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PLANT SCIENCES

Cornell Peat-Lite Mixes For Commercial Plant Growing

by James W. Boodley and Raymond Sheldrake, Jr.

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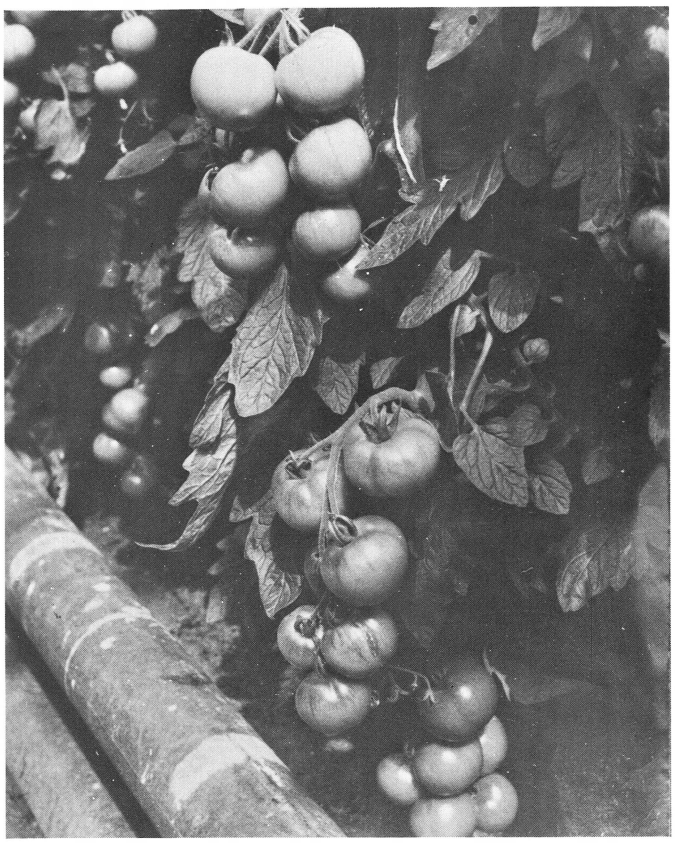


Commercial crops of greenhouse tomatoes growing in peat-lite mix.

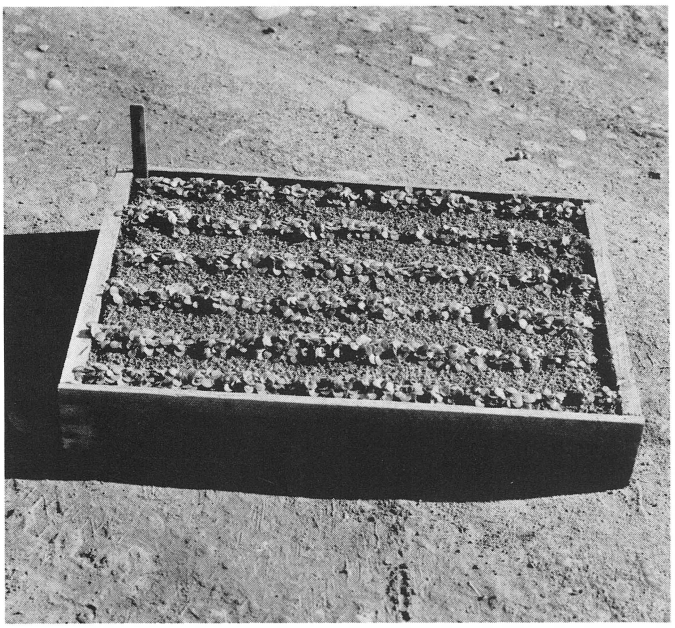
Good topsoil is becoming increasingly difficult to find. The nutrient content, drainage characteristics, and disease organism and weed seed content of topsoil are often difficult to determine. Unless topsoil is sterilized before it is used, poor crop growth may result.

