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COMPOSITION OF WATER SUPPLIES USED IN HORTICULTURE

Abstract: The results of a water survey in 1979 based on 77 samples obtained from growers in 18 counties in Ireland indicated that water from wells had the highest total hardness values at 260 mg/l ($CaCO_3$) as compared with mains supplies (143 mg/l), river supplies (114 mg/l) and samples obtained from glasshouse roofs (37 mg/l). Values for electrical conductivity, calcium and magnesium were in the same order as total hardness. Sodium levels were also highest in well samples (26 mg/l), while the mean zinc levels were less than 0.29 mg/l except for samples from glasshouse roofs which had a mean of 0.40 mg/l.

Due to lack of sufficient samples a valid inter-county comparison could not be made. However, there were large differences in the total hardness of water from North and South County Dublin, with values of 198 mg/l and 63 mg/l ($CaCO_3$) respectively.

Introduction

Water is used widely in horticulture for irrigation, feeding, for the application of sprays, and in boilers used by glasshouse growers. Water quality for the glasshouse industry is of special importance in view of the small volumes of peat used as a growing medium in relation to the quantity of water applied. The advent of growing by the nutrient film technique also requires pure water, as certain elements may be concentrated in the system.

Waters naturally high in salts may cause blockage of trickle irrigation systems (1, 2) and cause white deposits on the leaves of ornamental plants. In contrast, waters low in salts may allow the development of an increased level of blossom-end rot in tomatoes (3, 4). Water for use in boilers must be treated; the level of treatment depending on the hardness status of the water.

A detailed survey of the composition of water used by glasshouse growers was carried out in 1969 (5). However, because of the level of enquiries and requests for analyses since that time it was decided to carry out another, but smaller, survey in 1979. Data for this survey are presented in this communication.

Procedure

Lists and addresses of the growers were obtained from the current records at Kinsealy Research Centre. Sixty growers were selected at random from County Dublin while sample bottles were sent to a total of 60 growers from all other counties. Counties Meath, Kildare, Louth and Wicklow were best represented with 11, 6, 5 and 5 growers respectively. A further 15 counties were represented by from 1 to 4 growers. Because of the difference in the composition of water supplies between North and South County Dublin each was considered as a separate 'county' in the presentation of the results. The county was divided into "North and South" by a line joining central Dublin to Lucan.

The sample bottles (0.5 l, polythene), together with an enquiry as to the source of each sample, were sent to growers by post in January, 1979; three reminder notes were sent at intervals of 2 weeks.

Samples were tested for total hardness, electrical conductivity, calcium, magnesium and sodium contents as described previously (5) and zinc content was measured by a standard atomic absorption procedure.

Results and discussion

A response of 65% was obtained. Twenty-four samples came from wells, 34 from mains supply, 9 from rivers, 3 were rainwater from glasshouse roofs while the remaining 7 samples were from combined sources, e.g., a mixture of well water and water from the glasshouse roofs.

Data for sources: The mean values for water composition for samples from the different sources together with standard deviations are presented in Table 1. Samples from wells were the hardest and had the highest conductivity values. The sodium content was also highest in these samples.

TABLE 1: Mean values for the composition of water from different sources

	Total hardness ($CaCO_3$, mg/l)	Conductivity (μmhos)	Ca	Mg	Na (mg/l)	Zn	pH
Well supplies (24)[a]							
Mean	260	650	104	15	26	0.29	7.4
SD	105	250	50	6	14	0.56	0.38
Mains supplies (34)							
Mean	143	330	48	5	13	0.25	7.5
SD	91	260	35	3	3	0.59	0.45
River supplies (9)							
Mean	114	290	42	5	16	0.18	7.3
SD	82	210	45	4	6	0.50	0.50
Rain from roof (3)							
Mean	37	100	9	1	11	0.40	7.1

[a]The number of samples tested per source is shown in parentheses

Samples from mains and rivers were fairly similar in composition to each other while, as expected, the samples collected from the glasshouse roofs contained little dissolved salts. However, these samples had the highest mean zinc content at 0.4 mg/l with values of 0.3, 0.8 and 0.0 mg/l zinc in the three individual samples. Presumably galvanised fittings on the glasshouse roofs were responsible for the two samples containing zinc, or possibly zinc-based white paint. Only two of the nine samples of river water had any detectable zinc with values of 0.2 and 1.5 mg/l and a mean of 0.18 mg/l. Eighteen out of 34 samples from mains supplies contained no detectable zinc while the corresponding value for well supplies was 8 out of 24. Zinc is of particular significance in water for nutrient film growing as this is one of the elements that tends to become more concentrated in the circulating solution.

