	34.0	6.0	25.0
205	21	30.5	8.9	32.0	0.0	11.9	5.1	33.8	5.3	20.3	2.5	23.9	9.9	3.3	13.7	0.0	9.6	0.0	0.0	0.0	11.1	0.8	3.6	0.0	35.0	0.0	65.0	34.0	0.0
206	22	12.7	28.7	60.7	10.4	4.8	3.8	12.2	11.9	7.4	44.2	0.0	0.0	0.0	8.6	29.2	8.2	0.0	0.0	23.2	47.0	0.8	51.0	0.0	0.0	0.0	25.0	1.0	3.0
207	23	1.8	2.5	0.3	0.0	0.0	10.9	12.7	12.2	9.4	0.0	0.0	0.0	14.2	1.8	14.5	0.0	0.0	31.2	24.0	0.0	8.8	3.0	0.0	60.0	20.0	37.0	1.0	0.0
208	24	0.0	7.1	69.1	0.0	0.0	0.3	22.4	2.8	2.8	0.0	2.0	0.0	10.9	3.0	0.0	0.0	13.4	6.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	48.0	0.0	4.6
209	25	0.0	2.0	16.8	2.3	0.8	0.8	11.7	2.8	0.0	0.0	1.3	2.5	18.5	0.3	0.0	0.0	0.0	2.0	5.0	0.0	0.0	18.5	34.0	0.0	29.0	0.0	0.0	0.0
210	26	0.0	32.0	6.4	12.4	18.3	2.8	0.0	52.3	0.0	22.1	0.0	0.0	7.1	0.0	0.0	0.0	5.0	5.2	2.2	0.0	0.0	0.0	0.0	5.0	0.0	65.0	7.0	0.0
211	27	2.0	18.8	43.9	2.8	2.3	4.3	13.2	42.7	0.0	29.7	46.0	0.0	0.0	0.0	0.0	0.0	7.4	42.2	15.2	0.0	32.2	7.2	0.0	4.0	68.0	0.0	0.0	18.6
212	28	0.5	3.8	9.7	11.9	5.1	0.0	0.0	0.0	13.2	39.1	2.3	0.0	0.0	0.0	40.1	0.0	11.6	0.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4
213	29	14.7	44.5	0.8	21.6	5.1	41.9	1.3	0.0	20.8	0.0	12.7	0.0	0.0	77.5	0.0	0.0	0.0	0.0	0.0	56.2	7.5	9.0	0.0	50.0	18.0	0.0	37.0	11.0
214	30	0.5	19.6	4.6	14.7	0.0	14.7	23.1	43.4	42.2	0.0	4.6	0.0	38.4	6.1	0.0	0.2	0.0	28.2	14.0	4.1	40.5	30.0	44.0	60.0	51.0	0.0	32.0	0.0
215	31	0.0	42.4	1.0	0.0	11.4	0.0	0.5	19.1	16.5	61.0	0.0	0.0	70.6	6.9	0.0	0.0	29.6	0.0	64.0	0.0	0.0	5.4	0.0	5.0	44.0	22.0	6.0	6.2
216 FEB	1	1.3	39.4	16.0	0.0	0.0	2.8	21.8	136.9	5.1	0.0	48.0	0.0	50.8	0.0	0.0	0.0	0.0	25.2	8.0	10.4	0.0	4.0	0.0	55.0	0.0	0.0	53.0	5.0
217	2	0.0	12.4	5.3	0.0	0.0	0.3	0.0	13.0	0.0	0.0	12.6	0.0	77.7	0.0	0.0	2.2	0.0	16.2	0.0	0.0	51.1	0.0	0.0	0.0	0.0	0.0	40.0	0.8
218	3	2.5	3.0	7.6	11.7	0.0	47.2	25.4	16.8	26.7	0.0	0.0	15.5	24.4	0.0	39.6	1.8	33.0	2.4	0.0	0.0	25.0	0.0	0.0	70.0	0.0	0.0	17.4	0.0
219	4	30.2	3.8	15.0	0.0	0.0	19.1	9.1	0.0	54.1	38.4	77.7	17.3	30.0	36.8	0.0	0.6	1.0	30.1	0.0	54.2	1.8	0.0	0.0	0.0	0.0	0.0	17.6	0.0
220	5	3.3	0.0	0.8	0.0	1.3	8.4	0.3	0.3	50.0	0.0	10.2	7.6	9.7	0.0	0.0	9.4	11.6	4.2	7.6	24.1	0.0	41.0	18.2	0.0	2.0	18.0	24.0	2.2

STATION: TORTILLA FLATS RESEARCH PARK

DAY NO.	MONTHDAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
