Alstroemeria: The Effects of Irrigation Regime on the Flower Production Cycle (PC 33a)

Dr Clive Rahn
HRI, Wellesbourne

Lyndon Mason
ADAS, King's Lynn

Martyn Squires
Parigo Horticultural Company

LM197

CONTENTS

INTRODUCTION

Since the introduction of the first modern hybrids in 1961 (Goemans 1962) the crop has steadily increased in importance. In 1986 Deen reported that ***Alstroemeria*** was by then the second largest cut flower crop by area in the UK (presumably referring to protected crops). In 1989 it was the tenth most important cut flower to pass through the Dutch auctions with a total of 64 million Dfl worth of stems being sold (Flower Council of Holland 1990). The natural cropping cycle leads to peaks and troughs of production, which result in marketing problems and unstable prices. It is an aim of the commercial breeders to produce cultivars with all year round production capabilities and some progress has been made in this area. Cultural techniques are also known to have an affect on flower production. To date most work has concentrated on investigating the effects of day length, light intensity and temperature. No studies have been published concerning the relationship between supply of water to the plant and flower production. The breeding companies can supply only general recommendations to growers which do not attempt to address the possibility of influencing the cropping cycle. This may lead to poor and perhaps wasteful use of water in some situations. As the cost of water increases it will be of greater importance to schedule watering. This project aims to provide growers, via the HDC, with some practical experience of a system of crop watering that is intended to maximise the marketable yield of ***Alstroemeria*** by timing water usage to stage of plant growth. It was also hoped to investigate the breaking of dormancy through water usage. The following experiment was designed to improve irrigation management with a view to increasing control over the flowering and dormancy periods of the ***Alstroemeria*** crop.

MATERIALS AND METHODS

Experimental Layout

Micro propagated plants of the cultivars Eleanor and Carmen grown in 9 cm pots were planted on 3/3/91 into the glasshouse border sandy silt loam soil. The glasshouse type was wide span aluminium with pipe heating. The soil had previously been cultivated and flame sterilised. Prior to planting soil samples had been taken and the base levels of fertiliser adjusted in line with MAFF RB 209 recommendations. Further soil samples were taken at the end of the first flush of flowers, before the fourth flush and at the end of the trial in November 1992. Liquid fertiliser was applied during the growing season via the irrigation lines. Following planting all beds were watered to bring them to field capacity.

The ***Alstroemeria*** beds each covered an area of 32 m^2 and contained a total of 140 plants. Each of the trial beds was sub divided into 5 plots covering an area of 6.4 m^2 and containing 28 plants. This sub division of beds allowed for statistical analysis of the flower cropping data. A diagram of the bed layout is presented below (Figure 1).

A dial type gauge tensiometer (ELE model A) was sited at a depth of 20 cm in each replicated plot of the standard and regulated Eleanor beds (numbers 5 and 8) and a Jones-Rothwell evaporimeter (Grower leaflet No. 3 revised 1972 Re 56128) sited in the regulated Eleanor bed (No. 8). Tensiometer and evaporimeter readings were recorded daily between 8.30 and 9.30 am. Air temperatures and the appearance of the crop were also noted.

Irrigation of Regulated Beds

A series of desired soil tensions were set for the regulated beds at the outset of the trial. These desired soil tensions were related to the major physiological stages of crop growth and soil texture.

For purposes of this report the term "dormancy" describes a sharp reduction in the production of reproductive shoots, and to a lesser extent the production of vegetative shoots.

The target tensions for the regulated beds in the 1991/92 season were:-

		Soil Tensions (cb)
1991	Establishment	40
	Vegetative phase	30
	1st flush of flowers	30
	End of 1st flush	50
	Dormancy (summer)	75
	End of dormancy	30
	2nd flush	30
	Winter dormancy	30-75
1992 *	End of dormancy	35
	3rd flush	15
	Summer dormancy	10-20
	4th flush	15-20
	Winter dormancy	30-75

* The critical tensions during flowering were decreased in the second season as the beds were felt to be too dry in 1991.

