COMPARISON STUDIES OF BEDDING PLANTS GROWN IN BLACK PEAT VS. SPHAGNUM MOSS PEAT AND PERLITE VS. HAYDITE AGGREGATES

by

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INTRODUCTION

High quality bedding plant production depends upon a good growing medium that has proper aeration, good physical and chemical properties and is essentially disease-free. One of the more common mediums is a soil, organic material, and aggregate mixture.

Although many organic materials are available, sphagnum moss peats are most widely used. Since sphagnum moss peat is becoming scarce, Kansas bedding plant producers may have to find an alternate source of organic amendment. Domestic black peats may be a satisfactory substitute.

Aggregates used in greenhouse soil mixes range from inexpensive sharp sand and gravel to moderately expensive perlite, vermiculite, or calcined clays. Haydite is a reasonably priced calcined clay produced in Kansas that may be used as a substitute for perlite or other aggregates.

A 1:1:1 soil, peat, and aggregate mixture was used to compare all possible combinations of black peat, sphagnum moss peat, haydite, and perlite. Tomato, salvia, petunia, pepper, and ageratum seedlings were grown in the four mediums and were evaluated according to height, stem diameter, bloom date, and dry weight. Nutrient content, physical properties, and pH of the media were measured during the growing period.

LITERATURE REVIEW

Components of satisfactory bedding plant mediums fall into three categories: soil, organic matter, and coarse aggregate (12). The soil mixture recommendation by Penn State University on a volume basis for heavy soils (clay loam) is 1:1:1 soil, organic matter, and aggregate. For medium soils (silty loam), it is 2:1:1 soil, organic matter and aggregate and for light soils (sandy loam), it is 3:1:1 soil, organic matter, and aggregate. Tayama (11) states that soil, clay, silt, sand, or loam may be used satisfactorily as a bedding plant medium if corrected with amendments of organic matter such as peat, and aggregates such as perlite or calcined clay.

Numerous aggregates are available to the greenhouse growers today. Perlite is a volcanic rock product made by heating to 1800^{O}F. The exploded, porous material weighs 6 to 9 pounds per cubic foot and will absorb 3 to 4 times its weight in water. The calcined clays ('Turface,' 'TerraGreen,' and 'Arcillite') are aggregates used to improve the aeration of a medium. They are baked montmorillonite clays that are porous with good nutrient holding ability. The baked clay particles are highly resistant to breakdown (11). White (12) points out that calcined clay does not float to the surface of the medium as does perlite.

Among the various organic amendments available, sphagnum moss peat has excellent nutrient and water holding capacity (1,6). Sphagnum moss peat has many chemical and physical advantages over other organic materials. It is uniform, stable to steam and fumigation, is easily mixed, has good aeration, and is adaptable to a wide range of plants with only minor modifications (1).

Peat ranges in color from light brown to black by progressive states of decomposition. Sphagnum moss peat, oven-dried, can absorb 20 to 30 times its weight in water as reported by Lucas (9). Peats are naturally low in micronutrients. Sphagnum moss contains 0.6 to 1.4% Nitrogen. Baled peat may contain from 21 to 49% water as reported by a U.S.D.A. survey (9).

The pH of peat is controlled by the colloidal complex. The colloidal complex saturated with H^+ ions will develop a lower pH than a similarly charged acid mineral soil. Peats contain high quantities of calcium because of the highly absorptive nature of peat and the abundance of calcium in water entering the swamps by seepage. Peats show exceedingly vigorous nitrification because of the high nitrogen to carbon ratio which is conducive to microbial activity. Phosphorus and potassium content is exceddingly low in peat soils (8).

When soil is difficult to obtain, several soil-less media might be used. The recommended University of California media for bedding plants is a 3 parts sand to 1 part sphagnum moss peat mixture. The fine sand was chosen for its good aeration and drainage properties (1).

