MEASURE AND MANAGE

Soiless Mixes, Testing and Nutrition Guidelines

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Greenhouse growth media, or soiless mixes, have chemical and physical properties which are distinctly different than field soils. These soiless mixes are made up of various combinations of soil, bark, perlite, vermiculite, polystyrene beads and peat mosses.

These soiless mixes have good moisture holding capacity and excellent aerations properties, but lack nutrient holding capacity. Management of a fertility program on this media is very important. Being knowledgeable about characteristics of soil mixes is prudent for good plant growth and management. Before using soiless mixes it is best to have them analysed for pH, total salts and available nutrients. Manufacturers of these soils maintain quality control programs, however, these products can be highly variable. Therefore, it is a good practice to analyse your particular soil in order to avoid costly mistakes later on. Agri-Food Laboratories offers a testing program for these soiless mixes utilizing the Saturated Media Extract (SME).

The concentration of essential nutrients around the root is critical to plant growth and depends greatly on the moisture holding capacity. This feature allows for a set of general fertilizer guidelines to be produced regardless of the bulk density because the water holding capacity determines nutrient availability.

Desirable pH and soluble salt concentration are two very important test parameters. Maximum plant growth can be achieved by adjusting the media nutrient levels before planting by considering the following guidelines:

Soil pH:

Media pH influences the availability and uptake of all plant nutrients. For most plants, a pH range of 5.6 – 5.8 is desirable. Most water sources in Ontario are alkaline with pH values above 7, some as high as 8.5. Watering media with this water will cause the pH to increase. A general rule is that after a three month period pH in the media may rise by 0.5 to 1 pH unit.

Adjusting pH is best done prior to planting. For acidic soils limestone is used to raise the pH. In a weakly buffered soil, 2 lbs of finely ground limestone per cubic yard may change the pH from 4.5 to 5.5, whereas 5 lbs may be required in a highly buffered soil. Perlite and polystyrene have little buffering capacity, while some peat, bark and clay mixes will have a much higher buffering capacity.

When adding lime it is best to use a small quantity of media and add the appropriate amount of limestone, moisten the sample and place in a plastic bag for two weeks. Re-test the pH at that time and make necessary adjustments based on the re-testing. Always use finely ground limestone (100 mesh). Coarser materials may take up to 6 months to react. Avoid builder's lime or hydrated lime as it is extremely fast acting, may cause bodily harm and toxicity to newly planted stock. Calcitic lime provides calcium whereas dolomitic provides both calcium and magnesium.

High pH media should be avoided as it is much more difficult to lower the pH than to raise it. However, the use of acid forming fertilizer in a continuous feed irrigation system may, over time, lower the pH. Avoid using large quantities of ammonia base fertilizers after liming, otherwise a rapid release of ammonia may burn foliage.

Soluble Salts:

Soluble ions or nutrients such as nitrate nitrogen, ammonium nitrogen, potassium, calcium, magnesium, chlorides, sulphates and sodium contribute to the soluble salts reading. Total soluble salt content is determined in solution by using a solu-bridge meter and expressed as millisiemens (mS). To convert total salts to parts per million, multiply the reading by 640.

Mixing Fertilizer into a media will cause the soluble salt level to increase. Generally, one pound of soluble fertilizer mixed into a cubic yard of media will increase the soluble salt reading 1.0 mS. Soluble salt build-up can be minimized by watering to cause some leaching. Extremely high levels of salt (4.0 mS) may require an extended leaching period. Opinions vary on how much water to use and how often. It is generally thought that one prolonged soaking is beneficial as it reduces the chances of destroying soil structure.

Soluble salt guidelines for greenhouse growth media using various media to water ratios.

SOLU-BRIDGE READING

Saturation Extract	1 part media to 1 parts water	1 part media to 5 parts water	Comments
0 – 0.74	**0 – 0.25**	**0 – 0.12**	Very low salt levels. Indicates very low nutrient status.
0.75 – 1.99	**0.25 – 0.75**	**0.12 – 0.35**	Suitable range for seedlings and salt sensitive plants.
2.0 – 3.49	**0.75 – 1.25**	**0.35 – 0.65**	Desirable range for most established plants. Upper range may reduce growth of some sensitive plants.
3.50 – 5.00	**1.25 – 1.75**	**0.65 – 0.90**	Slightly higher than desirable. Loss of vigour in upper range. Acceptable for high nutrient requiring plants.
5.00 – 6.00	**1.75 – 2.25**	**0.90 – 1.10**	Reduced growth and vigour. Wilting and marginal leaf burn.
6.00 +	**2.25 +**	**1.10 +**	Severe salt injury symptoms with likely crop failure.

Nitrate Nitrogen:

Plants deficient in nitrogen become pale green to yellow in the lower leaves. Optimum N rates vary with plant age, desired growth, species and light conditions. Nitrogen leaches quite readily and may require constant monitoring.