221	6	0.0	0.5	30.2	0.5	9.1	13.7	3.6	6.4	93.0	27.7	0.0	0.0	2.3	11.2	0.0	25.6	15.0	30.2	18.0	0.0	9.0	2.6	0.0	16.0	0.0	0.0	28.4	0.0
222	7	0.0	56.1	2.0	2.3	0.0	16.3	39.9	75.7	34.0	0.0	0.0	0.0	0.0	0.0	0.0	38.0	24.6	4.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	8.0	0.0	9.0
223	8	1.3	33.3	14.7	0.0	0.0	1.5	25.4	77.0	3.6	0.0	3.0	0.0	3.6	12.2	0.0	3.4	32.0	0.0	0.0	16.0	0.0	0.0	8.6	0.0	0.0	0.0	0.0	11.0
224	9	2.3	1.3	0.0	44.7	0.3	11.2	4.9	13.5	34.5	36.6	4.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0	6.4	0.0	45.8	4.0	0.0	0.0	0.0	0.0	0.0	64.0
225	10	3.8	9.4	31.8	0.0	0.3	88.9	1.0	0.0	5.3	23.1	49.5	0.0	0.0	0.0	52.3	0.0	25.0	0.0	0.0	0.0	20.6	0.0	0.0	0.0	30.0	13.5	39.0	22.0
226	11	0.0	2.5	18.0	18.8	0.0	11.9	10.2	0.0	1.3	44.7	1.8	5.3	1.3	13.2	7.6	0.0	5.0	28.4	0.0	92.2	10.8	14.0	0.0	24.0	0.0	0.0	24.6	6.4
227	12	2.3	5.3	3.0	0.0	0.0	25.9	0.8	45.7	0.0	1.8	2.3	0.0	0.0	7.4	19.8	3.2	7.0	4.4	0.0	16.1	1.4	0.0	0.0	16.0	0.0	0.0	1.0	33.2
228	13	4.3	0.0	16.3	4.8	2.3	3.8	2.8	0.0	3.8	15.0	14.5	0.0	0.0	30.0	40.3	9.4	0.0	0.0	0.0	9.0	31.0	6.2	50.7	14.0	0.0	0.0	2.0	7.0
229	14	0.0	3.8	35.1	5.1	11.2	0.0	65.0	26.4	11.7	0.0	0.0	34.3	0.0	33.5	0.0	0.0	15.6	0.0	0.0	10.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0
230	15	0.0	19.1	28.7	0.0	6.9	0.0	29.7	0.5	0.0	13.7	0.0	7.1	0.0	2.3	81.3	57.8	29.6	1.0	1.2	26.1	0.0	4.2	0.0	1.4	0.0	0.0	0.0	0.0
231	16	10.7	7.6	7.9	0.0	2.0	7.6	18.5	2.0	0.0	0.0	2.8	23.1	0.0	0.0	0.0	0.0	2.4	0.6	20.0	0.0	53.4	8.0	0.0	10.3	0.0	0.0	6.8	0.0
232	17	35.8	0.5	1.5	0.0	14.7	1.8	8.1	0.0	15.5	0.0	0.0	4.1	0.0	0.0	115.3	28.6	3.8	0.6	10.4	0.0	35.0	11.2	6.2	21.0	0.0	48.5	2.0	0.0
233	18	17.3	6.1	22.4	0.0	1.3	4.3	1.8	0.0	5.6	0.0	49.5	0.3	0.0	21.8	3.6	0.0	6.4	0.0	0.0	42.2	8.0	0.0	0.0	21.0	40.0	0.0	2.0	0.0
234	19	4.1	1.0	0.0	24.6	0.0	14.5	8.4	0.0	39.9	0.0	6.6	0.0	0.0	31.0	3.8	0.0	16.6	0.0	0.0	6.1	0.0	0.0	0.0	42.0	5.0	2.0	0.0	0.0
235	20	0.8	25.4	0.0	0.0	0.0	21.8	2.3	0.3	0.0	42.2	0.0	0.0	0.0	1.3	0.0	9.4	4.4	14.2	3.4	0.0	0.0	0.0	0.0	16.0	15.0	0.0	25.3	9.0
236	21	18.3	0.0	11.9	0.0	0.0	0.0	36.1	24.9	0.0	7.6	0.0	14.0	0.0	25.7	5.1	0.0	0.0	0.0	0.0	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
237	22	1.3	25.1	11.4	0.0	0.0	0.0	3.8	45.5	1.8	36.8	4.3	0.0	0.0	1.8	0.0	0.0	0.0	24.0	68.2	18.2	0.0	21.0	0.0	0.0	0.0	0.0	0.0	28.0
238	23	0.0	16.5	0.3	0.0	0.0	0.0	8.6	59.7	0.3	0.0	0.0	7.1	5.3	0.0	0.0	65.4	5.2	62.4	0.0	0.0	12.5	0.0	4.1	0.0	0.0	0.0	41.0	0.2
