

HDC PROJECT FV/76

Control of Volunteer Oilseed Rape  
In Vegetable Crops

W. Bond

Horticulture Research International  
Wellesbourne  
1991

## **HDC PROJECT FV/76**

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Location: HRI-Wellesbourne  
Start date: 1.5.91

### **CONTROL OF VOLUNTEER OILSEED RAPE IN VEGETABLE CROPS**

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#### **INTRODUCTION**

Volunteer oilseed rape (OSR) can be a problem in vegetable crops when they form part of an arable rotation. Seed shed during the harvesting of oilseed rape may give rise to around 500 volunteer seedlings/m<sup>2</sup> in following crops. Previous trials at HRI - Wellesbourne have demonstrated that several established pre- and post-emergence herbicides will control OSR (Bond & Burch, 1988). When it is known that volunteer OSR is likely to occur, suitable residual treatments may be applied. However, the problem is often not appreciated until the first rape seedlings appear. Emergence may be spread over a period of weeks and, even if a post-emergence herbicide is available, it can be difficult to determine the optimum dose and timing of application.

The main objective of project FV/76 was to define the optimum rate and time of application of some established post-emergence herbicides to control seedling OSR at different growth stages. Drilled lettuce, transplanted calabrese, sprouting broccoli and Chinese cabbage were included as indicators of crop selectivity.

#### **METHODS**

The herbicides used were commercial formulations of linuron (Linuron 50 WP; 50% wp), bentazon (Basagran; 480 g/l ec), prometryne (Gesagard; 50% wp), ioxynil (Totril; 225 g/l ec), pendimethalin (Stomp 330; 330 g/l ec), metoxuron (Dosaflo; 50% sc) and sodium monochloracetate (SMA) (Cromptex Steel; 95% wp).

The trial site was Pump Ground Field at Horticulture Research International, Wellesbourne. The soil was a sandy loam with around 2% organic matter and pH 6.8. The land was prepared in early spring, following a previous cereal crop, and allowed to weather before being marked into 1.52 m wide beds and the base fertiliser applied. Shortly before drilling, Nitram (100 kg N/ha) was applied and a seedbed prepared. Plots were marked out in a randomised block design with four replicates of each spray treatment, and there were 3 untreated control plots per block.

Single rows of oilseed rape cv. Global were drilled on 13, 21 and 29 May 1991 (S1, S2 & S3 respectively). A row of lettuce cv. Saladin was drilled on 13 May, and module

grown (308s) plants of calabrese cv. Green Comet, sprouting broccoli cv. Early Purple and Chinese cabbage cv. Fullmark were planted out on 18 May. Three replicates were planted with broccoli and calabrese and one replicate with Chinese cabbage. Yaltox granules (0.4 g/plant) were applied around the transplanted brassicas to guard against cabbage root fly attack. The herbicides were applied in 256 l/ha water (except SMA, applied in 300 l/ha water) at full, half, and the first of the split half + half doses of the standard rate on 14 June. Weather conditions were dry but breezy and screens were used to prevent spray drifting onto other plots. Maximum and minimum temperatures were 18.2 and 8.5 °C respectively. Light rain fell about 8 hours after the sprays were applied. At the time of spraying the last drilled row of OSR had just emerged and plants in the two earlier sowings were at the 2- and 3-4 leaf stages respectively. The drilled lettuce seedlings had four leaves and the transplanted crops were well established. Weeds were at the seedling stage except for an occasional larger plant. Application of the second part of the split dose treatment was delayed by wet weather until 28 June. Plants were still exhibiting symptoms of injury from the earlier sprays making growth stages difficult to determine. Conditions were again breezy and plots were screened during spraying. Maximum and minimum temperatures were 20.6 and 8.4 °C respectively and there was no rainfall for several days after treatment. Full weather data for the period of the trial, as recorded at the weather station at HRI-Welliesbourne, is attached. Phytotoxic effects on OSR and the crops were assessed visually as percent injury on 21 June, 3 July and 7 July. The level of overall weed control was also assessed and the effect on individual weed species noted. Plant stand and fresh weight of OSR from one metre of row per plot on each of the three sowings was recorded on 24 July when the earliest sown plants were in flower.

## RESULTS

The effects of the different herbicide treatments on plant number and fresh weight of OSR are given in Table 1. The results are also given in Figure 1 as histograms of the percent remaining compared with the untreated controls. Percent injury to OSR, assessed on 24 June 1991 after the first sprays had been applied and on 3 and 11 July 1991 after the second sprays had been applied, is given in Table 2. The percent injury to the crops, assessed on the same dates, is shown in Table 3. The level of overall weed control recorded on the three dates is given in Table 4. The main species were *Chenopodium album* (fat hen), *Matricaria* spp. (mayweeds), *Solanum nigrum* (black nightshade), *Stellaria media* (chickweed), *Fumaria officinalis* (fumitory), *Capsella bursa-pastoris* (shepherd's purse), *Urtica urens* (annual nettle), *Lamium amplexicaule* (henbit deadnettle), *L. purpureum* (red deadnettle), *Polygonum aviculare* (knotweed), *Veronica persica* (field speedwell), *Poa annua* (annual meadowgrass) and *Senecio vulgaris* (groundsel).

The effects of the different herbicides on OSR, vegetable crops and weeds are summarised individually:

Linuron (1.7, 0.85 & 0.85+0.85 kg product/ha)

Linuron caused progressive leaf yellowing and scorch of OSR at all growth stages; necrotic patches developed on the worst affected leaves. In the first sowing of OSR the linuron treatments gave a consistent reduction in plant number to below 80% of the

untreated, while plant fresh weight was reduced by up to 50%. Later in the trial the appearance of treated plants gradually improved but growth remained checked. Plant stand in the second sowing of OSR was reduced and plant fresh weight remained low until harvest. Most seedlings in the third sowing were killed; a few survived but growth was noticeably checked.