Once one of these tensions had been reached or exceeded by 3 of the 5 tensiometers in the regulated bed a metered dose of water was applied to maintain the tension as closely as possible to the desired point. The volume of water to be applied was determined using evaporimeter readings. This instrument gave a reasonable estimate of water loss from the crop and soil surface when an adjustment was made for the percentage ground cover and height of the crop. Initially this was made using a calibration curve for the tomato crop supplied with the evaporimeter which was not fully suited for use with the ***Alstroemeria*** crop. In order to overcome this problem, tensiometer readings were monitored following irrigation. Subsequent water applications were proportionately reduced if trigger values were exceeded or increased if tensions fell short of the desired values.

During the first season it had been found that soil tensions had varied on a day to day basis by a greater margin than was desirable. This was caused by difficulties in accurately applying small volumes of water to the crop via the irrigation system.

To overcome this problem once irrigation trigger points were reached the quantities of water required on each day were totalled until they reached a minimum level for accurate watering. Thereafter water use estimates were accumulated once again until further water could be applied.

Irrigation of Control Beds

No soil tension targets were set for these. The need for irrigation was judged by the hand assessments of soil moisture content in the bed. Water applications and soil tensions were recorded.

The numbers of saleable stems in all grades harvested and the numbers of 1st grade stems obtained were recorded, as was the date of harvesting for each of the 5 plots per bed of the standard and regulated Carmen and Eleanor beds.

FLOWER PRICES

An estimate has been made of the economic importance of any change in the harvesting pattern facilitated by the manipulation of the irrigation regimes.

Prices obtained for Parigo Horticultural Company for 1st and 2nd grade ***Alstroemeria*** by a New Covent Garden wholesale company for the period November 1991 to October 1992 have been provided for use in this report and are shown in Table 1.

Table 1.

***Alstroemeria* Prices November 1991-October 1992**

	1st Grade		2nd Grade	
1991	**Bunch £**	**Stem £**	**Bunch £**	**Stem £**
Nov.	2.82	0.56	1.89	0.38
Dec.	2.95	0.59	2.45	0.49
1992				
Jan.	2.97	0.59	2.45	0.49
Feb.	2.95	0.59	2.15	0.43
March	2.25	0.45	1.67	0.34
April	1.72	0.34	1.64	0.33
May	1.01	0.20	0.67	0.13
June	1.32	0.26	1.36	0.27
July	2.38	0.48	1.45	0.29
Aug.	1.96	0.39	1.36	0.27
Sept.	2.05	0.41	1.35	0.27
Oct.	1.93	0.39	1.36	0.27

RESULTS

Number of Marketable Stems

The number of marketable stems are shown in Table 2 and Figs 1 abcd for Eleanor, and Table 3 and Figs 2 abcd for Carmen, the quantities of water used are shown in Table 4.

There appeared to be no significant difference in total numbers of marketable Eleanor stems over the 2 year period as a whole between control and regulated irrigation regimes. Overall number of marketable stems were depressed in 1991 on the regulated beds but not significantly so in spite of much smaller quantities of water applied to the regulated beds. Where there were significant differences they were usually in favour of the control regime. However there were some marked advantages in the production of quality stems. The regulated regime gave rise to significantly more early first grade stems in February of the second year (1992) and produced more first grade stems in March and April. At the time of the main flush the number of first grades was significantly down but this is at a time of over supply and so less important. The final flush in September of 1992 was also much better supplied with first grade blooms where the irrigation regime was regulated.

The peak of flower production in May 1992 coincided with peak water use. Significantly more water was applied in 1991 to the control beds than the regulated beds. In 1992 the regulated beds received water more evenly with less severe drying between irrigations so regulated and control beds received similar quantities of water.

One of the aims of the experiment was to see if the application of water could influence the end of dormancy. In August larger than necessary quantities of water were applied than was needed for growth. This may have lowered soil temperatures enough for the dormancy period to end. Stem production was earlier and produced significantly higher numbers of 1st grade stems in the following September and October.

The total number of marketable stems of Carmen harvested over the 2 years were significantly lower from the regulated beds than the control beds. The yields of total and Class I stems were significantly down in the drier 1991 season on the regulated beds but not in 1992 where the beds were kept wetter. The regulated beds did lead to heavier production of flowers in March, August and September of 1992. Indicating that the dormancy in Carmen may also be broken with application of water.