239	24	10.9	0.0	28.4	25.9	8.1	0.0	3.6	0.0	1.0	0.0	33.0	6.6	0.0	0.0	31.2	2.2	3.0	11.0	0.0	0.0	16.0	28.4	21.3	50.0	0.0	18.0	8.6	0.0
240	25	23.9	0.0	9.9	0.0	0.0	3.6	12.7	0.0	0.8	0.0	0.0	5.6	0.0	32.8	0.0	1.0	0.0	24.0	0.0	56.1	9.0	1.8	0.0	42.0	1.5	12.5	36.0	0.0
241	26	2.0	0.0	9.7	0.0	2.0	3.3	8.1	42.2	17.3	22.1	1.3	26.2	22.1	34.8	5.3	45.8	50.6	4.0	9.0	22.1	0.0	0.0	10.0	68.0	58.0	6.5	0.0	0.0
242	27	33.5	5.1	2.8	0.0	10.2	1.3	6.1	8.1	4.1	0.0	1.0	1.3	25.9	14.7	0.0	1.8	0.0	14.2	3.2	10.0	0.0	20.0	0.8	0.0	0.0	0.0	3.0	0.0
243	28	11.2	0.0	5.3	0.0	0.0	0.0	20.1	6.9	21.6	23.6	0.0	18.5	2.8	0.0	19.3	0.0	18.6	42.2	61.2	8.3	0.0	40.6	0.0	0.0	15.0	42.0	2.0	0.0
244	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.9	0.0	0.0	0.0	25.9	0.0	0.0	0.0	10.4	0.8	0.0	0.0	18.3	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0
245 MAR	1	2.0	3.6	20.1	0.0	22.6	0.3	4.6	0.5	0.0	4.8	20.1	1.3	16.0	5.8	0.0	6.2	6.4	28.6	1.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
246	2	8.4	2.5	0.0	1.3	4.6	0.0	3.3	7.9	0.0	0.0	42.2	34.0	0.0	0.0	10.2	10.0	3.2	0.0	60.0	0.0	0.2	9.6	0.0	13.0	0.0	23.0	6.0	0.0
247	3	0.0	1.0	34.3	0.8	23.4	15.0	12.2	0.0	16.3	2.0	0.0	12.7	0.0	0.0	1.3	6.6	16.2	0.0	0.0	0.0	39.0	1.4	7.0	0.0	0.0	0.0	0.0	5.0
248	4	27.2	0.0	5.6	14.2	44.7	0.0	12.2	5.8	165.4	0.0	5.3	17.5	0.0	44.2	0.0	1.6	7.0	10.2	0.0	0.0	52.0	0.0	0.0	23.0	12.0	15.0	0.0	0.0
249	5	0.0	0.0	0.0	36.1	13.2	11.7	11.9	10.9	63.0	7.1	56.6	6.6	67.3	0.0	0.0	8.0	22.8	0.0	56.4	0.0	12.0	24.0	0.0	2.2	0.0	0.0	0.0	2.2
250	6	0.0	0.0	1.3	0.0	17.5	10.9	0.5	0.0	3.0	0.0	0.0	4.3	0.0	3.8	2.5	11.8	14.2	20.0	1.4	0.0	0.0	0.0	21.3	4.4	8.0	0.0	0.0	1.0
251	7	0.0	0.0	5.3	10.7	6.9	2.3	0.8	0.5	0.0	29.0	43.7	10.7	2.0	18.8	8.6	27.6	5.8	4.2	26.1	1.0	0.0	0.0	6.0	0.3	0.0	0.0	0.0	0.0
252	8	0.0	0.0	21.6	37.8	6.4	14.7	0.0	15.2	0.0	0.0	0.0	1.3	43.2	35.6	6.9	28.4	10.4	15.4	9.2	0.0	0.0	4.2	59.0	0.0	0.0	16.0	0.0	0.0
253	9	15.2	0.0	0.0	23.9	0.3	24.1	99.1	0.0	0.0	10.9	0.0	26.7	0.0	0.0	10.3	26.2	5.2	15.0	1.1	0.0	0.8	0.0	0.0	18.0	0.0	0.0	0.0	5.0
254	10	1.3	0.0	0.0	49.0	9.4	0.0	2.3	0.0	6.1	0.0	0.0	27.4	0.0	0.0	8.1	2.2	0.0	1.2	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
255	11	0.0	44.7	2.8	18.8	3.0	0.0	0.0	25.9	0.0	0.0	10.4	0.0	0.0	61.2	0.8	37.2	0.0	0.0	0.0	37.1	17.0	0.0	12.8	0.0	2.5	0.0	0.0	0.0