The leaves of broccoli and calabrese developed yellow patches soon after treatment. The effect of a single spray was not severe but the second spray of the split dose treatment caused more injury. Plants soon overcame the damage from a single dose of linuron but plants treated twice took much longer to recover.

Lettuce suffered severe scorch and yellowing of the leaves. Growth was checked and most plants eventually died. Death was hastened where a second dose of herbicide was applied.

Chinese cabbage was severely scorched and leaves developed necrotic patches. Damage was very severe where the split dose of herbicide had been applied and many plants were killed. Most of the linuron treated plants bolted prematurely without hearting.

Weed control was good with *S. nigrum*, *Thlaspi arvense* (pennycress), *S. vulgaris*, *C. bursa-pastoris*, *U. urens* and *L. amplexicaule* all killed. The main survivors were *P. aviculare*, *F. officinalis* and *Matricaria* spp..

#### Bentazon (3, 1.5 & 1.5+1.5 l product/ha)

Bentazon caused severe scorch and yellowing of OSR in the first and second sowings. In the first sowing, the full dose reduced plant numbers by 50% but the other treatments appeared less effective. Plant weight was affected more than plant number and recovery was slow. In the second sowing plant stand was reduced by around 50% and plant weight by about 60%. Most seedlings in the third sowing were killed.

Broccoli and calabrese developed large pale green or yellow patches on the leaves. Plants treated only once, recovered and grew away, but those that received a second dose remained affected for much longer and some never recovered completely.

There was moderate scorching on lettuce plants initially but when only a single dose of bentazon was applied most plants recovered. Where a second spray was applied, crop injury was much more severe.

Leaf scorch on Chinese cabbage was very severe even with a single application of chemical. Where two sprays were applied some plants were killed.

Bentazon treatments gave moderately good weed control and most plants of *C. album*, *S. media*, *Matricaria* spp., *U. urens*, *L. purpureum* and *S. nigrum* were killed. Some larger plants of *C. album* were only scorched and did not die. The main survivors were *F. officinalis*, *P. aviculare*, *P. annua* and *Viola arvensis* (field pansy).

#### Prometryne (2.3, 1.15 & 1.15+1.15 kg product/ha)

Very few plants were killed in the earliest sowing of OSR. There was some initial scorch but most plants recovered and grew away from the early check to growth. Recovery was somewhat slower where a second dose of herbicide was applied. In the second sowing, about 60% of the seedlings survived after treatment, although the leaves were yellow and scorched. Prometryne killed most of the OSR seedlings in the third sowing, around 20% remained but the growth was severely checked.

The sprays caused a very slight yellowing of the foliage on broccoli and calabrese, but plants treated with a single spray recovered quickly. Injury was greater and recovery slower where a second spray was applied but even then the effects were not severe.

Lettuce suffered moderate scorch initially and this progressively increased especially where a second application was made.

Chinese cabbage was also scorched, with more extensive injury where the split dose was applied.

Weed control was moderately good. All treatments killed *U. urens*, *C. bursa-pastoris*, *S. media*, *T. arvense* and *S. nigrum*. The main survivors were *Matricaria spp.*, *S. vulgaris* and occasional large plants of *C. album* and *P. aviculare*.

#### Ioxynil (2.8, 1.4 & 1.4+1.4 l product/ha)

Treated plants showed damage symptoms within a few days of spraying. There was some scorching of the earliest sown OSR and both plant number and weight were reduced, but not greatly. OSR plants in the second sowing were well controlled by ioxynil and plant weight and number were reduced by around 70%. The herbicide was also very effective in killing the small OSR seedlings in the third sowing. However, possibly because ioxynil has no residual activity, some late emerging seedlings escaped.

Ioxynil caused severe scorch of both calabrese and broccoli. There was some recovery as the trial progressed but not where a further dose of chemical was applied.

Lettuce was severely scorched by all the ioxynil treatments and many plants died.

Chinese cabbage was also severely scorched and surviving plants bolted without hearting.

Weed control was very good and despite a lack of residual activity the level of weed control remained high throughout the trial. Ioxynil killed *U. urens*, *L. amplexicaule*, *Matricaria spp.*, *C. bursa-pastoris*, *T. arvense*, *S. nigrum*, *C. album* and *Veronica persica*. The main survivors were *P. aviculare*, *Poa annua* and *F. officinalis*.

#### Pendimethalin (4, 2 & 2+2 l product/ha)

Unlike the other herbicides pendimethalin tended to stunt and distort the growth of OSR. The larger plants in the first and second sowings of OSR suffered a check to growth and leaves became darker green. There was slight distortion of the later developing leaves but any growth effects were only temporary. At harvest there was little reduction in plant weight compared with the untreated. Stunting was much more severe

in the small OSR seedlings of the third sowing. Growth ceased at the 1-2-leaf stage and leaves became thickened, dark green and brittle. Seedlings gradually developed necrotic patches and most eventually died.

Calabrese and broccoli were not severely affected by the sprays but newly produced leaves had a wrinkled appearance. Later developing leaves expanded normally where a single spray had been applied but where a second dose was sprayed, leaf distortion continued. Plant growth suffered a slight check and treated plants were darker green than the controls.

Lettuce seedlings became stunted, and leaves were dark green and leathery in appearance. There was some recovery as the trial progressed but plants remained checked and somewhat distorted.

The leaves of Chinese cabbage were also darker in colour and distorted. Plant growth became progressively more stunted as the trial continued.

Weed control appeared poor initially but as stunting and distortion of the susceptible weeds increased, the level of weed control improved. Species that were killed or severely stunted included *C. album*, *S. nigrum*, *U. urens*, *L. amplexicaule*, *L. purpureum*, *F. officinalis*, *T. arvense* and *Fallopia convolvulus*. *P. annua* was only slightly stunted but root development was inhibited and plants were easily pulled out. The main survivors were *Matricaria spp.* and *S. vulgaris*.

