Water Quality

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INTRODUCTION

Good water quality is a must in container production and propagation. In Denmark, there has been, and still is, ample water resources available. However, the quality of this water can vary considerably even within a small district. Since 1970, I have advised over 200 nurseries on the use of their water resources.

ARTESIAN WATER

Artesian water is rain water that over time has percolated down to the artesian water level. It is illegal to use surface water from streams and lakes, and collected rainwater is only used to a lesser extend because of uncontrollable levels of contaminating substances. The majority of water used in nurseries is, therefore, Artesian well water.

Chemically pure water does not exist in nature since even rainwater has absorbed nitrogen, oxygen, carbon dioxide, sulphur, etc., with ions from costal regions such as chloride, sodium, and magnesium added in. Rain water on its way through the soil absorbs additional carbon dioxide from the soil. Additionally when water becomes a weak acid, it is able to solubilize calcium carbonate, sodium, manganese, etc., and these are carried along as the water moves downward through the soil.

Water Reserves. Denmark's yearly rainfall varies from 500 to 800 mm and supplies the artesian water reserves with between 1 and 4 million litre per ha. (Fig. 1). The flow of water and the possibilities for pumping artesian water are greatly influenced by the physical conditions of the soil.

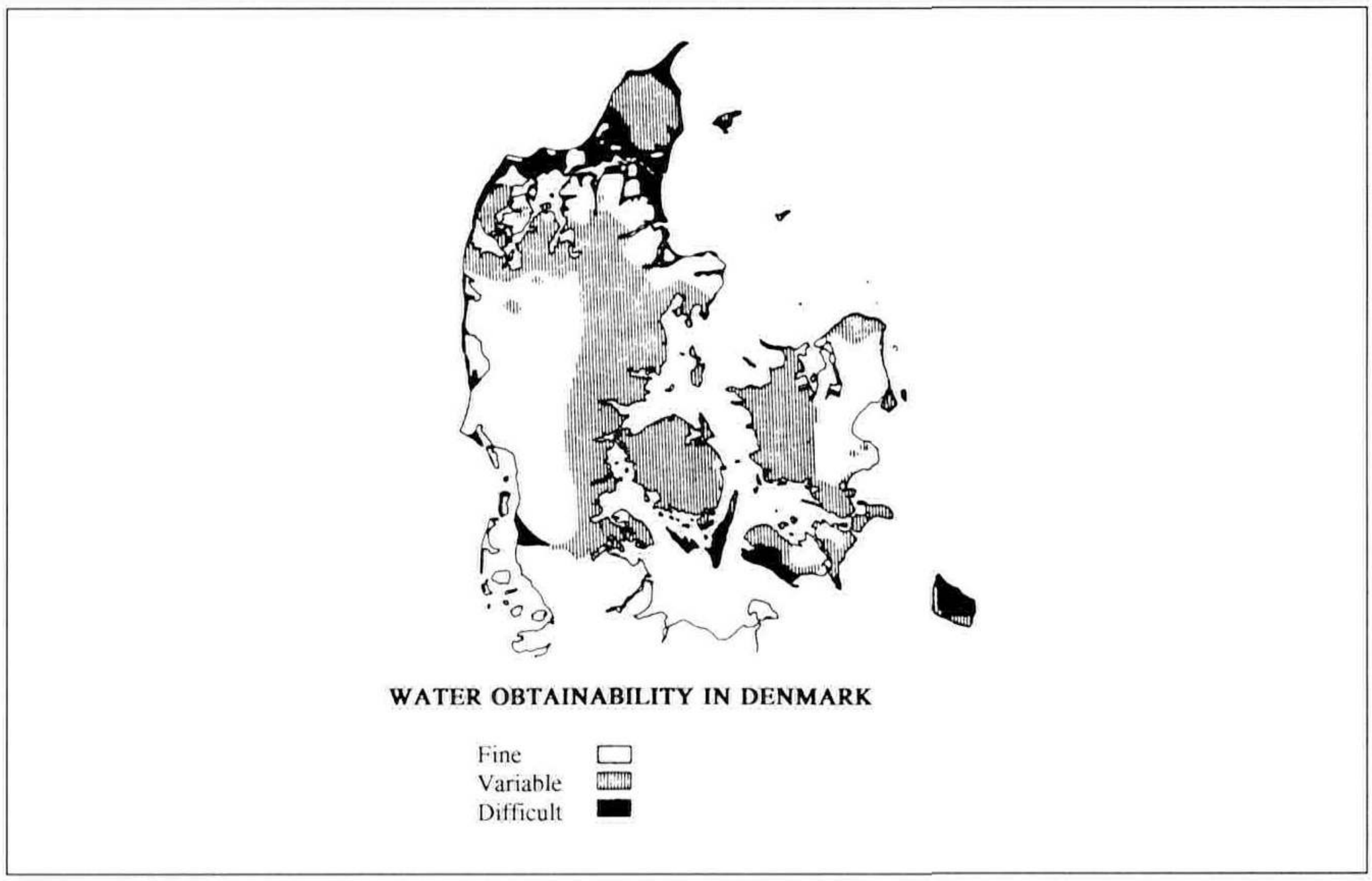

Figure 1. Water obtainability in Denmark.

Quality. Most of the ions dissolved in artesian water have a supplementary effect when liquid fertilizer is added. Calcium and magnesium, as well as micronutrients, are often present at high levels in addition to unwanted ions, such as chloride and sodium. Sodium bicarbonate functions as a buffer in the soil water, however, it can increase pH to a toxic level (Table 1, Nutrient location number 3). It is sometimes necessary to inject acid to reduce the pH. Table 1 shows examples of water quality at eight different locations in Denmark. Locations 4 and 7 have the best artesian water, whereas locations 1, 2, and 3 have a poor quality.