256	12	0.0	6.4	1.3	28.4	17.5	8.9	0.0	13.0	24.9	13.5	4.3	0.0	44.7	32.8	27.4	26.2	4.2	0.0	44.4	4.1	76.6	10.4	0.0	0.7	2.0	0.0	12.4	0.0
257	13	0.0	0.0	0.5	3.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	60.7	8.4	22.9	24.6	0.0	13.2	3.0	0.0	86.0	0.0	0.0	15.4	0.0	0.0	0.0	0.6
258	14	7.9	0.0	4.8	14.7	1.0	0.0	0.0	1.0	0.0	3.8	0.0	0.0	1.3	24.1	20.8	4.8	50.0	0.0	0.0	0.0	0.0	0.0	50.5	23.0	0.0	0.0	0.0	0.0
259	15	17.8	0.0	0.0	3.0	16.5	0.0	2.8	0.0	1.8	0.0	46.7	27.2	0.5	6.4	0.0	38.0	0.0	3.2	5.2	0.0	0.0	0.0	29.0	16.8	22.0	0.0	0.0	11.0
260	16	0.5	0.5	0.0	0.0	3.8	0.0	18.5	0.0	0.0	0.0	3.0	52.3	0.0	4.1	0.0	22.6	19.8	0.0	11.2	0.0	0.0	0.0	21.3	0.2	0.0	5.0	0.0	0.0
261	17	0.0	5.8	0.0	0.0	1.0	0.5	0.5	0.0	55.1	0.0	0.0	105.4	0.0	12.4	67.3	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.4	0.0	0.0	0.0	0.0
262	18	2.5	1.5	2.3	15.5	0.0	12.4	0.5	0.0	67.6	0.5	0.0	11.2	0.0	0.5	25.9	18.4	0.8	0.0	0.0	3.0	0.0	0.0	0.0	20.0	28.0	0.0	2.0	0.0
263	19	0.0	0.0	0.0	6.6	8.1	1.3	0.0	0.0	1.5	13.7	2.3	1.3	0.0	49.5	0.0	10.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	13.6	2.0	0.0	0.0	3.0
264	20	0.0	0.0	0.0	5.8	57.4	1.8	0.0	0.0	0.5	0.0	17.5	2.8	9.9	25.4	7.1	0.0	7.0	-0.0	3.2	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
265	21	0.0	0.0	1.8	12.2	3.0	0.3	7.9	0.0	28.4	0.0	18.5	0.0	0.0	3.6	0.0	0.2	147.8	32.4	0.0	2.3	0.0	0.0	0.0	44.0	0.0	0.0	10.0	0.0
266	22	0.0	0.0	61.7	0.5	5.3	8.6	22.4	0.0	0.0	0.0	10.2	0.0	31.5	23.6	64.8	81.6	113.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	18.4	0.0
267	23	0.0	0.0	7.9	6.4	13.5	1.0	39.1	0.0	0.0	0.0	1.3	0.0	0.0	18.0	0.0	72.5	8.0	0.0	0.0	0.0	8.0	0.0	12.0	0.0	28.0	0.0	0.0	13.0
268	24	0.0	0.0	14.0	0.3	25.7	39.9	2.8	0.0	0.0	0.0	55.4	0.0	0.0	5.8	4.3	36.4	0.0	0.0	0.0	72.2	23.0	26.4	4.0	0.0	0.0	0.0	0.0	30.0
269	25	0.0	0.0	11.9	0.8	12.7	0.0	0.0	0.0	0.0	0.0	5.8	0.0	19.8	0.5	7.9	0.0	0.0	0.0	0.0	0.0	1.4	6.0	32.0	25.4	0.0	0.0	0.0	28.0
270	26	11.4	0.0	0.0	7.6	62.0	0.0	0.0	0.8	43.7	0.0	4.3	0.0	0.0	3.3	0.0	0.0	1.0	0.0	29.4	0.0	0.0	1.4	0.0	1.0	0.0	19.0	0.0	0.0
271	27	0.0	0.0	28.4	0.0	2.8	0.0	0.0	6.3	7.4	0.0	7.4	0.0	32.3	0.0	0.0	0.0	22.4	0.0	0.0	0.0	9.3	12.6	26.0	0.0	0.0	0.0	0.0	7.8
272	28	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	40.0	0.0	0.0	0.0	11.0