#### Metoxuron (7, 3.5 & 3.5+3.5 l prod/ha)

Metoxuron caused severe scorch and yellowing of OSR in the first and second sowings. In the first, there was some stand reduction and plant weight was reduced to 40% of the untreated. Plant number was also reduced in the second sowing but the half rate of herbicide was less effective than the full dose. All the treatments in the second sowing reduced plant weight to around 20% of the controls. Most seedlings in the third sowing were killed and the few survivors showed little sign of recovery.

Broccoli and calabrese exhibited slight scorch but plants recovered except where a second application of herbicide was made.

Lettuce was slightly scorched initially but injury later became progressively worse, even where a single half dose of metoxuron was applied.

Chinese cabbage suffered severe scorch and many plants bolted without hearting.

Metoxuron killed seedlings of *C. album*, *T. arvense*, *S. nigrum*, *V. persica*, *P. annua*, *U. urens*, *C. bursa-pastoris* and *Matricaria spp.* Larger plants of *C. album* and some other weeds were only scorched and later recovered. *Polygonum aviculare* and *F. officinalis* were not controlled.

#### Sodium monochloracetate (SMA) (33.5, 16.8 & 16.8+16.8 kg product/ha)

The leaves of OSR plants treated with SMA soon developed scorched and necrotic

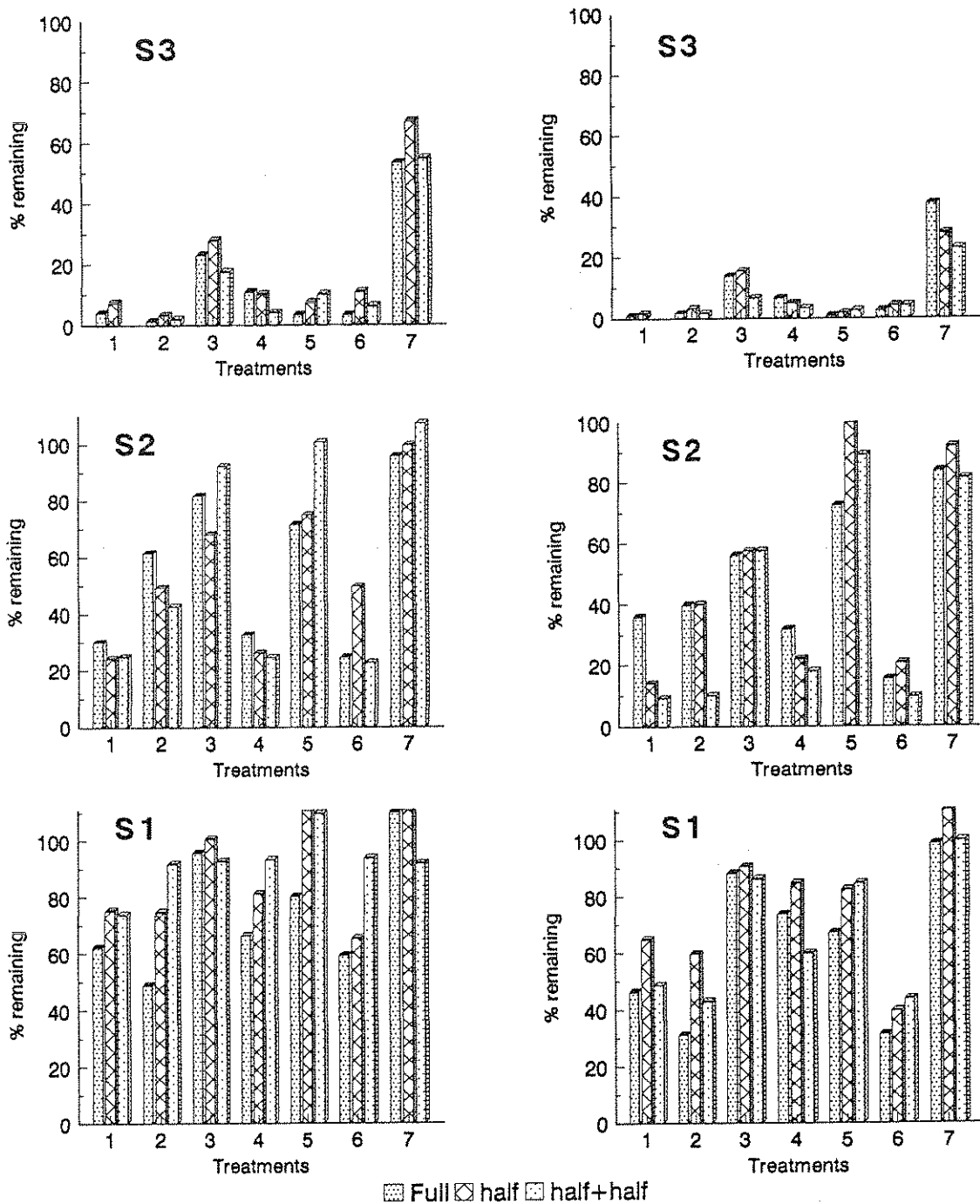
The level of weed control was moderate to good with most treatments. SMA was the least effective herbicide. Some weeds recovered from the local scorching of the SMA spray and others may have been protected by crop leaves during application.

Timing was very important in determining the effectiveness of the herbicides. Obviously the earlier the growth stage of the OSR at the time of treatment the more effective the herbicides. The dose of herbicide had no consistent effect on the final level of OSR control and a half-rate application was often as effective as the full dose. The split dose treatments caused the most damage to the crops and, at least initially, to the OSR.

## REFERENCES

- Bond, W. & Burch, P.J. (1988) Evaluation of herbicides for control of volunteer oilseed rape in vegetable crops. *Tests of Agrochemicals and Cultivars 9. Annals of Applied Biology*, 112 (Supplement).

**Figure 1 Control of Volunteer Oilseed Rape**  
 plant number                      plant weight



Full    half    half+half

- |              |                 |
|--------------|-----------------|
| 1 Linuron    | 5 Pendimethalin |
| 2 Bentazon   | 6 Metoxuron     |
| 3 Prometryne | 7 SMA           |
| 4 Ioxynil    |                 |



TABLE 1. Effect of herbicides on number (plants/m) and weight (g) of OSR at harvest on 24.7.91 following sowing at different times.