Artificial soils, on the other hand, offer the grower several advantages. Two basic artificial soil mixes, referred to as peat-lite mixes, have been developed through research at Cornell. Basically composed of sphagnum peat moss and horticultural vermiculite or perlite, peat-lite mixes are readily available, easy to handle, and produce uniform plant growth from year to year. Sterilization of peat-lite mixes is usually unnecessary if reasonable care is taken during mixing and handling. Nutrients are added according to a formula for controlled nutrition of crops from planting to selling. The cost of peat-lite mixes compares favorably with that of properly prepared soil mixes.

Developed primarily as a medium for starting flower and vegetable transplants, the versatility of the mixes has enabled growers to use them in other areas where controlled plant growth is desired. Many types of plants have performed well in the peat-lite mix.

The authors are members of the faculty of the New York State College of Agriculture and Life Sciences. Dr. Boodley is a professor in and chairman of the Department of Floriculture and Ornamental Horticulture. Dr. Sheldrake is a professor in the Department of Vegetable Crops.

Plants grow very well in all kind of containers with the peat-lite mix.



The mix has done an outstanding job of producing seedlings of all kinds.

Components of Artificial Soils

Sphagnum peat moss: Medium to fine horticultural-type imported sphagnum peat moss is preferred to domestic peats. Domestic peat mosses frequently contain large quantities of nutrients or other materials in unknown amounts and are usually too decomposed to provide the desired structural and water drainage characteristics. When used directly from the bale, sphagnum peat moss is usually free of most disease organisms and weed seeds. Baled peat moss may need to be shredded if the bale is hard and dry. Upon shredding, compressed bales of 7.5 cubic feet will yield about 17 cubic feet of peat moss. Polyethylene-bound bales of 6 cubic feet will yield about 9 to 10 cubic feet of peat moss when shredded. Growers should determine the expansion ratio for their peat.

Vermiculite: Vermiculite, a micaceous material that has been heated to approximately 1800°F., is sterile and has a bulk density of 6 to 8 pounds per cubic foot. The unique platelike structure of vermiculite enables it to hold and release large quantities of water and minerals for plant growth. Vermiculite has a relatively high cation exchange capacity which results in good buffering characteristics that resist rapid changes in pH and permits the use of somewhat higher fertility levels without plant damage.

Vermiculite contains some potassium and magnesium. An application of calcium is recommended. Calcium is supplied in the form of limestone and superphosphate to bring the pH of the mixture into the proper range as well as to supply the necessary phosphorus.

Only horticultural grade vermiculite should be used for plant growing since the less rigorous quality control used with construction grades may not exclude toxic contaminants.

Most of the domestic vermiculite ore comes from mines in Montana and South Carolina. Four sizes are available ranging from the large pea size, number 1, to the finer grade, number 4. For horticultural purposes, sizes 2, 3, and 4 have been satisfactory.

Perlite: Perlite is a form of volcanic rock that has expanded during heating to 1800°F. It is sterile and has a pH of 7.0 to 7.5 and a bulk density of 6 to 9 pounds per cubic foot. Unlike vermiculite, perlite has no cation exchange capacity or buffering capacity. (It contains sodium and aluminum in appreciable amounts that can be extracted by growing plants.) Perlite does not decay or deteriorate except through physical destruction. It holds water on its irregular surface areas.

Preparation of Mixes

Thorough mixing of the components is very important to success with the peat-lite mixes. Small quantities can be mixed efficiently in a home concrete mixer but a large concrete mixer, such as a transit-mix truck or other large blender is necessary for rapid uniform preparation of large quantities. When mechanical mixers are used, shredded peat moss can be uniformly distributed throughout the other components in 5 minutes or less. If mixed by hand with shovels, the components should be turned a sufficient number of times to ensure thorough mixing.