In this experiment the regulated regime was designed to control dormancy in Orchid type ***Alstroemeria*** of which Eleanor is a typical example. It is interesting to note that yields of Carmen (a non-orchid type) were significantly depressed in the regulated beds during 1991. This indicates the need for an irrigation regime to be tailored, where possible to suit broad cultivar types.

TABLE 2. ELEANOR NUMBER OF SALEABLE STEMS

	Total Stems/sq. m				1st Grades Stems/sq. m				2nd Grades Stems/sq. m			
	Control	Regulated	n	SED	Control	Regulated	n	SED	Control	Regulated	n	SED
Month												
May 1991	17.2	14.3	NS	3.13	11.2	9.7	NS	1.61	6.0	4.6	NS	1.81
June 1991	38.2	29.9	NS	5.34	22.1	16.2	NS	3.01	16.0	13.8	NS	2.74
July 1991	5.8	2.0	**	1.20	1.0	0.4	**	0.21	4.8	1.6	*	1.15
August 1991	3.4	5.5	NS	1.49	0	0	NS	-	3.4	5.5	NS	1.49
September 1991	0.4	0.2	NS	0.26	0	0	NS	-	0.4	0.2	NS	0.26
October 1991	0.8	0.8	NS	0.55	0	0	NS	-	0.8	0.8	NS	0.55
November 1991	2.7	1.3	NS	0.91	1.9	0.8	NS	1.01	0.8	0.5	NS	0.52
December 1991	5.4	2.5	**	0.75	2.8	2.0	NS	0.78	2.6	0.5	**	0.50
January 1992	5.4	4.0	NS	1.01	1.6	2.2	NS	0.48	3.8	1.7	*	0.88
February 1992	4.2	5.4	*	0.46	2.8	3.9	*	0.50	1.4	1.5	NS	0.64
March 1992	12.2	13.3	NS	1.33	6.4	8.5	NS	1.33	5.8	4.8	NS	0.62
April 1992	27.3	28.0	NS	2.99	21.5	26.4	NS	2.49	5.8	1.6	***	0.89
May 1992	91.5	76.6	*	5.43	65.9	56.2	**	2.93	25.6	20.4	NS	3.15
June 1992	2.8	2.5	NS	1.19	0.2	0	NS	0.19	2.6	2.5	NS	1.19
July 1992	3.7	5.8	NS	1.87	0	0	NS	-	3.7	5.8	NS	1.87
August 1992	12.5	12.8	NS	3.08	0	0	NS	-	12.5	12.8	NS	3.08
September 1992	20.8	29.4	NS	7.33	7.2	15.8	*	3.60	13.6	13.6	NS	3.91
October 1992	29.5	36.5	*	3.04	15.8	22.8	**	2.03	13.7	13.8	NS	1.65
TOTAL												
1991	73.9	56.6	NS	9.28	39.1	29.0	NS	4.54	34.9	27.6	NS	5.69
1992	209	214	NS	15.00	121.4	135.8	*	6.11	88.5	78.5	NS	10.68
GRAND TOTAL	284	271	NS	19.71	160	165	NS	8.33	123	106	NS	13.08

n = NS, treatment effect not significant; *, **, *** significant at 5, 1 and 0.1% level of probability.