273	29	0.0	20.8	73.7	0.0	1.8	0.0	0.0	0.0	0.0	12.4	0.0	0.0	1.8	2.5	0.0	0.0	0.4	0.0	0.0	0.0	0.0	1.2	21.0	6.0	0.0	0.0	0.0	50.0
274	30	0.0	0.0	1.0	0.0	4.8	0.0	0.5	2.0	0.0	16.6	3.0	0.0	0.0	0.0	0.0	0.0	34.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
275	31	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	4.0	22.0	0.0	39.0	0.0	5.1

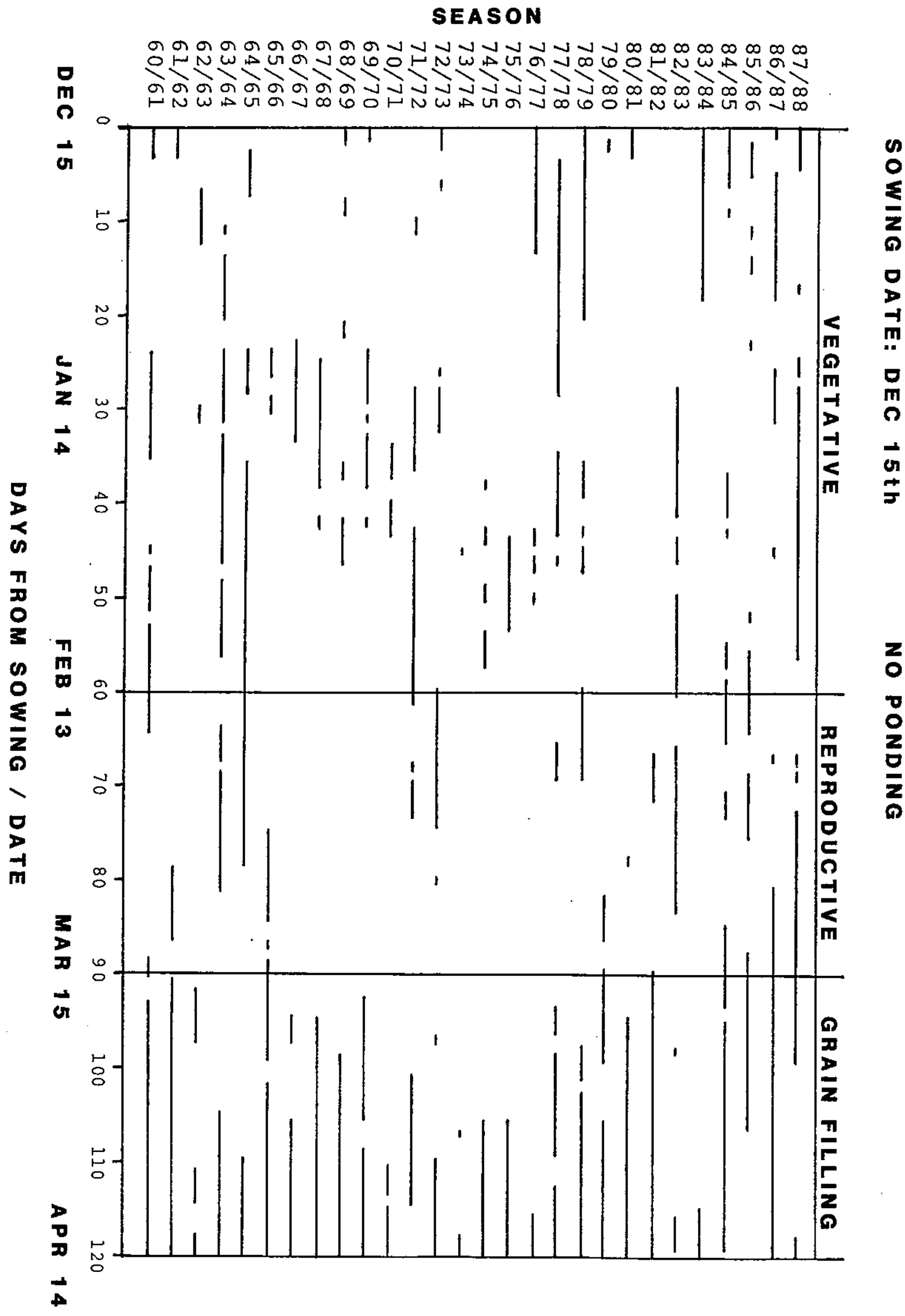
STATION: TORTILLA FLATS RESEARCH PARK

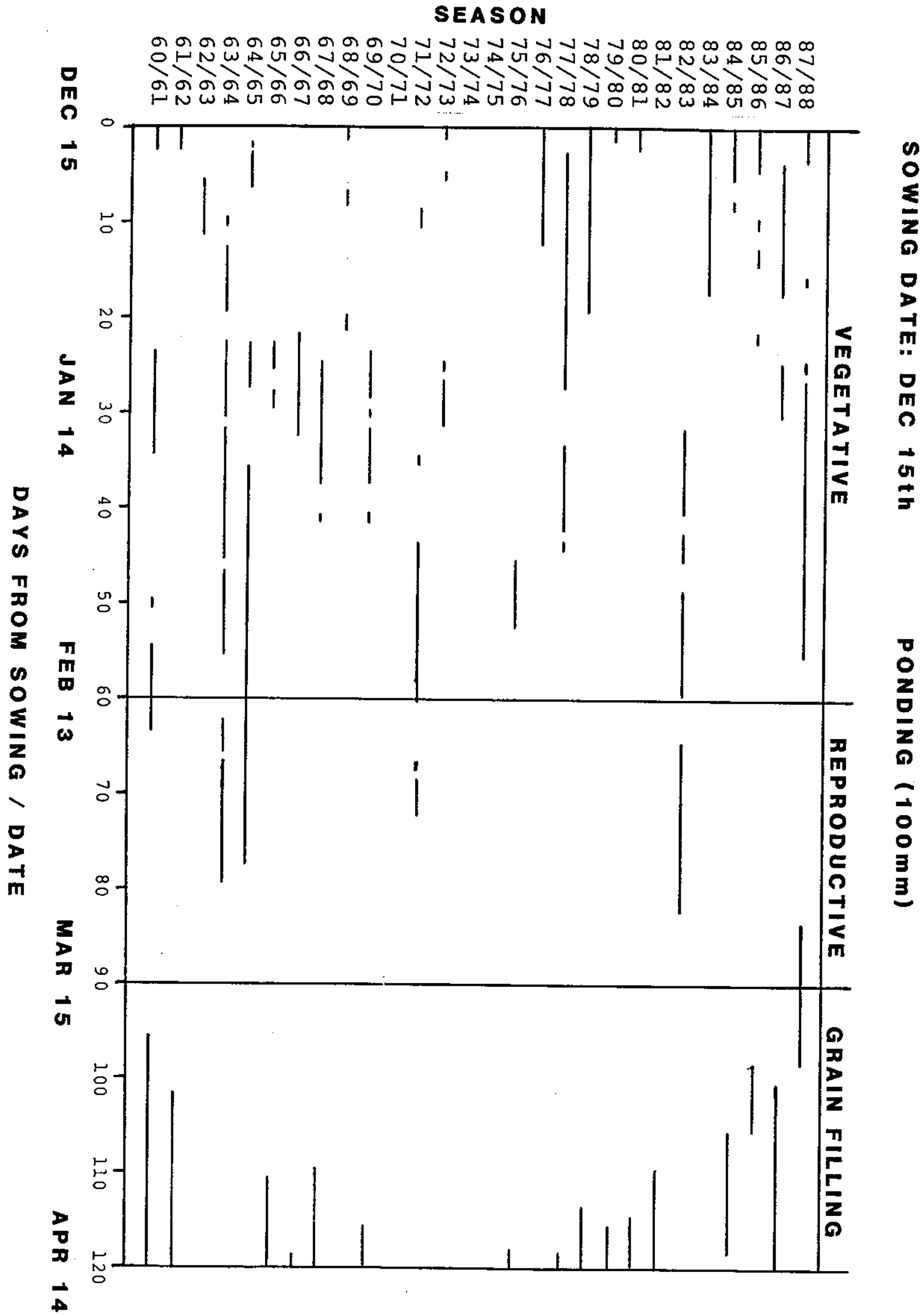
DAY NO.	MONTHDAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
276	APR 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	1.0	0.0	0.0	0.0
277	2	3.0	0.0	0.0	1.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	20.8	0.4	5.4	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	23.0	0.0	0.0
278	3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	2.0	0.0	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
279	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.2	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
280	5	0.0	0.0	0.0	2.8	0.0	0.0	0.0	4.4	0.0	0.0	7.4	0.0	9.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	0.0	0.0	19.0	0.0	0.0
281	6	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4
282	7	0.0	0.0	24.6	1.5	0.0	0.0	0.0	16.5	0.0	0.0	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
283	8	0.0	0.0	3.3	15.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.3	0.8	17.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0
284	9	0.0	0.0	14.7	12.4	0.0	0.0	0.0	0.3	0.0	0.0	1.8	97.8	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0
285	10	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	3.0
286	11	12.2	0.0	7.9	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
287	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.0	0.0	0.0
288	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	0.0
289	14	28.7	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	165.0	0.0	13.0	0.0
290	15	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	25.0	0.0	0.0
291	16	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	21.1	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0
292	17	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.5	1.8	0.0	0.0	21.8	2.2	0.0	0.0	46.2	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