Boodley and Scheldrake (4, 5) reported that a problem with the U. C. Mix is an unavailability of useable fine sand and an excessive weight of 90 pounds per cubic foot as compared to vermiculite or perlite at 6 to 8 pounds per cubic foot. In the mid-west problems may occur with peat-lite mix due to high alkaline water which increases the pH of the medium too high for plant growth. Availability of good uniform soils free from pesticide residue is scarce. Cost of many amendments is increasing along with equipment and labor for mixing soils. Peat-lite mixes support consistant high quality crops, are light in weight, and have a high water holding capacity. This decreases the number of watering applications and increases shelf life of bedding plants.

Knavel (7) reported that tomato transplants grown in peat-Turface mixtures were superior to those grown in peat-perlite mixes. Peat-Turface grown plants were taller and heavier, producing both higher and earlier yields than the peat-perlite mixes. Knavel found that the difference in texture, structure, and initial nutrient content was probably responsible for the different response by plants in the two media. He stated that the lattice effect or plate-like structure of Turface would form a more compact medium while perlite having a more spherical form compacts less.

Ball (2) states that many bedding plant growers still use equal parts of soil, peat and perlite, but there is a trend toward soil-less mediums. Bedding plant mixes vary greatly across the United States with peat as the major organic component. Other amendments often used include vermiculite, perlite, hypnum peat, sawdust, and sand.

For growers turning toward commercially prepared soil-less mixtures, White (12) recommends the 'U. C. Mix' or the 'Peat-Lite' mixes.

Dr. Boodley (4) states that,

> "The mixes were developed to fill a need for the commercial horticulturist. They are not a panacea for all cultural problems. They are not destined to result in the elimination of soil as a growing media. They will not make a poor grower a good grower. It has been shown both commercially and research-wise that they have a definite place in the horticulture industry."

Ball (3) states the trend in bedding plants is toward the faster crop. Petunias in peat, vermiculite, fertilizer, (commercial peat-lite mixes) grow more uniformly and faster. A savings of 20% of the time from transplant to sales can be gained with peat-lite mixes. In a survey of six growers, cost was $32.00 per cubic yard for a 1:1:1 sterilized, ready-to-use soil mixture which is close to the cost for commercial peat-lite mixes.

The objectives of this thesis were to determine if black domestic peat and haydite were substitutable for sphagnum moss peat and perlite respectively, for bedding plant production. Seedling bedding plants were evaluated in the peats and aggregates with equal parts of silty clay loam.

Results of this study were written in manuscript form to be submitted for publication in the Florists' Review.

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COMPARISON STUDIES OF BEDDING PLANTS GROWN IN BLACK PEAT VS. SPHAGNUM MOSS PEAT AND PERLITE VS. HAYDITE AGGREGATES

by Lyle Turner and Richard H. Mattson[1]

Bedding plant production depends on a medium that supports high quality crops. Many growers still use the basic 1:1:1 soil, peat, and aggregate soil mixture (1, 4). The type of medium used is determined by crop specificity, cultural practices used, and the availability of inexpensive components. This study examined five types of bedding plants grown in four media containing equal parts of soil, peat, and aggregate. Comparisons were made of sphagnum moss peat versus black peat and perlite, horticultural grade, versus haydite, 1/4" by 1/8" grade, an arcillated clay.

'Bigboy' tomatoes, 'Starkist' petunias, 'Red Piller' salvia, 'Blue Blazer' ageratum, and 'California Wonder' peppers were planted February 1, 1973 and transplanted three weeks later into 15 x 15 x 9 cm plastic market paks. Six flowers were transplanted per pak while vegetables were transplanted 12 per pak.

Four replications of each crop in each medium were placed at random in a polyethylene greenhouse at $21^{o}\pm C$ day and $12^{o}\pm C$ night temperatures. Soil samples were collected on

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the day of transplanting and at three week intervals thereafter. Seedlings in each medium received an equal application of 20-20-20 soluble fertilizer at 200 ppm every third watering. After six weeks soil samples were collected and Spurway analysis was conducted.