TABLE 1. Components for Producing the Peat-Lite Mixes

Mixture	Sphagnum Peat (cu yd[1])	Hort. Vermiculite (cu yd)	Hort. Perlite (cu yd)	Ground Limestone (lbs)	Super-Phosphate 0-20-0 (lbs)	Calcium or Potassium Nitrate (lbs)	Fritted Trace Elements (ozs)	Iron Sulfate (ozs)	10-10-10 Fert. (lbs)	Osmocote 14-14-14 18-9-9 18-6-12	Mag-Amp (lbs)	Douglas Fir Bark Fine Grind 1/8-1/2" (cu yd)	Wetting Agent (ozs)
1. Peat-lite Mix A for seedlings or bedding plants	0.5	0.5		5	1–2	1	2	—	—	—	—		3
2. Peat-lite Mix A for greenhouse tomatoes with liquid feed	0.5	0.5		10	2.5	1.5	2						3
3. Peat-lite Mix A for greenhouse tomatoes (no liquid feed)	0.5	0.5		10	2.5	1.5	2			10	5		3
4. Peat-lite Mix A for pot plants with slow release	0.5	0.5		10	1.0	1.5	2			5	5		3
5. Peat-lite Mix A with farm fertilizer	0.5	0.5		5					5				3
6. Peat-lite Mix B	0.5		0.5	5	2	1.5 K-nitrate	2						3
7. Peat-lite Mix B with farm fertilizer	0.5		0.5	5					8				3
8. Cornell Foliage[2] Plant Mix	0.5	0.25	0.25	8	2	1.0 K-nitrate	2[y]	0.75	2.5				3
9. Cornell Epiphytic[2] Mix	0.33		0.33	7	4.0	1.0 K-nitrate	2[y]	0.50	2.5			0.33	3

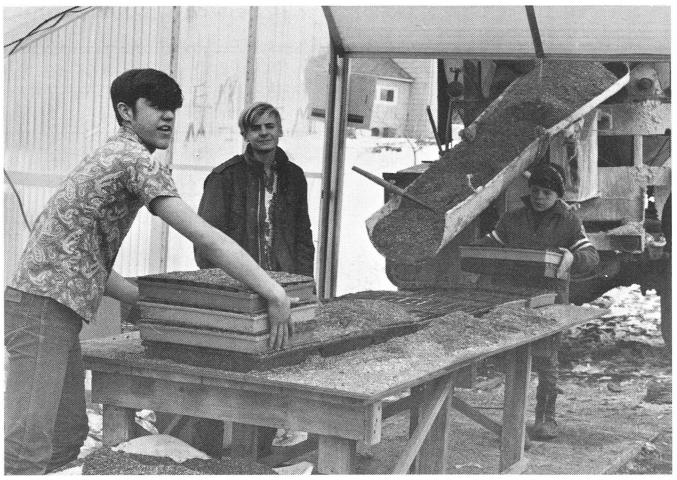
[1] One cubic yard equals 27 cubic feet or 22 bushels. However, 15 to 20 percent shrinkage occurs in mixing and for 1 full yard of mix use an additional 4 bushels. To obtain 1 full yard of mix use 26 bushels.
[2] Developed by Russell C. Mott of the L. H. Bailey Hortorium, Cornell University.

If the peat moss is very dry, 1 gallon of warm water for every 2 bushels of medium-grade moss will help to keep the dust down and will permit easier wetting and handling. By reducing the surface tension of the water, wetting agents speed its movement and reduce the amount of water required to wet the peat-lite mix (Table 2). They also aid in future wetting of the mixes during growth. Three ounces of non-ionic wetting agent in 5 to 10 gallons of water facilitates the wetting of 1 cubic yard of the mix. Another good technique is to blend 3 ounces of the wetting agent in 1 quart of vermiculite and then add 1 quart of this granular formulation to each cubic yard of mix.

The basic peat-lite mixes differ slightly in composition. Peat-lite mix A is a combination of 50 percent (by volume) sphagnum peat moss and 50 percent horticultural grade vermiculite (2, 3, or 4). Mix B is composed of sphagnum peat moss and horticultural perlite in the same proportions. Both mixes have been successfully tested at Cornell and used by many plant growers throughout New York State. It is suggested that growers first use the mixes on a trial basis to become familiar with growth responses to this method of culture. Plant growers who have never used the mix should try the first formulation listed in Table 1. Combinations for other purposes are also given in Table 1.

Although only 10–10–10 fertilizer is listed (in Mixes 5, 7, 8, and 9) others such as 6–12–6 or 5–10–10 may be used in the same amounts. In some instances in which ammonium sulfate was the principal source of nitrogen in these low analysis fertilizers, ammonium toxicity has

When using large quantities, a good mechanical mixer is essential for proper blending of the ingredients.