293	18	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	1.8	3.0	0.0	0.0	1.4	0.0	0.0	0.0	1.1	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
294	19	7.6	0.0	0.5	0.0	0.0	0.0	1.5	0.8	0.0	0.0	0.0	27.4	23.6	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0
295	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
296	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
297	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.5	0.0	0.0	14.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
298	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
299	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
300	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
301	26	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
302	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
303	28	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
304	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
305	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
306	MAY 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
307	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
308	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
309	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
310	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
311	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
312	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
313	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
314	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
315	10	0.0	0.0	0.0	1.8	0.0	0.0	0.0	27.4	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
316	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
317	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
318	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
319	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
320	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
321	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
322	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
323	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0
324	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	0.0
325	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
326	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
327	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
328	23	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
329	24	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
330	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

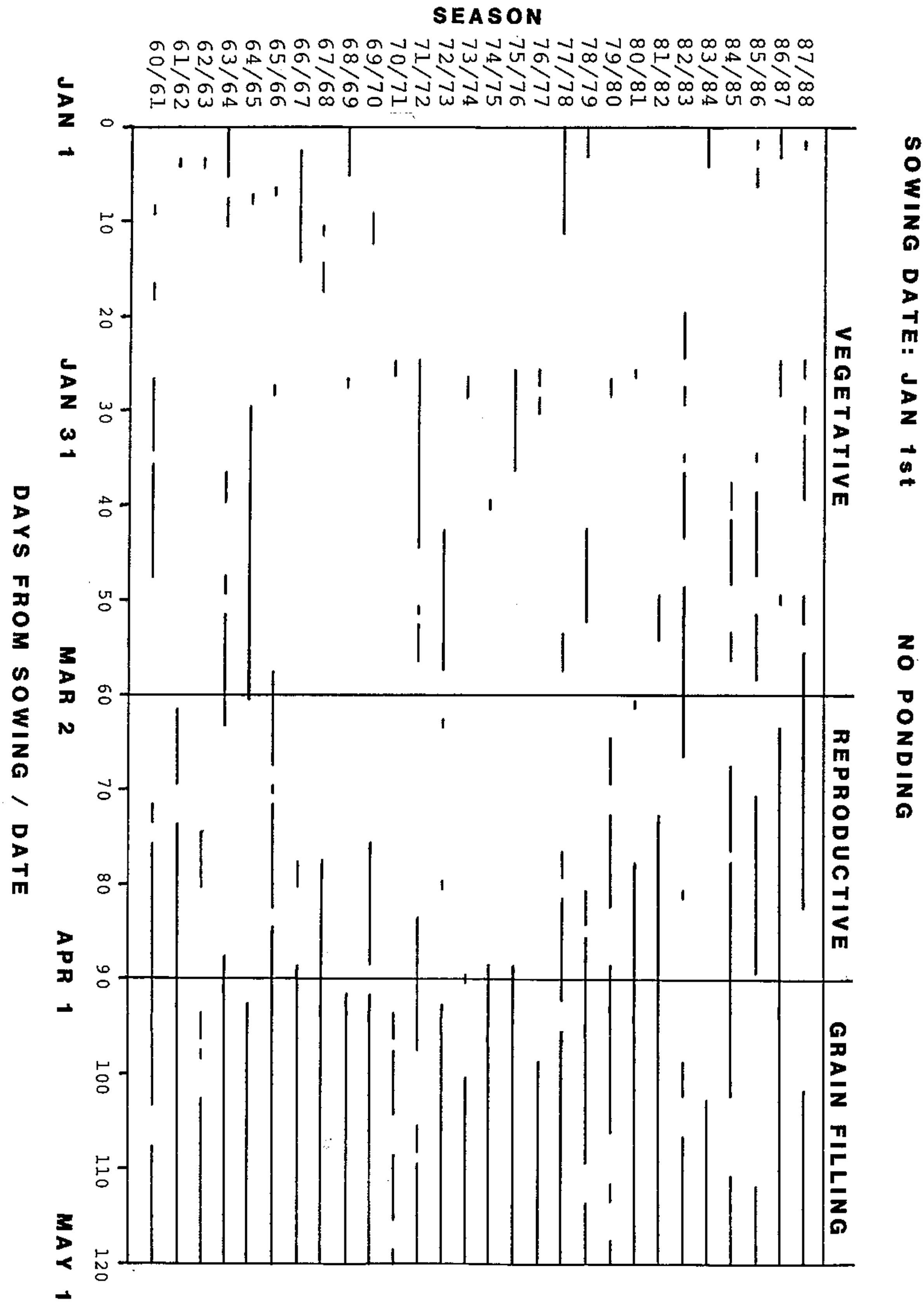
STATION: TORTILLA FLATS RESEARCH FARM

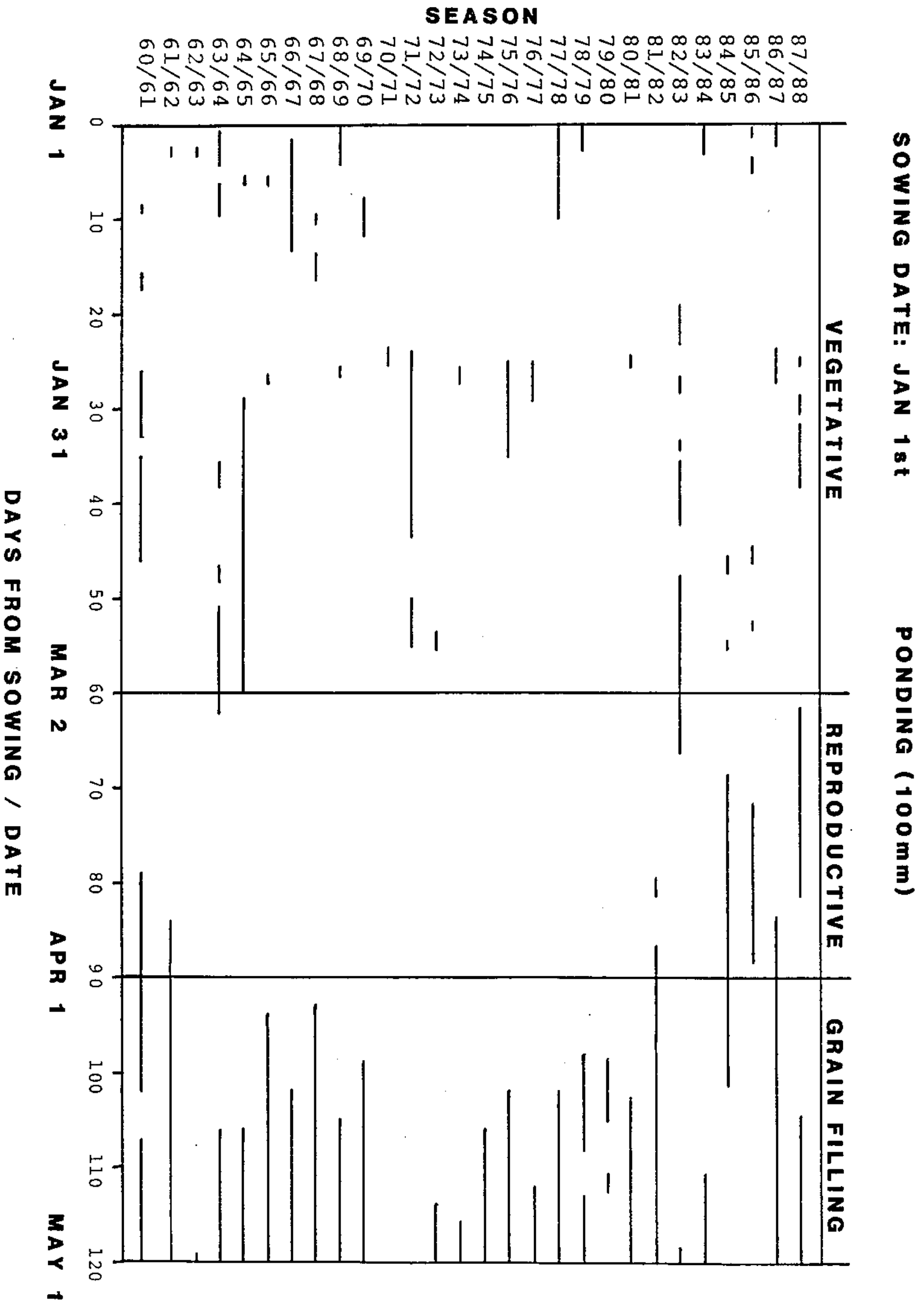
DAY NO.	MONTHDAY	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77	77 78	78 79	79 80	80 81	81 82	82 83	83 84	84 85	85 86	86 87	87 88
331	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
332	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
333	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
334	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
335	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
336	31	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
337 JUN	1	0.0	0.0	0.0	1.8	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
338	2	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
339	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
340	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
341	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
342	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
343	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
344	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
345	9	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
346	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
347	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
348	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
349	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
350	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
351	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	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
352	16	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
353	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
354	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
355	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
356	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
357	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
358	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
359	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
360	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
361	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