Herbicide	Rate*	<u>S1 (13 May)</u>		<u>S2 (21 May)</u>		<u>S3 (29 May)</u>	
		Number	Weight	Number	Weight	Number	Weight
Linuron	1.7	31	1013	24	356	2	1
	0.85	38	1418	19	140	3	3
	0.85+0.85	37	1063	20	91	0	0
Bentazon	3	25	683	48	394	1	3
	1.5	38	1305	39	396	1	5
	1.5+1.5	46	940	33	100	1	3
Prometryn	2.3	48	1925	64	555	9	21
	1.15	51	1980	53	569	10	24
	1.15+1.15	47	1883	72	570	7	10
Ioxynil	2.8	33	1613	26	316	4	10
	1.4	41	1853	21	219	4	8
	1.4+1.4	47	1310	19	179	2	5
Pendi-methalin	4	40	1470	56	718	1	1
	2	62	1805	59	1090	3	3
	2+2	55	1850	79	883	4	4
Metoxuron	7	30	688	19	155	1	4
	3.5	33	868	39	206	4	6
	3.5+3.5	47	960	18	95	2	6
SMA	33.5	55	2158	75	830	20	58
	16.8	65	2420	78	910	25	42
	16.8+16.8	46	2008	84	805	20	35
Untreated	-	50	2182	78	989	37	153
LSD 5% for comparison with untreated		11	452	19	241	7	37
LSD 5% for comparison between treatments		13	554	23	295	9	47

\*Rates are given as kg or l product/ha

TABLE 3. Herbicide injury scores (%) in the different crops  
(assessed 24.6.91 / 3.7.91 / 11.7.91)

Herbicide	Rate*	Broccoli	Calabrese	Lettuce	Chinese cabbage
Linuron	1.7	23/13/2	23/15/2	68/92/95	75/75/60
	0.85	20/17/2	20/17/2	55/90/96	70/60/55
	0.85 + 0.85	18/40/40	20/40/43	59/90/98	70/85/90
Bentazon	3	23/13/0	33/15/0	44/30/18	70/60/35
	1.5	15/10/0	25/13/0	35/29/19	60/60/50
	1.5 + 1.5	15/43/23	28/40/35	33/65/53	70/85/80
Prometryne	2.3	7/8/0	8/8/0	60/85/81	60/50/65
	1.15	7/12/0	7/8/0	55/70/76	60/60/20
	1.15 + 1.15	7/32/15	7/32/22	55/85/95	50/70/80
Ioxynil	2.8	60/65/25	60/65/22	84/91/83	75/70/50
	1.4	57/62/23	57/60/20	83/86/86	75/70/60
	1.4 + 1.4	57/65/45	57/65/48	84/90/89	70/80/75
Pendi- methalin	4	27/40/17	18/40/23	44/69/56	20/50/70
	2	23/43/22	17/40/22	35/71/48	20/50/65
	2 + 2	23/43/43	18/43/43	38/70/46	15/60/65
Metoxuron	7	22/22/0	25/25/0	58/85/89	70/80/70
	3.5	12/25/3	17/25/3	45/83/79	75/60/65
	3.5 + 3.5	12/53/35	15/57/45	46/85/96	60/75/85
SMA	33.5	12/5/0	12/5/0	60/60/56	30/10/10
	16.8	8/5/3	8/5/3	68/61/69	30/10/10
	16.8 + 16.8	7/37/18	7/40/18	61/75/83	30/60/30
Number of replicates		3	3	4	1

\*Rate given as kg or l product/ha

TABLE 4. Percent weed control with the different herbicide treatments

Herbicide	Rate*	<u>% weed control assessed</u>		
		24.6.91	3.7.91	11.7.91
Linuron	1.7	75	82	74
	0.85	68	69	69
	0.85+0.85	64	74	71
Bentazon	3	73	68	66
	1.5	63	73	67
	1.5+1.5	65	74	73
Prometryne	2.3	60	69	66
	1.15	55	64	64
	1.15+1.15	53	70	75
Ioxynil	2.8	89	83	78
	1.4	86	81	78
	1.4+1.4	86	85	88
Pendimethalin	4	40	71	69
	2	33	73	71
	2+2	38	67	70
Metoxuron	7	75	73	68
	3.5	65	76	70
	3.5+3.5	68	81	76
SMA	33.5	60	56	51
	16.8	57	55	55
	16.8+16.8	40	64	56

(mean of 4 replicates)

\*Rate given as kg or l product/ha

HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

MAY 1991 (PART 2)

