Effect of watering frequency and inert medium on carnations

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It is easier to under water an inert medium than to over water it. The less water an inert medium holds, the more critical becomes the importance of adequate irrigation frequency. The more water a medium holds the less the variation in yield due to watering frequency, but the advantages of using an inert medium begin to disappear with increasing water-holding capacity. The medium and watering frequency, resulting in the highest yield, may not result in the highest mean grade, and it may be necessary to sacrifice some yield in order to improve quality.

Methods

CSU White Pikes Peak was subjected to three different irrigation frequencies in four kinds of inert media, beginning July, 1968. A preliminary report was given in CFGA Bul. 227. A brief description of the media is repeated in Table 1. Table 2 describes the watering frequencies employed to termination in June, 1969. Although the number of times each treatment was watered varied throughout the year, the frequencies for the particular season bracketed the

Table 1. Description of media used in experiment.

Description	Bench capacity (qts/ft²)[1]	(lbs/gal)[2]
A. River sand and gravel (squeegee) 1.4% by weight smaller than 0.02''	2.0	0.8
B. ''Regular'' idealite, 0.5% by weight smaller than 0.02''	1.8	0.7
C. Fine idealite, 5% by weight smaller than 0.02''	4.5	1.8
D. Coarse idealite, no particles smaller than 0.2''	1.5	0.6

[1]Maximum moisture-holding capacity calculated for a square foot of bench area 7'' deep.
[2]Maximum moisture holding capacity for a gallon of medium 7'' deep.

Table 2. Irrigation frequencies in inert media experiment.

Date started	Wet (X)	Medium (Y)	Dry (Z)
July 3,'68	Six times daily	Four times daily	Twice daily
Aug. 12	Five times daily	Three times daily	Once daily
Sept. 3	Four times daily	Twice daily	Every other day
Oct. 31	Three times daily	Once daily	Every other day
Nov. 16	Twice daily	Skip on cloudy days once daily	Once every third day
Jan. 3,'69	Three times daily	Once daily, skip on cloudy days	Once every third day
Apr. 19	Four times daily	Three times daily	Once daily

extremes. Each of the four media were replicated once in each watering treatment for a total of 10 carnation plants per medium per watering frequency. A modified peripheral system was used to apply water and nutrients automatically. Data for mean grade and yield were subjected to analysis of variance on the means. However, only total yield, yield per plant and mean grade are presented with some calculations on percentage differences between treatments.

Yield

Yields for the various treatments and interactions are presented in Table 3 and Fig. 1. There were no statistically significant differences among media, but the differences as the result of watering treatment and the interaction between time and watering (Fig. 1) were highly significant. However, the 12% decrease in yield between gravel (A) and fine idealite (C) (about 2 flowers per plant) could be considered important. There was a 17% decrease in yield between

Table 3. Effect of inert root substrate and irrigation frequency on yield of carnations.

Treatment	Total yield	Yield per plant	Percent decrease in total yield from ____ to ____	
Irrigation frequency:				
Wet (X)	727	18.2	X to Z	17%
Medium (Y)	699	17.5	Y to Z	14%
Dry (Z)	603	15.1	X to Y	3%
Inert medium:				
A. (Gravel)	539	18.0	A to C	12%
B. (Reg. idealite)	533	17.8		
D. (Coarse idealite)	491	16.4	A to D	9%
C. (Fine idealite)	476	15.9		
Interaction (Frequency on medium):				
XD	198	19.8	XD to ZD	32%
XA	192	19.2	XD to XA	3%
YB	192	19.2		
YA	186	18.6	XD to YA	6%
XB	182	18.2	XD to XB	8%
YC	163	16.3	YA to YC	12%
ZB	159	15.9	XD to YC	18%
YD	158	15.8	YC to YD	3%
ZC	158	15.8	XB to YD	13%
XC	155	15.5	YC to XC	5%
ZA	151	15.1		
ZD	135	13.5		

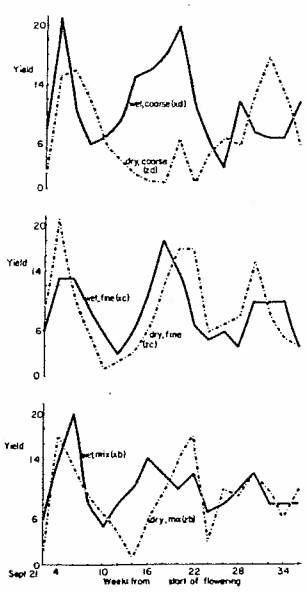

Fig. 1. Effect of watering frequency and medium on timing in carnations.

extremes of irrigation or a calculated difference in yield of 9.3 flowers per square foot, assuming 3 plants per square foot.