Desirable nitrate-nitrogen concentration in a greenhouse growth medium saturation extract:

	ppm NO_3-N in extract
Seedlings	40 –70
Young pot and foliage plants	50 –90
Pot and bedding plants—growing on	80 –160
Roses, mums, snapdragons, in ground or raised beds	120 –200
Lettuce and tomatoes in ground beds	125 –225
Celery transplants	75 –125

Nitrogen Fertilizer needed to increase the nitrate level in the saturation extract 10 ppm N:

Nitrogen carrier	N Content	To increase test level 10 ppm use:		
	%	Oz/bu	Oz/cu yd	Oz/100 sq ft
Potassium Nitrate	13	0.12	2.3	4.6
Calcium Nitrate	15	0.10	2.0	4.0
Ammonium Nitrate	33	0.45	0.9	1.8
Urea	45	0.35	0.7	1.4

Phosphorus:

Adequate P is required for good root development and flower quality. Deficient plants exhibit slow growth in roots and tops. In severe cases of P deficiency the foliage may display a purple colour. Phosphorus does not leach readily, however, some fibrous peat mixes can lose considerable amounts as high as 30%.

Plants grown in cool (45ºF –50ºF) areas may exhibit P deficiency even with adequate P available. This deficiency is due to low temperatures which inhibit root growth. Raising temperatures 5 degrees Fahrenheit will enable the plant to grow out of this condition more easily than adding additional P. Excessive fertilization combined with high pH values may reduce the availability of micronutrients.

Desirable phosphorus concentrations in greenhouse growth media saturation extracts:

	ppm P in extract
Seedlings	5 –9
Bedding and pot plants	6 –10
Lettuce and tomatoes in ground beds	10 –15
Roses, mums, snapdragons, in ground or raised beds	10 –15
Azaleas	7 –12
Celery transplants	10 –15

Phosphorus fertilizer needed to increase the phosphorus level in the saturation extract 2 ppm P:

Phosphorus carrier	P_2O_5 Content	To increase test level 2 ppm use:		
	%	oz/bu	lb/cu yd	lb/100 sq ft
Normal superphosphate	20	0.72	0.90	1.8
Concentrated superphosphate	46	0.33	0.40	0.8
Bone Meal	25	0.60	0.75	1.5

Potassium:

Potassium is the nutrient which is often overlooked. Deficient plants show a marginal yellow or chlorosis in the older leaves. Many plants have potassium requirements equal to or greater than nitrogen. Demand for potassium is greatest during the plant's vegetative development.

Desirable potassium concentrations in greenhouse media saturation extracts:

	ppm K in extract
Seedlings	100 –175
Bedding plants	150 –225
Pot plants	175 –250
Lettuce and tomatoes in ground beds	200 –300
Roses, mums, snapdragons, in ground or raised beds	200 –275
Azaleas	125 –200
Celery transplants	250 –300

Potassium fertilizer needed to increase the potassium level in the saturation extract 25 ppm:

Potassium carrier	K_2O Content	To increase test level 25 ppm use:		
	%	oz/bu	oz/cu yd	lb/100 sq ft
Potassium Nitrate	44	0.19	3.75	0.46
Potassium Sulfate	50	0.16	3.25	0.40
20-20-20	20	0.41	8.25	1.03

Calcium:

Availability of calcium for uptake is dependant upon pH and other cations present such as magnesium and potassium. Calcium deficiency shows as abnormal growth or death of the growing point.

Calcium carriers to increase the calcium level in the saturation extract 25 ppm:

Calcium carrier	Ca Content	To increase test level 25 ppm use:		
	%	oz/bu	oz/cu yd	lb/100 sq ft
Calcitic lime	30 –34	0.21	4.2	0.53
Dolomitic lime	20 –24	0.30	6.0	0.75
Calcium Sulphate	23	0.29	5.8	0.75

Calcium Nitrate	19	0.35	7.0	0.88
Normal superphosphate	20	0.33	6.7	0.84
Concentrated superphosphate	13	0.51	10.2	1.28

Magnesium:

Availability of magnesium is similar to calcium. Dolomitic limestone is a good source of magnesium if pH adjustment is needed. Epsom salts is also a good source of magnesium if pH adjustment is not needed. Magnesium is involved with phosphorus uptake and allocation with the plant. Magnesium shortages often mimic phosphorus deficiency.

NUTRIENT BALANCE

Potassium, magnesium and calcium compete for similar uptake sites at plant root surfaces. Increasing one cation in relation to others will subsequently lower the availability of the remaining cations. Similarly, a high sodium level will also lower the availability of potassium, magnesium and calcium. Therefore, balance as well as level of nutrients is critical for maximum uptake.

The following table expresses the balance as a percent of total soluble salt concentration. Plant growth is better with balanced nutrition even at low fertility levels. High soluble salt readings are better tolerated by plants in a balanced nutrient situation.

Desirable nutrient balance in saturation extract:

Nutrient	% of total soluble salt
Nitrate –N	8 –10
Ammonium –N	Less than 3
Potassium	11 –13
Calcium	14 –16
Magnesium	4 –6
Sodium	Less than 10
Chloride	Less than 10

MICRONUTRIENTS

Micronutrients are essential nutrients required in small quantities. Most soiless mixes are low in micronutrients. All micronutrients, with the exception of molybdenum, become less available as the pH rises. Therefore, to prevent deficiencies maintain, pH at or below 6 as well as assuring an adequate supply. The following table lists the suggested micronutrients and rates.

Suggested general micronutrient formulation to mix into stock growth media:

Compound	Quantity to use per cu yd.
Iron chelate (6% iron)	1.0 oz
Manganous sulphate	1.0 oz
Copper sulphate	0.3 oz
Zinc sulphate	0.2 oz
Sodium borate (borax)	0.1 oz
Sodium molydbate	0.03 oz