Date	Dry Bulb	Wet Bulb	Maximum	Minimum	Grass	Concrete	----- Soil Temp -----					Evaporation (mm)	R.H.	
	Temp	Temp	Temp	Temp	Minimum Temp	Minimum Temp	10cm	20cm	30cm	50cm	100cm			
			**TD**										**TD**	
1	6.9	6.2	10.1	4.6	3.0	3.8	6.7	7.1	8.4	8.4	8.7	0.0	90	
2	7.5	5.9	12.9	0.1	-6.9	-1.4	5.9	5.7	7.8	8.1	8.6	1.8	77	
3	7.6	4.8	12.7	1.9	-3.6	0.3	6.9	6.4	7.9	8.1	8.5	3.3	61	
4	7.2	5.4	10.6	5.2	4.8	5.6	8.6	8.7	9.0	8.6	8.5	2.3	74	
5	8.7	6.1	10.1	4.6	2.2	4.2	8.3	7.8	8.8	8.7	8.6	1.8	65	
6	7.3	4.8	12.2	2.7	-3.7	1.1	8.3	7.7	8.5	8.5	8.6	1.3	64	
7	8.7	7.3	10.7	5.5	1.0	4.9	10.1	9.4	9.2	8.8	8.6	1.8	81	
8	8.3	6.7	14.1	6.1	-1.2	4.4	9.1	8.9	9.1	8.8	8.6	1.8	78	
9	12.2	7.9	15.4	1.4	-4.9	1.0	10.4	9.3	9.2	9.1	8.7	2.3	50	
10	13.4	10.4	16.2	5.2	0.2	5.5	12.1	11.2	10.3	9.6	9.0	2.5	67	
11	11.5	9.3	14.9	4.8	0.8	4.3	12.4	11.6	10.6	9.9	9.2	1.8	73	
12	13.6	10.1	19.1	0.4	-4.7	0.6	11.5	10.1	10.1	9.8	9.4	3.0	61	
13	16.9	14.2	21.1	9.9	8.4	9.5	14.1	13.1	11.3	10.3	9.6	1.8	73	
14	11.1	8.3	15.9	4.6	-1.9	3.1	12.4	11.9	11.6	10.8	9.9	2.3	66	
15	11.1	8.4	13.9	3.7	-1.4	3.6	12.8	12.1	11.6	11.1	10.2	3.0	66	
16	10.2	9.4	11.7	8.5	6.4	8.1	11.6	11.9	11.6	10.9	10.3	1.0	90	
17	10.4	9.6	12.9	8.7	7.6	8.8	11.1	11.0	11.4	10.8	10.4	-0.3	90	
18	12.9	11.3	16.3	9.5	8.6	9.3	12.5	11.3	11.5	10.9	10.5	1.3	81	
19	15.2	13.0	19.6	10.0	9.1	10.2	13.4	12.3	12.2	11.4	10.6	2.5	76	
20	14.4	12.1	22.4	9.1	6.6	8.4	14.4	13.4	12.3	11.9	10.8	2.3	74	
21	19.5	16.1	24.9	10.1	6.0	9.5	17.2	15.3	13.6	12.6	11.1	3.3	69	
22	16.2	13.3	19.6	8.4	1.6	8.3	16.7	15.9	14.1	13.1	11.4	3.3	71	
23	14.6	12.3	17.0	8.3	2.4	8.9	16.3	15.7	14.1	13.2	11.8	1.5	80	
24	17.0	14.2	20.0	10.5	5.1	10.1	16.6	15.3	14.0	13.2	12.1	2.3	72	
25	14.5	12.3	16.0	6.3	0.4	6.3	15.7	14.9	14.0	13.4	12.3	1.8	76	
26	14.8	12.7	17.1	11.6	9.6	11.3	15.8	15.1	14.1	13.4	12.4	2.0	77	
27	16.3	13.3	20.4	11.2	9.0	11.4	17.5	15.8	14.3	13.5	12.5	3.8	70	
28	11.1	8.7	11.9	8.8	6.3	8.6	14.8	14.9	14.1	13.7	12.6	3.3	71	
29	10.4	8.3	12.7	8.3	7.4	9.7	13.7	13.5	13.3	13.2	12.7	1.5	74	
30	10.3	8.9	12.1	8.9	8.1	9.3	12.9	13.1	13.1	13.0	12.6	2.0	82	
31	9.7	8.1	11.6	8.7	8.1	9.2	12.6	12.8	12.3	12.8	12.5	2.0	79	

# HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE

Field & Glasshouse Dept.

## AGRO-MET STATION MONTHLY RECORDS

### MAY 1991 (PART 1)

Date	Total Cloud	Wind Direction Deg/10	Wind Speed (Knots)	Present Weather (Code)	Visibility (Code)	State of Ground No Snow/Ice	Depth of Snow Snow/Ice (cms)	Rainfall (mm) **TB**	Run of Wind (km) **TB**	Sunshine (hrs) **TB**	Weather Codes SHTC	Solar Radn. MJ/m <sup>2</sup>
1	8	NNE 02	09	61	6	1		0.5	273	1.2	0000	9.7
2	8	NNW 34	13	5	6	1		TR	252	6.5	0000	18.7
3	7	NNW 34	19	5	7	1		1.8	292	8.6	0000	23.9
4	6	NNE 02	13	1	7	1			334	3.3	0000	10.3
5	7	N 36	13	2	6	1		TR	277	3.6	0000	10.6
6	7	NNW 34	09	2	7	0		TR	156	4.7	0000	13.5
7	8	NNE 02	09	60	7	0		TR	235	2.9	0000	12.9
8	8	NNE 02	09	5	6	0			141	6.5	0000	21.6
9	4	SSW 16	02	5	7	0			80	11.3	0000	28.0
10	3	SSW 20	02	5	5	0			160	5.5	0000	21.6
11	8	W 27	09	2	7	0			132	2.5	0000	14.8
12	7	SW 23	09	3	8	0			231	11.3	0000	27.5
13	7	WSW 25	13	5	6	0		1.2	222	4.7	0000	21.9
14	7	NE 05	05	3	8	0			138	9.4	0000	22.4
15	7	NNW 29	13	5	7	0		5.1	259	8.3	0000	17.4
16	8	NNW 29	09	10	6	1		TR	190	0.0	0000	5.3
17	8	NW 32	09	10	6	1		0.3	100	0.0	0000	4.3
18	6	W 27	09	2	7	1			154	3.6	0000	11.9
19	7	NW 32	13	5	6	0		TR	182	2.5	0000	14.3
20	3	NNW 29	09	3	7	0			162	11.0	0000	20.1
21	5	SSW 20	09	5	6	0			147	13.7	0000	20.3
22	7	NW 32	09	5	7	0			184	10.1	0000	17.9
23	8	N 36	09	5	6	0		TR	101	1.0	0000	9.5
24	7	NW 32	09	5	7	0		TR	109	1.3	0000	11.6
25	8	W 27	09	5	7	0			150	0.7	0000	10.6
26	8	NE 05	13	5	7	0			104	0.0	0000	11.5
27	7	NNW 34	13	5	7	0		TR	264	3.3	0000	14.4
28	8	NE 05	13	2	8	0		TR	291	0.0	0000	7.9
29	8	NNE 02	13	2	8	0		TR	242	0.0	0000	3.3
30	3	NNE 02	09	5	6	0			202	0.0	0000	5.7
31	8	NNE 02	09	5	6	0			252	0.0	0000	5.4

HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

MAY 1991 (PART 3)

SUMMARY

	TOTAL	MEAN
RAINFALL (mm)	8.9	0.3
WINDRUN (km)	6066	195.7
SUN HOURS	138.5	4.47
DRY BULB TEMP		11.9
WET BULB TEMP		9.7
MAXIMUM TEMP		15.4
MINIMUM TEMP		6.7
GRASS TEMP		3.1
CONCRETE TEMP		6.4
SOIL TEMP 10CM		12.3
SOIL TEMP 20CM		11.7
SOIL TEMP 30CM		11.4
SOIL TEMP 50CM		11.0
SOIL TEMP 100CM		10.4
NO. OF DAYS WITH RAIN		5
NO. OF DAYS WITHOUT RAIN		26
HIGHEST TEMPERATURE		24.9
LOWEST TEMPERATURE		0.1

# HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE

Field & Glasshouse Dept.

## AGRO-MET STATION MONTHLY RECORDS

### JUNE 1991 (PART 1)

Date	Total Cloud	Wind Direction Deg/10	Wind Speed (Knots)	Present Weather (Code)	Visibility (Code)	State of Ground		Depth of Snow (cms)	Rainfall (mm) **TB**	Run of Wind (km) **TB**	Sunshine (hrs) **TB**	Weather Codes SKTG	Solar Radn. mj/m <sup>2</sup>
						No Snow/Ice	Snow/Ice						
1	8	NNE 02	13	5	6	0				166	4.7	0000	14.4
2	8	SSW 20	09	2	8	0			1.3	262	0.1	0000	7.8
3	6	WNW 29	13	2	8	0			TR	130	6.6	0000	15.4
4	7	WNW 32	09	2	8	0			TR	135	10.0	0000	17.6
5	7	SSE 16	13	2	7	0			2.9	253	1.6	0000	10.8
6	8	W 27	05	10	5	1			0.1	94	0.2	0000	9.1
7	8	NNE 02	09	5	6	1				229	0.0	0000	5.6
8	8	S 18	05	5	6	0			2.0	361	0.0	0000	9.0
9	7	SW 23	24	80	7	1			0.7	519	6.7	0000	18.3
10	7	WSW 25	19	3	8	0			0.1	271	6.6	0000	14.2
11	8	SW 23	19	61	6	0			1.1	452	1.7	0000	8.3
12	7	SR 23	19	3	8	0			0.7	518	7.9	0000	14.1
13	7	SW 23	24	3	7	1			5.5	387	8.5	0000	17.4
14	4	W 27	24	2	8	0			4.1	333	7.5	0000	13.0
15	8	N 06	13	51	5	1			8.1	160	1.2	0000	5.0
16	8	W 27	09	61	6	1			1.2	134	1.9	0000	10.9
17	7	WNW 32	09	2	8	1			TR	181	3.0	0000	12.6
18	7	WSW 25	09	2	8	1			2.9	339	2.4	0000	12.0
19	7	SW 23	05	3	8	1			TR	170	1.2	0000	11.3
20	7	NE 05	09	5	6	1			0.3	134	7.2	0000	16.7
21	8	SE 14	09	51	5	1			0.5	347	5.2	0000	13.5
22	7	S 18	13	80	3	0			1.2	322	6.0	0000	15.7
23	8	S 18	13	2	7	0			11.7	157	0.5	0000	7.5
24	8	S 18	09	2	6	1			13.7	216	0.4	0000	8.1
25	8	SW 23	19	1	7	1			0.6	333	0.4	0000	9.4
26	7	SSW 20	13	3	7	1			5.5	319	3.6	0000	19.7
27	7	WNW 29	09	5	6	1			0.5	155	5.9	0000	16.6
28	6	W 27	09	2	8	1			TR	149	11.9	0000	18.0
29	2	NW 34	05	2	8	0				286	3.6	0000	19.8
30	7	SSW 20	09	3	6	0			TR	253	9.5	0000	20.0

HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

JUNE 1991 (PART 2)