Water Analysis. Artesian water must be analyzed in order to optimize liquid fertilizer use. In the beginning, 25 years ago, water was analyzed by the same standards as drinking water. Today, supplementary analyses for boron, copper, zinc, and sometimes molybdenum are conducted. The composition of the added nutrient elements is determined in accordance with the water analyses, and pH is regulated by sulfuric acid, phosphoric acid, or nitric acid injection. The relationship between nitrate and ammonium nitrogen can also influence pH—nitrate increases pH, whereas ammonium causes pH to decrease during the growing period.

Water Purification. A high salt level in artesian water may cause growing disorders as well as technical problems. Ion exchange is widely used in laboratories, but is not used in nurseries. Reverse osmosis is the preferred method in nurseries. With reverse osmosis, water quality becomes equal to distilled water. Water treated by reverse osmosis is ideal for mist and fog propagation.

CONCLUSION

It is a must that water quality and mineral nutrition be optimized in an up-to-date production nursery. High quality water used in irrigation and ebb and flow systems is composed of artesian water supplemented with an optimal nutrient composition designed for the crop in production. Carbonates and pH may be controlled by acids, and the proportion between ammonia and nitrate will insure a stable pH during the growing period. When a nursery is able to control these parameters, water conservation and recycling will be a natural part of plant production.

Table 1. Comparison of artesian water quality in relation to a full nutrient solution. Levels of mineral nutrient is given as mg per litre (=ppm), pH, hydrogen carbonate, and chloride. ND = not determined.

Nutrient Location	N	K	Mg	Ca	Na	Fe	Mn	B	Cu	Zn	HCO_3	SO_4	Cl	$NaHCO_3$	pH
1. Amager	0	14	50	106	640	1.09	0	0 56	0.002	0.03	449	310	1108	0	7.8
2. East Zealand	0	6	92	280	43	8.00	0.14	0.07	0.12	0.22	433	604	72	0	7.5
3. Central Zealand	0	3	3	7	259	0.34	0	1.52	0.03	0.10	566	0	19	684	8 4
4. Central Fyn	0	2	10	78	17	0	0	0	0	0.06	210	49	40	0	7.6
5. Central Jylland	2	1	4	4	17	11.76	0	0.01	0.005	0.09	32	10	30	0	6.0
6. West Jylland	29	11	19	25	36	0.23	1.69	0.08	0.037	0.54	18	79	62	0	4.8
7. Hornum Exp.Sta.	0	0	5	47	9	1.00	0	0.02	0.005	0.15	154	0	16	0	7.6
8. Liq. nutrition	182	146	30	0	0	1.80	0.56	0.16	0.100	0.09	0	16	0	0	ND
9. Toxic level	ND	ND	100	150	50	5.00	1.00	0.25	0.20	0.25	>100	>100	50-100	100	ND