TABLE 3. CARMEN NO OF SALEABLE STEMS

Month	Total Stems/sq. m				1st Grades Stems/sq. m				2nd Grades Stems/sq. m			
	Control	Regulated	n	SED	Control	Regulated	n	SED	Control	Regulated	n	SED
May 1991	23.5	15.3	**	2.57	11.2	9.7	NS	1.61	12.3	5.6	**	1.52
June 1991	34.4	22.1	*	4.34	8	2.1	**	1.66	26.4	20.0	NS	3.61
July 1991	14.5	4.4	***	1.51	1.4	0.2	**	0.28	13.0	4.2	***	1.45
August 1991	4.7	3.2	NS	1.02	0	0.1	NS	0.16	4.7	3.1	NS	1.09
September 1991	6.0	2.3	**	0.83	0	0.1	NS	0.06	6.0	2.2	***	0.80
October 1991	8.6	4.6	**	1.18	0	0.22	NS	0.22	8.6	4.4	**	1.18
November 1991	3.0	2.0	NS	0.56	0	0	NS	-	3.0	1.9	NS	0.56
December 1991	6.7	2.4	***	0.57	0	0	NS	-	6.7	2.4	***	0.57
January 1992	2.9	2.5	NS	0.33	0.8	1.5	NS	0.36	2.1	1.0	**	0.26
February 1992	2.8	3.6	NS	0.55	0.4	1.9	**	0.42	2.3	1.6	NS	0.42
March 1992	3.3	6.3	***	0.59	2.0	4.6	**	0.65	1.3	1.8	NS	0.24
April 1992	15.8	18.4	NS	1.42	12.8	15.8	*	1.28	3.8	2.6	*	0.43
May 1992	50.7	40.4	***	1.29	21.3	15.6	**	1.70	29.1	24.8	**	1.35
June 1992	22.0	30.8	**	2.52	1.3	1.0	NS	0.49	20.7	29.8	**	2.46
July 1992	45.4	12.2	***	5.83	0	0	NS	-	45.4	12.2	***	5.83
August 1992	29.5	33.4	NS	2.43	0	0	NS	-	29.5	33.4	NS	2.43
September 1992	28.6	37.5	NS	4.24	0	0	NS	-	28.6	37.5	NS	4.24
October 1992	28.5	26.6	NS	2.79	0	0.8	*	0.30	28.5	25.8	NS	2.68
TOTALS												
1991	101	56	***	8.95	20.7	12.5	**	2.06	80.7	43.8	***	7.58
1992	229	212	NS	11.97	37.8	41.2	NS	2.28	191.5	170.6	NS	11.76
GRAND TOTAL	331	268	**	18.76	58.5	53.8	NS	2.30	272	214	*	17.69

n = NS, treatment effect not significant; *, **, *** significant at 5, 1 and 0.1% level of probability.

Table 4.

Quantities of Water Applied litre/m^2

	Control	Regulated
March	27	27
April	46	54
May	92	19
June	66	37
July	58	10
August	21	14
September	19	30
October	24	21
November	0	7
December	0	0
Total 1991	**353**	**219**
January	6	0
February	30	22
March	22	41
April	49	57
May	77	73
June	39	18
July	44	56
August	50	75
September	51	64
October	46	27
Total 1992	**414**	**433**
GRAND TOTAL	**767**	**652**

Conclusions

The regulated watering technique as devised for the 1991 season appears to have had a detrimental effect on the cultivar Carmen both in terms of overall stem production and also the production of first grade stems. As the only significance in the watering regime was a much reduced quantity during the May to August period in the first year it may be assumed that the physiology of the plant had been disturbed in some way.

The story with Eleanor is rather different in that even though the overall number of stems for both the control and regulated regime was similar, it has resulted in a redistribution of the peaks of production. The May peak appears to have been redistributed in September and October which is a time of significantly improved returns. More importantly the number of first grade stems is also improved during the September/October period, with second grade remaining much the same.

A rough calculation of what this means financially would be as follows:-

Reduction in first grade stems in May is 15 flowers per sq. m therefore at a price of 20p per stem the reduction in income is 15 x 0.2 = £3 per sq. m.

Increase in first grade stems in September/October is approximately 16 flowers per sq. m. At an average price of 40p per stem the increase in income = 16 x 0.4 = £6.4.

This means an overall increase of £3.40 per square metre which assuming 65% space utilisation represents £22,100 per hectare. If this is repeated in future years the potential increase in income is very significant. However, as this is only based on figures for one crop the experiment would need to be repeated before firm recommendations could be given to growers.

The fact that the total number of stems produced by Eleanor were very similar with both regimes serves to indicate that an increase in yield during certain times of the year will lead to an almost similar reduction at other times. Providing the reduction is at a time of glut and the increase during a time of shortage such a shift will make economic sense.

REFERENCES

Deen J (1986). Licence to make money. Horticulture week 11 July 1986.

Flower Council of Holland (1990). Facts and figures about the Dutch horticultural industry. 1990 edition.

Goemans, J.A.M. (1962). Breeding of *Alstroemerias*. Journal of the Royal Horticultural Society 87 1962.

MAFF (1988). Fertiliser recommendations for agricultural and horticultural crops. MAFF reference book RB 209 HMSO.