The discharge chute of the mixer can be used for rapid filling of packs and flats.

developed. Plant growth has been satisfactory when nitrate nitrogen furnished at least 50 percent of the total nitrogen supply.

Certain fertilizers can be added when a longer-lasting effect is desired. The materials listed in Table 3 should be used at the rates given.

The fertilizer should be added uniformly to the mix. If hand turning is done, spread the materials on a clean surface and sprinkle the limestone and fertilizer evenly over the pile. Turn with a large scoop. After all the ingredients have been added the pile should be turned about 5 times to ensure thorough mixing. For mechanical mixers, a 3 to 5 minute agitation will give thorough mixing.

Sanitation in Mixing: Although the mixtures are essentially sterile, they can be contaminated. When mixing, storing, and handling artificial soils, growers should take precautions against contaminating them with disease organisms contained in soil or other debris. All tools, containers, and mixing areas should be washed with a disinfectant or should be steam sterilized. A good disinfectant for floors, tools, or mixing equipment can be prepared by using 1 gallon of clorox in 10 gallons of water. These mixes can be steam sterilized if desired before use and can be reused if steamed.

Planting Procedure

The mixes can be stored indefinitely without developing phytotoxic conditions. If a mix is to be stored, add additional water and cover the pile with plastic to retain the moisture. Small quantities keep well in covered plastic garbage cans or large plastic bags.

At the time of use, the following procedure should be used.

1. Fill the containers to be planted.
2. Firm the medium, particularly the edges.
3. If the mix is dry, wet it thoroughly.
4. After transplanting, water the plants.
5. Keep the containers moist until the plants are established and then water as needed. Avoid excessive applications of water during extremely dark weather.

Handling After Transplanting

The same temperature control, ventilation, and generally good growing conditions should be maintained for plants in peat-lite mixes as for soil-grown crops. Fertilization procedures may be handled differently.

When long-lasting sources of nutrients are used for bedding plants, no further feeding is necessary after planting. Where 6–12–6, 10–10–10, or potassium or calcium nitrate is used, feeding should begin 3 weeks after planting, but the period before feeding begins will depend largely on the frequency of watering. Plant appearance and soil tests are useful indicators of the need for fertilizers. No extra feeding will be needed for seedling flats. Plants such as mums, poinsettias, and greenhouse tomatoes should be fed immediately after potting or benching.

Fertilizers will leach from peat and perlite mixtures faster than from peat and vermiculite. Therefore, plants grown in Mix B may require more frequent applications or higher concentrations of fertilizer. To feed at every watering with a proportioner, follow the data given in Table 4 for the necessary dilution amounts. This method is highly recommended.

Certain crops may require special fertilizer additions, but using fritted trace elements (FTE) as recommended should adequately supply the majority of crops that are started in the mixes. Should iron chlorosis develop, it can be corrected by an application of chelated iron (6 to 10 percent Fe) at the rate of .5 teaspoonful per gallon of water applied as a spray to the foliage. If the problem persists repeat the application in 10 days.

TABLE 2. Chemicals, Source, and Rates of Use for Various Wetting Agents[1]

Chemical	*Source*	*Percent Active*	*Rate/Yard*[2] *(ozs)*
Aqua Gro	Aquatrols Corp. of America Box 385 Delair, New Jersey 08110	100%	3
Ethomid 0/15	Armour Ind. Chemical Co. 401 North Wabash Avenue Chicago, Illinois	100	3
Gafac PE 510	General Aniline & Film Co. 104 West 51st Street New York, New York	100	3
Hallco CPH 123	C. P. Hall Company 5145 West 65th Street Chicago, Illinois	100	3
Neutronyx 600	Onyx Chemical Company 190 Warren Street Jersey City, New Jersey	100	3
Hydro-Wet (L 237)	Colloidal Products P. O. Box 621 Petaluma, California	87.5	3
Super Soaker	Western Peat P. O. Box 3006 Houston, Texas 77001	100	3
Tetronic 908	Wyandotte, Chemical Co. Wyandotte, Michigan	100	3
Triton B-1956	Rohm & Haas Company Independence Mall W. Philadelphia, Pennsylvania	77	3

1 No endorsement of products is intended, nor is criticism of unnamed products implied.
2 The simplest way to add wetting agents is in the granular formulation. See p 4 for method. If used as a liquid, dilute the 3 ounces in 5 to 10 gallons of water and add to the mix. To wet dry mixes after preparation use a drench of 1 pint per 100 gallons. This is equivalent to about 1 teaspoonful per gallon for small amounts.