362	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
363	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
364	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
365	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
366	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

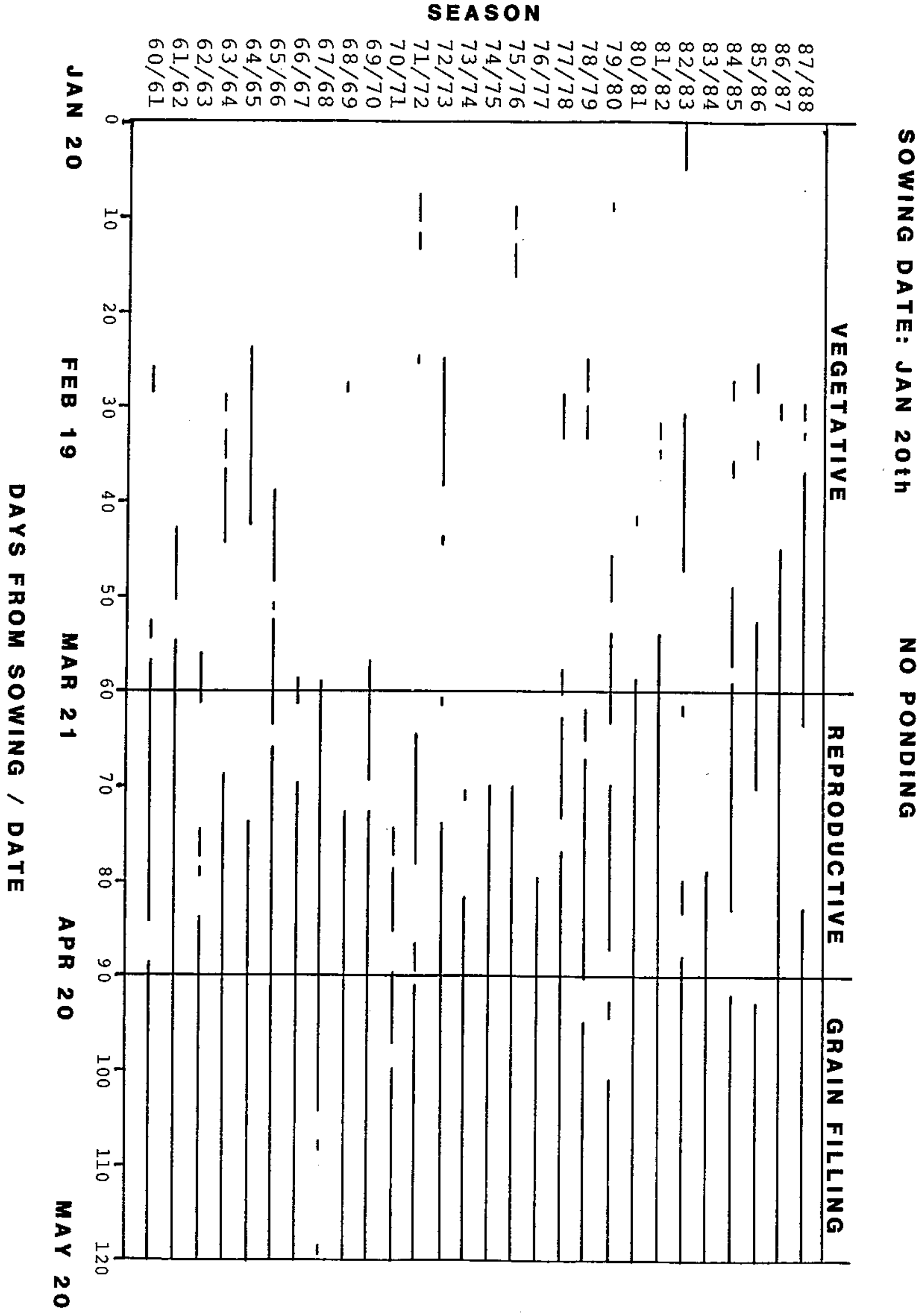
Appendix 2: Stress periods (———) during the rice growing season for rice sown on three dates with and without ponding

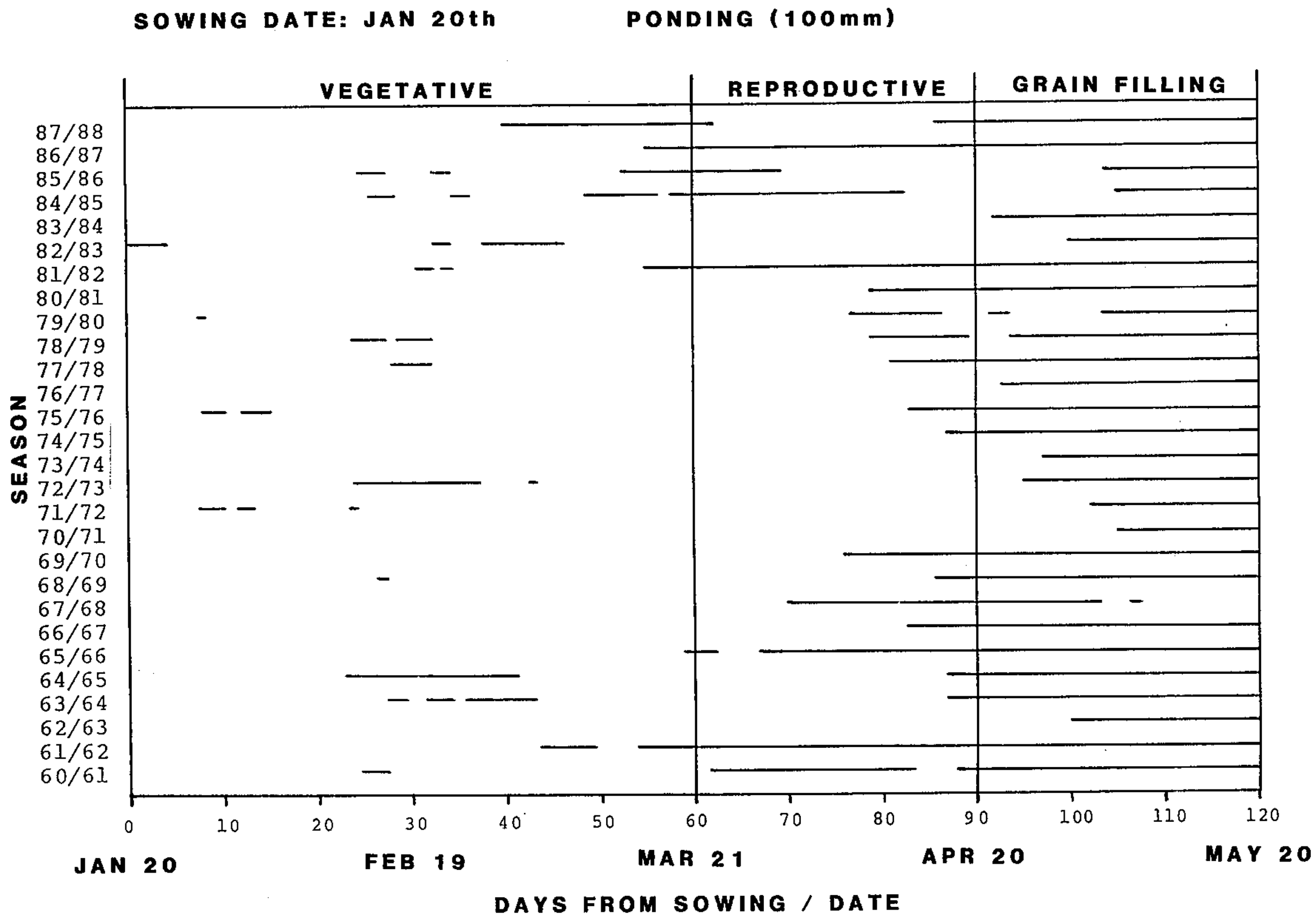



SOWING DATE: DEC 15th
PONDING (100mm)
VEGETATIVE
REPRODUCTIVE
GRAIN FILLING
SEASON
87/88
86/87
85/86
84/85
83/84
82/83
81/82
80/81
79/80
78/79
77/78
76/77
75/76
74/75
73/74
72/73
71/72
70/71
69/70
68/69
67/68
66/67
65/66
64/65
63/64
62/63
61/62
60/61
0
10
20
30
40
50
60
70
80
90
100
110
120
DEC 15
JAN 14
FEB 13
MAR 15
APR 14
DAYS FROM SOWING / DATE


SOWING DATE: JAN 1st
NO PONDING
VEGETATIVE
REPRODUCTIVE
GRAIN FILLING
SEASON
87/88
86/87
85/86
84/85
83/84
82/83
81/82
80/81
79/80
78/79
77/78
76/77
75/76
74/75
73/74
72/73
71/72
70/71
69/70
68/69
67/68
66/67
65/66
64/65
63/64
62/63
61/62
60/61
0
10
20
30
40
50
60
70
80
90
100
110
120
JAN 1
JAN 31
MAR 2
APR 1
MAY 1
DAYS FROM SOWING / DATE


SOWING DATE: JAN 1st
PONDING (100mm)
SEASON
VEGETATIVE
REPRODUCTIVE
GRAIN FILLING
60/61
61/62
62/63
63/64
64/65
65/66
66/67
67/68
68/69
69/70
70/71
71/72
72/73
73/74
74/75
75/76
76/77
77/78
78/79
79/80
80/81
81/82
82/83
83/84
84/85
85/86
86/87
87/88
0
10
20
30
40
50
60
70
80
90
100
110
120
JAN 1
JAN 31
MAR 2
APR 1
MAY 1
DAYS FROM SOWING / DATE


SOWING DATE: JAN 20th
NO PONDING
VEGETATIVE
REPRODUCTIVE
GRAIN FILLING
SEASON
87/88
86/87
85/86
84/85
83/84
82/83
81/82
80/81
79/80
78/79
77/78
76/77
75/76
74/75
73/74
72/73
71/72
70/71
69/70
68/69
67/68
66/67
65/66
64/65
63/64
62/63
61/62
60/61
0
10
20
30
40
50
60
70
80
90
100
110
120
JAN 20
FEB 19
MAR 21
APR 20
MAY 20
DAYS FROM SOWING / DATE


SOWING DATE: JAN 20th
PONDING (100mm)
VEGETATIVE
REPRODUCTIVE
GRAIN FILLING
SEASON
87/88
86/87
85/86
84/85
83/84
82/83
81/82
80/81
79/80
78/79
77/78
76/77
75/76
74/75
73/74
72/73
71/72
70/71
69/70
68/69
67/68
66/67
65/66
64/65
63/64
62/63
61/62
60/61
0
10
20
30
40
50
60
70
80
90
100
110
120
JAN 20
FEB 19
MAR 21
APR 20
MAY 20
DAYS FROM SOWING / DATE