Date	Dry Bulb	Wet Bulb	Maximum	Minimum	Grass	Concrete	----- Soil Temp -----					Evaporation	R.H.
	Temp	Temp	Temp	Temp	Minimum	Minimum	10cm	20cm	30cm	50cm	100cm	(mm)	
			**TB**		Temp	Temp						**TB**	
1	9.4	6.8	13.2	7.4	6.5	7.7	12.2	12.2	12.4	12.6	12.4	2.3	66
2	10.6	7.9	13.1	-0.7	-3.0	0.0	12.1	11.5	11.9	12.4	12.4	1.8	66
3	10.9	6.7	12.7	6.6	5.0	6.1	12.2	11.2	11.8	12.1	12.2	2.5	55
4	11.7	8.1	14.1	0.6	-5.2	0.5	11.9	10.6	11.6	11.9	12.1	1.9	57
5	11.6	9.5	15.1	0.7	-6.2	1.5	11.7	11.2	11.6	11.9	12.0	1.0	75
6	11.7	11.1	16.7	3.1	8.4	8.9	12.3	11.9	11.9	11.9	11.9	0.3	93
7	13.1	12.1	14.0	8.7	4.9	8.6	12.9	12.6	12.5	12.2	11.9	1.5	38
8	11.4	9.6	15.4	8.9	7.9	9.2	12.9	12.3	12.4	12.3	11.9	1.0	79
9	15.1	12.1	19.2	10.9	9.0	9.8	13.7	12.7	12.6	12.4	12.0	3.8	68
10	15.5	12.2	17.9	10.8	9.5	10.5	14.7	13.4	12.9	12.6	12.1	3.0	66
11	12.2	10.4	16.9	4.6	-2.3	3.7	12.9	12.5	12.6	12.6	12.2	1.5	78
12	16.4	12.7	17.9	11.4	10.7	11.5	15.2	13.4	12.9	12.4	12.2	4.1	63
13	15.3	12.2	16.6	8.7	6.9	3.2	13.4	12.3	12.8	12.6	12.3	3.3	68
14	13.7	10.4	18.2	8.5	5.6	7.4	13.5	12.4	14.7	12.6	12.3	0.8	64
15	11.5	11.0	12.1	9.2	3.8	10.0	13.3	13.4	13.0	12.6	12.2	0.3	94
16	11.4	10.6	15.2	7.7	4.8	7.0	12.5	12.1	12.7	12.6	12.3	1.5	90
17	12.1	9.4	15.2	6.7	2.4	6.1	12.6	12.2	12.9	12.7	12.3	1.3	68
18	11.9	9.4	13.4	4.9	0.0	3.7	12.4	11.9	12.8	12.3	12.4	0.3	70
19	12.6	11.0	16.2	3.7	3.0	3.4	12.8	12.0	12.7	12.6	12.4	2.0	91
20	13.7	11.4	17.6	3.7	-1.1	3.6	12.7	11.6	12.6	12.6	12.4	2.0	74
21	13.1	12.7	20.1	10.0	3.7	9.0	13.2	13.1	13.4	13.0	12.3	4.3	95
22	17.3	13.3	18.9	10.7	7.7	9.5	15.2	14.2	13.9	13.2	12.5	2.6	61
23	14.5	12.4	15.2	7.4	2.6	6.3	14.1	13.4	13.7	13.3	12.6	0.2	77
24	15.2	14.1	17.4	3.3	3.5	3.2	15.2	13.4	13.7	13.3	12.7	-0.3	98
25	17.4	16.4	18.9	13.4	13.4	13.9	15.6	14.6	14.4	13.6	12.7	1.0	90
26	15.2	14.3	19.4	9.8	7.4	8.9	14.6	13.6	14.5	13.9	12.9	3.3	96
27	14.4	12.6	19.1	9.7	9.7	10.2	14.6	14.0	14.3	14.1	13.0	3.3	30
28	16.4	13.4	20.6	8.4	3.2	3.1	15.7	14.3	15.1	14.4	13.2	3.6	70
29	16.3	12.3	20.3	5.6	-0.2	6.1	15.3	14.0	15.2	14.3	13.5	3.3	61
30	17.3	16.8	22.9	13.2	11.9	13.2	16.3	15.2	15.9	15.0	13.3	3.3	82



HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

JUNE 1991 (PART 3)

SUMMARY

	TOTAL	MEAN
RAINFALL (mm)	64.7	2.2
WINDRUN (km)	7810	260.3
SUN HOURS	138.0	4.60
DRY BULB TEMP		13.6
WET BULB TEMP		11.4
MAXIMUM TEMP		16.8
MINIMUM TEMP		7.8
GRASS TEMP		4.6
CONCRETE TEMP		7.5
SOIL TEMP 10CM		13.6
SOIL TEMP 20CM		12.8
SOIL TEMP 30CM		13.2
SOIL TEMP 50CM		12.9
SOIL TEMP 100CM		12.4
NO. OF DAYS WITH RAIN		21
NO. OF DAYS WITHOUT RAIN		9
HIGHEST TEMPERATURE		22.9
LOWEST TEMPERATURE		-0.7

# HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE

Field & Glasshouse Dept.

## AGRO-MET STATION MONTHLY RECORDS

### JULY 1991 (PART 1)

Date	Total Cloud	Wind Direction	Wind Speed	Wind Weather	Present Weather	Visibility	State of Ground	Depth of Snow	Rainfall	Run of Wind	Sunshine	Weather Codes	Solar Radn.
		Deg/10	(Knots)	(Code)	(Code)	(Code)	No Snow/Ice	Snow/Ice (cms)	(mm)	(km)	(hrs)	SHTG	nj/m <sup>2</sup>
									**TB**	**TB**	**TB**		
1	8	SW	23	09	2	8	0			137	5.9	0000	16.4
2	7	S	18	05	5	6	0		17.1	192	8.4	0000	24.9
3	8	NE	05	05	60	4	1		TR	219	6.8	0000	22.2
4	8	NE	05	13	5	4	1			332	9.3	0000	27.7
5	4	NE	05	13	5	6	0		3.8	307	12.8	0000	26.3
6	5	SSE	16	09	3	8	1			153	11.6	0010	26.2
7	4	ESE	11	09	5	7	0		0.3	227	11.7	0000	24.4
8	8	S	18	09	61	7	1		0.7	483	1.5	0000	15.3
9	7	WSW	25	13	5	7	0			210	8.3	0000	25.5
10	6	SSE	16	09	5	7	0			232	11.3	0000	29.8
11	6	SSE	16	09	5	6	0		TR	399	8.0	0000	24.8
12	8	SSW	20	24	5	7	0		TR	351	3.9	0000	17.9
13	8	SSW	20	19	2	7	0			283	1.3	0000	17.6
14	4	W	27	13	1	8	0		TR	322	11.8	0000	31.9
15	8	W	27	13	2	8	0		0.6	278	4.5	0000	11.7
16	7	WSW	25	09	60	5	1		3.7	186	7.9	0000	15.5
17	6	SW	23	09	3	7	0		10.9	200	2.6	0000	13.2
18	7	S	18	13	60	8	1		TR	366	5.8	0000	18.8
19	8	W	27	09	1	8	1			202	2.4	0000	18.3
20	6	W	27	09	5	8	0			150	10.2	0000	27.2
21	5	W	27	05	5	8	0			59	7.6	0000	19.2
22	7	SSE	16	09	5	6	0			148	5.3	0000	20.0
23	7	SSE	16	09	5	6	0		0.6	247	2.1	0000	17.4
24	7	WSW	25	09	80	6	1		4.6	204	4.5	0000	20.5
25	8	NW	32	05	60	6	1		TR	140	5.2	0000	19.6
26	8	NNW	34	05	5	6	0			98	5.3	0000	21.3
27	5	SW	23	05	2	6	0			133	12.6	0000	30.0
28	8	S	18	05	5	6	0			161	7.4	0000	18.2
29	4	NNE	02	09	5	6	0			293	10.4	0000	20.3
30	7	SW	23	09	5	6	0		35.6	159	0.0	0000	9.8
31	4	SSW	20	09	3	8	1		2.4	142	7.8	0000	24.7

HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

JULY 1991 (PART 2)

Date	Dry Bulb	Wet Bulb	Maximum	Minimum	Grass	Concrete	----- Soil Temp -----					Evaporation	R.H.
	Temp	Temp	Temp	Temp	Minimum	Minimum	10cm	20cm	30cm	50cm	100cm	(mm)	
			**TB**									**TB**	
1	16.7	14.2	21.6	12.5	8.1	11.9	18.1	17.2	16.4	15.3	13.7	2.8	75
2	16.7	14.3	21.9	8.9	2.7	8.8	17.8	16.8	16.3	15.5	14.0	3.3	75
3	15.7	15.4	22.9	13.9	13.6	14.2	17.3	17.5	17.1	16.2	14.4	2.3	97
4	17.4	16.3	26.0	14.6	12.4	14.9	17.8	17.6	17.6	16.5	14.6	5.1	89
5	21.5	18.3	26.2	13.7	11.9	12.9	19.6	18.2	17.7	16.9	14.9	4.6	72
6	20.5	18.1	24.1	16.1	15.2	15.9	20.1	19.4	18.3	17.2	15.1	3.8	78
7	21.8	17.8	25.2	11.4	7.1	11.1	19.8	18.6	18.5	17.6	15.4	5.1	66
8	15.9	14.9	20.7	14.6	12.6	14.3	19.3	19.4	18.7	17.8	15.7	4.1	89
9	17.3	14.0	22.4	13.6	13.1	13.3	18.0	17.2	17.6	17.2	15.9	2.8	67
10	19.1	16.0	24.6	11.6	8.7	11.9	19.4	18.1	17.5	17.1	15.8	4.8	71
11	23.2	19.1	27.4	15.6	13.6	15.0	21.3	20.0	18.4	17.6	15.9	5.1	66
12	17.0	14.2	21.4	10.6	5.0	10.0	18.6	18.6	18.1	17.6	16.1	2.0	72
13	18.7	15.4	23.0	12.6	10.1	11.8	18.4	17.7	17.5	17.1	16.1	3.0	69
14	19.0	14.5	24.0	11.5	9.7	10.7	18.8	17.6	17.5	17.1	16.2	4.8	59
15	17.4	14.7	20.7	14.6	13.1	14.9	19.0	19.0	17.4	17.3	16.1	4.6	73
16	16.1	15.1	20.5	12.0	7.3	11.3	17.7	17.7	17.4	17.1	16.2	2.5	89
17	17.9	14.5	20.1	10.1	4.0	9.6	17.0	16.3	17.1	17.0	16.2	3.6	68
18	15.0	14.4	22.1	12.6	12.2	12.9	16.1	16.6	16.9	16.8	16.1	2.5	93
19	16.4	14.3	20.1	14.0	13.2	14.1	16.4	16.4	17.1	16.8	16.1	2.3	78
20	19.0	16.0	21.7	12.5	9.7	12.4	18.3	16.9	17.1	16.8	16.1	3.6	72
21	19.0	15.4	21.7	10.8	6.1	10.9	19.4	18.0	17.5	17.1	16.1	2.5	67
22	20.1	16.6	23.7	8.6	3.6	9.2	19.1	18.0	17.5	17.3	16.1	2.8	68
23	21.2	18.1	23.9	13.6	10.9	13.6	19.8	18.9	17.9	17.5	16.2	3.0	72
24	16.0	14.3	19.0	10.3	4.5	9.8	17.8	17.4	17.4	17.2	16.2	1.3	32
25	14.7	14.2	21.1	12.8	11.9	13.0	16.6	16.9	17.2	17.1	16.3	1.3	94
26	17.1	15.4	24.5	13.6	8.0	12.9	17.8	17.4	17.6	17.2	16.3	3.3	83
27	18.9	15.6	25.6	12.1	6.7	11.8	19.2	18.3	18.1	17.7	16.5	3.6	69
28	17.9	16.5	25.1	10.9	5.7	10.9	19.8	19.5	18.5	18.0	16.6	4.1	86
29	23.5	18.0	29.2	12.7	8.6	12.0	21.1	19.8	18.7	18.2	16.6	6.1	56
30	19.4	16.9	20.6	15.6	13.2	14.9	20.6	20.6	19.0	18.4	16.8	1.5	77
31	18.6	16.1	23.1	13.4	12.7	13.5	18.3	17.9	18.0	17.9	17.0	2.3	76

HORTICULTURE RESEARCH INTERNATIONAL, WELLESBOURNE  
Field & Glasshouse Dept.

AGRO-MET STATION MONTHLY RECORDS

JULY 1991 (PART 3)

SUMMARY

	TOTAL	MEAN
RAINFALL (mm)	80.3	2.6
WINDRUN (km)	7013	226.2
SUN HOURS	214.7	6.93
DRY BULB TEMP		18.3
WET BULB TEMP		15.8
MAXIMUM TEMP		23.0
MINIMUM TEMP		12.6
GRASS TEMP		9.5
CONCRETE TEMP		12.4
SOIL TEMP 10CM		18.7
SOIL TEMP 20CM		18.0
SOIL TEMP 30CM		17.7
SOIL TEMP 50CM		17.2
SOIL TEMP 100CM		15.8
NO. OF DAYS WITH RAIN		11
NO. OF DAYS WITHOUT RAIN		20
HIGHEST TEMPERATURE		29.2
LOWEST TEMPERATURE		8.6