Timing the Crops

When bedding plants are grown in peat-lite mixes, the timing schedule must be changed because the plants will reach a salable size in minimum time.

For most annual plants experience has shown that 5 weeks is the maximum amount of time needed between transplanting and sales when the crops are properly fertilized and grown at a minimum night temperature of 60°F. Maturity can be delayed somewhat by keeping the plants cooler than 60°F after they have become established.

Applications of growth retardants have helped to produce compact plants; however, plants in peat-lite mixes require stronger dosages or more frequent applications than are recommended for soil-grown plants to obtain the same effects. To gain experience, growers should first use the media for their final crops of the bedding plant season. ALAR or B-Nine used at 2,500–5,000 ppm (0.25 to 0.50 percent) once or twice as a spray has proven effective and safe on most bedding plants grown in the mix. Read the manufacturer's label for a list of plants on which the product can be safely used.

Media Cost

Cost comparisons were calculated on the basis of a single unit purchased at retail prices effective when this bulletin was being prepared: a 6-cubic-foot compressed bale of peat moss cost $4.50, and a 6-cubic-foot bag of either vermiculite or perlite cost $4.30. Volume lot purchases of any of these materials could substantially reduce the cost. Table 5 shows the cost of various materials on both a cubic yard and an individual pack basis. Although the cost of fertilizer is not included, it would amount to less than one-tenth of one cent per pack or about 50 cents per cubic yard.

Potted Crops

In addition to bedding plant production, peat-lite mixes have been used successfully to produce potted chrysanthemums, geraniums, African violets, poinsettias, gloxinias, begonias, foliage plants, and orchids. In fact, all plants can be produced in peat-lite mixes.

Potted Bulbs for Easter

Both mixes have been successfully used in forcing tulips, hyacinths, and daffodils for Easter sales. The only fertilizer added for bulbs has been ground limestone at the recommended rate of 5 pounds per cubic yard because the bulb contains an adequate supply of other nutrients to complete growth. If the mix appears to be too lightweight, clean sand can be added. A mixture 1:1:1 by volume of peat moss, vermiculite, and sand will add enough weight to prevent the pots from tipping. (Even less sand may be needed. Sand weighs about 100 pounds per cubic foot.)

Through experimentation, a combination by volume of 2:1:1, peat moss, vermiculite, and perlite has been found to produce the best growth in lilies being forced for Easter. Both calcium and dolomitic limestone were added at a rate of 5.5 pounds each per cubic yard of mix. Twenty-two ounces of ammonium nitrate were added also. A regular feeding program was started as soon as shoot tips emerged from the medium. It is recommended that lilies be grown in clay pots for greater stability or that a small amount of clean sand be added to the mix for greater weight.

Poinsettias

Poinsettias grow well in both mixes. If additional weight is desired use 15 to 20 percent sand. The sand should be steam sterilized since it could be infested with root-rot organisms. Use constant liquid feeding with 16 ounces of calcium nitrate, 8 ounces of potassium nitrate, and 2 ounces of ammonium nitrate per 100 gallons of water (approximately 320 ppm N, 220 ppm K, and 250 ppm Ca).

Steaming and Storage

As discussed earlier, one of the prime advantages of the peat-lite mixes is that they do not require steaming. However, they can be steam sterilized if a specific condition demands. If the mix is to be steam sterilized, do not add slow release fertilizer until after steaming.