The present findings are similar to those found for different sources in the 1969 survey (5), with the exception of zinc which was not tested in the earlier survey.

Data for counties: Only data from Dublin North, Dublin South and County Meath can be compared; there were insufficient samples from other counties and the mean results could be greatly influenced by water source. However, data for the remaining counties are included for completeness (Table 2).

The results show that samples from Meath were hardest. The difference in the composition of water between North and South Dublin, found in the previous survey, was confirmed here with North Dublin having the harder water. The result was influenced by the fact that 8/27 samples came from wells in North Dublin compared with 0/8 in the South. However, the means for the 15 mains samples from North Dublin were still higher than those for the mains samples from South Dublin. This is due to the origin of the water, which comes from the mountain-fed reservoirs in the south and from limestone regions in the north. South Dublin samples also had relatively low zinc levels (Table 2).

Conductivity and hardness: Regressions were carried out on conductivity values versus total hardness and conductivity versus calcium content for the 77 samples tested. It should be noted that the samples were from a range of sources and varied widely in calcium content. The correlation coefficient was +0.90 for the former and +0.92 for the latter. The equations of the regression lines were as follows:

$$\text{Total hardness } (CaCO_3, \text{ mg/l}) = 16.86 + 0.372 \text{ conductivity } (\mu\text{mhos})$$

$$\text{Calcium (mg/l)} = -6.51 + 0.170 \text{ conductivity } (\mu\text{mhos})$$

These data suggest that for practical purposes the conductivity value is a reasonable index of total hardness or calcium content in natural water samples. The correlation coefficient between conductivity and calcium content agrees closely with that of +0.91 obtained in the previous survey (5).

TABLE 2: Mean values for the composition of water from the different counties

	Total hardness ($CaCO_3$, mg/l)	Conductivity (μmhos)	Ca	Mg	Na (mg/l)	Zn	pH
Dublin North (27)[a]							
Mean	198	460	69	9	21	0.32	7.6
SD	125	290	43	7	15	0.64	0.42
Dublin South (8)							
Mean	63	136	15	2	11	0.08	7.4
SD	19	39	10	1	2	0.10	0.24
Meath (9)							
Mean	262	619	101	14	19	0.37	7.6
SD	58	96	30	6	4	0.84	0.31
Kildare (4)							
Mean	185	440	83	8	14	0.40	7.3
SD	111	254	58	6	6	0.75	0.55
Monaghan (4)							
Mean	198	580	102	12	19	0.40	7.3
SD	100	270	55	8	6	0.67	0.60
Tipperary (3) (Mean)	81	140	22	2	12	0.16	7.1
Cork (3)	93	250	21	8	20	0.00	6.6
Waterford (3)	180	480	42	16	33	0.30	6.7
Wicklow (3)	99	290	40	15	18	0.50	7.2
Donegal (2)	48	140	11	3	18	0.10	6.8
Wexord (2)	103	270	29	8	20	0.50	7.5
Roscommon (1)	220	650	140	9	15	0.50	7.3
Clare (1)	72	150	19	2	13	0.00	7.0
Galway (1)	180	370	70	4	15	0.30	7.5
Louth (1)	450	1050	210	22	27	0.00	7.3
Limerick (1)	190	380	65	5	14	0.00	7.5
Kerry (1)	20	80	1	1	1	0.70	6.5
Offaly (1)	150	740	155	11	17	0.40	7.3
Cavan (1)	150	300	42	10	16	0.00	7.3

[a]The number of samples tested is shown in parentheses

Conclusions

The results indicate the wide variation in water composition within counties and from county to county. There were also large differences in the composition of the water from the different sources. These findings emphasise the necessity of testing each 'new' water source being used by growers in order to establish its composition. Rainwater collected from glasshouse roofs can be used for 'diluting' samples of well water which are very hard.

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