Of considerable interest was the interaction between medium and watering frequency. The less water a medium held, the more important adequate watering became. There was a decrease in yield of 32% between the wet-coarse idealite (XD) treatment

and the dry-coarse idealite (ZD) treatment. This medium held only 1.5 qts/ft^2 of water. On the other hand, the extremes with fine idealite (YC to XC) resulted in a 5% decrease in yield. The dry-fine idealite treatment (ZC) actually produced slightly more flowers than the wet irrigation treatment (XC). In terms of possible yield per square foot, the differences would be 18.9 and 2.4 flowers for the XD to ZD and YC to XC comparisons, respectively.

The more water a medium held, the less serious was the effect of reduced irrigation on timing (Fig. 1). For most of the media, reducing frequency slowed development, resulting in lower production during off-peaks and slowing the return to a second crop. The extreme example was between wet and dry treatments with coarse idealite (XD and ZD) where the return to second crop was delayed past the peak for the wet treatment by 10 weeks. With fine idealite (XC and ZC), the delay amounted to about 2 weeks with intermediate results for gravel and regular idealite (A and B).

Mean grade

Results for mean grade are presented in Table 4. None of the inert media could be watered on the dry schedule given in Table 2 without significant reduction in grade. The wet and medium treatments for fine idealite (XC and YC) were among the group of 6 treatments in which the highest mean grades were not significantly different from each other. The medium-coarse idealite (YD) also was found in this group, whereas the wet-coarse idealite (XD) had a lower mean grade. The difference in yield between wet-coarse (XD) and medium-fine (YC) was 18%, that between medium-fine (YC) and medium-coarse (YD) was 3%. While, in general, irrigation on the schedules given for wet and medium treatments in Table 2 resulted in highest mean grade, there were significant exceptions when the interaction between medium and watering frequency was compared.

Table 4. Effect of root substrate and irrigation frequency on mean grade of carnations.

Treatment		Grade	hsd (0.05)[1]
Irrigation frequency:	Wet (X)	3.86	
	Medium (Y)	3.85	
	Dry (Z)	3.37	
			0.10
Inert medium:	B.(Reg. idealite)	3.78	
	C.(Fine idealite)	3.71	
	A.(Gravel)	3.65	
	D.(Coarse idealite)	3.62	
			0.12
Interaction (Frequency on medium):			
	XB	4.04[2]	
	XC	3.91	
	YC	3.91	
	YD	3.87	
	YB	3.82	
	YA	3.79	
	XA	3.77	
	XD	3.71	
	ZB	3.48	
	ZA	3.39	
	ZC	3.32	
	ZD	3.28	
			0.27

[1]Difference required for valves to be significantly different from each other.

[2]Figures bounded by the same line are not significantly different from each other.

Discussion

There appears to be a choice in the selection of inert media and watering intervals, depending upon whether the grower desires maximum yield, maximum quality or a compromise. If yield is desired, a coarse, low water-holding capacity medium might be selected and irrigated frequently (wet schedule, Table 2). However, as bench capacity decreases, fewer mistakes can be tolerated. If high grade is desired, a higher moisture capacity with an irrigation frequency similar to the medium schedule (Table 2) might be selected. The added advantage is that the danger of under watering is not so great. A compromise might be made.

For example, comparing the wet irrigation regime (X) on different media offers interesting possibilities. Media D and A had highest yield but D was only 8% higher in yield than Medium B. Medium B produced significantly higher mean grade flowers than either A or D. If the goal is higher grade flowers with a wet regime, Medium B would be the best compromise. If the goal were high yield only, Medium A or Medium D would be selected for a wet irrigation regime.

For a medium (Y) moisture regime there were no significant differences in mean grade among media, hence, selection of the medium would be entirely on the basis of yield. From Table 3, one would select YB, YA, YC, and YD in that order.

In general, greater safety will be obtained with inert media having neither excessively high nor excessively low moisture holding capacities such as those typified by fine and coarse idealite (C and D). The medium (Y) irrigation regime used in this experiment appears safest on inert media having water holding capacities around 1.8 to 2.5 quarts per square foot. It is better to over water an inert medium than to under water and get results typical of Treatment Z.

Nothing has been said in regard to the gradual increase in moisture capacity that will likely occur from decaying roots adding organic matter to the inert medium. Differences in idealite have been observed between the first and second plantings in Denver. It is to be expected that organic matter will gradually increase until the medium is not much different from a gravelly soil. The irrigation frequency will have to be reduced, and the advantages of inert media will be gradually lost. How long this will take has not been determined.