The basic mixes can be stored indefinitely with no harmful effects. If the moisture is relatively low they can be stored even if they contain slow release fertilizers. However, since the release factor on some slow release types is a function of moisture and temperature, storage is a questionable practice. Mixes containing Osmocote® should

TABLE 3. Long-Lasting Forms of Fertilizers[1] (Add only one)

Material	*For 1 Cubic Yard*	*For 2 Bushels*
Osmocote 14–14–14 or 18–9–9	5 lbs	3.8 oz
Nitroform	2 lbs	1.5 oz
Uramite	2 lbs	1.5 oz
Bordens 38	2 lbs	1.5 oz
Urea	1 lb	0.75 oz
MagAmp (7–40–6) (medium particle size)	5–10 lbs	7.5 oz
Peters (14–7–7)	5 lbs	3.8 oz
Scotts (23–7–7)	3 lbs	2.3 oz

[1] No endorsement of products is intended nor is criticism of unnamed products implied.

TABLE 4. Amounts of Fertilizer to Make Stock Solutions for Dilution Ratios 1:12 (Hozon), 1:100, and 1:200 to Provide Approximately 200 ppm Actual Nitrogen to the Crop

Nitrogen Content of Fertilizer (%)	*Ounces per Gallon of Concentrate*		
	1:12 (Hozon)	*1:100*	*1:200*
12	2.8	22.6	45.0
13	2.6	20.8	41.6
14 (potassium nitrate)	2.4	19.3	38.6
15 (calcium nitrate)	2.2	18.0	36.0
17	2.0	15.9	31.8
18	1.8	15.0	30.0
19	1.8	14.2	28.4
20 (ammonium sulfate)	1.6	13.5	27.0
21	1.6	12.9	25.8
22	1.4	12.3	24.6
23 (23–0–23)[1]	1.4	11.7	23.4
24	1.4	11.3	22.6
25 (25–10–10)	1.2	10.8	21.6
33.5 (ammonium nitrate)	1.0	8.1	16.2
44–46 (urea)	0.4	6.0	12.0

[1] Prepared by using 50 percent by weight ammonium nitrate and 50 percent by weight potassium nitrate.

TABLE 5. Comparative Costs of Peat-Lite Combinations Based on Retail Prices for Single Units of Ingredients

Medium	*Cost per Cubic Foot*	*Cost per Pack*[1]	*Cost per Cubic Yard (No Fertilizer)*
A. Peat Moss	.32	.033	—
B. Vermiculite	.66	.033	$16.80
C. Perlite	.66	.033	16.80

[1] Market Pak #42; 500 packs per yard.

Poinsettias flourish in the peat-lite mix.

not be stored longer than 7 to 10 days unless the storage temperature is 40°F or lower.

Greenhouse Tomatoes

Excellent crops of greenhouse tomatoes can be grown in peat-lite mixes. Use the mix recommended in Table 1. It is essential to include trace elements. Tomatoes should be placed on a regular feeding schedule immediately after planting.*

* See Cornell Vegetable Crops Mimeo 49, "Production of Greenhouse Tomatoes in Ring and Trough Culture" by R. Sheldrake, Jr. and Stewart Dallyn.

Tropical Plants

Two modifications of the original peat-lite mixes have been formulated for growing tropical plants by Russell C. Mott, Experimentalist in the Bailey Hortorium. The Cornell Foliage Plant Mix and the Cornell Epiphytic Mix are especially adapted for their respective plant types. Their formulas are given in Table 1. The foliage plant mix is recommended for plants having fine root systems that do best at high moisture levels (palms, ferns, begonias, pelargonium, and similar plants).

The epiphytic mix is for plants that usually grow on other plants for support (philodendron, peperomia, crassulas). Such plants require excellent drainage and can withstand dry conditions between waterings. The epiphytic mix achieves these conditions through replacement of part of the sphagnum peat moss with Douglas fir bark.

Fir bark is the ground bark of the Douglas fir which is screened to a definite size. Finely ground fir bark has a dry weight of 11.5 pounds per cubic foot. Fresh bark has a pH of about 5.0. Upon weathering it becomes slightly more alkaline. The bark contains some nutrients, but these will not adequately meet the requirements of growing plants.

Bench Crops

Trials with cut chrysanthemums, snapdragons, carnations, and roses have shown the mixes to be a good growing medium. Generally a 2 peat:1 perlite:1 vermiculite combination has been most satisfactory. Fertilizers are added according to Table 1. The trace element mix must be added for crops to be grown longer than 3 months. Liquid feedings should be scheduled as they would be for soil-grown cut flower crops.

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