Crops were measured for height, stem diameter and dry weight six weeks after transplanting. 'Starkist' petunias and 'Red Piller' salvia grown in black peat mixes were significantly taller than those grown in the sphagnum moss peat media (Table 1). 'Blue Blazer' ageratum height was not affected by media components. 'Bigboy' tomatoes grown in sphagnum moss peat and perlite were significantly taller with greater stem diameter than in the other mediums studied. 'California Wonder' peppers also had significantly greater height in sphagnum moss peat and perlite but diameter of stems were similar to those grown in the other media. Dry weights and maturity of all bedding plants were similar in the four media.

All media supported quality marketable plants. Knavel(3) noted that a difference in crop response in various media was probably due to texture, structure, and original nutrient content of each media. Most crop response, in this study, was found in nutrient content variation of the sphagnum moss peat versus black peat rather than a variation in the aggregates, perlite versus haydite.

As shown in Table 2, the pH of all four media (5.7

Table 1. Growth responses of bedding plants grown in four media.

Crop	Media*	Height (cm)	Ave.Stem Diameter (mm)	Dry Weights Total/Pak (g)	Bloom From Transplant (days)
Petunia 'Starkist'	S-R-H	7.6	4.8	1.3	60
	S-R-P	6.8	4.3	1.2	57
	S-B-H	10.0	3.5	1.1	58
	S-B-P	8.9	5.0	1.5	59
Salvia 'Red Piller'	S-R-H	6.5	3.6	1.5	70
	S-R-P	7.4	3.0	1.2	72
	S-B-H	8.0	3.8	1.3	66
	S-B-P	8.0	3.7	1.2	65
Ageratum 'Blue Blazer'	S-R-H	7.0	4.8	2.2	65
	S-R-P	7.5	4.0	2.0	58
	S-B-H	7.0	4.0	1.5	66
	S-B-P	7.8	3.8	1.3	58
Tomato 'Bigboy'	S-R-H	15.9	4.5	2.5	--
	S-R-P	18.8	5.5	2.5	--
	S-B-H	16.6	4.4	2.3	--
	S-B-P	17.0	4.3	3.2	--
Pepper 'California Wonder'	S-R-H	6.8	3.2	1.0	--
	S-R-P	8.5	3.5	1.8	--
	S-B-H	5.1	2.0	1.1	--
	S-B-P	4.3	2.3	.9	--
LSD (.05)		.93	.53	NS	NS

*S = silty clay loam
R = "red" sphagnum moss peat
B = black peat
P = perlite
H = haydite

Table 2. Nutrient content of media at transplanting and 6 weeks after.

Time of Analysis	Media*	pH	Soluble salts (mhos/cm)	Nitrates (ppm)	Ammonium (ppm)	Phosphates (ppm)	Potassium (ppm)	Calcium (ppm)
Initial	SRH	6.3	15	5	11	2	15	68
	SRP	5.7	5	3	4	1	14	66
	SBH	6.3	42	170+	1	1	12	136
	SBP	6.3	48	170+	1	1	12	154
After 6 weeks	SRH	6.1	21	38	6	2	13	72
	SRP	5.7	23	26	4	1	12	68
	SBH	6.3	42	117	2	1	11	116
	SBP	6.3	48	122	2	1	10	124
LSD (.05)		.24	9.6	40.2	2.9	.3	1.1	15

*S = silty clay loam
R = "red" sphagnum moss peat
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to 6.3) fall within the accepted range for best crop growth in high organic soils (4, 6). Spurway soil tests show only slight variation in nutrient content in the media between initial and final soil analysis. After six weeks, the black peat mixtures contained significantly more nitrates, calcium and total soluble salts and less ammonium, phosphates and potassium than the sphagnum moss peat mixtures.

The sphagnum moss peat media initially contained more ammonium than the black peat media which indicates a higher degree of ammonification by micorbial activity (1). The black peat mixtures show more nitrates (Table 2) present initially which would indicate a higher degree of nitrification (1). To amend the black peat media, super phosphate could be added to the initial mixture to balance the phosphate to nitrogen ratio for best plant growth and allow for phosphate fixation by the peats (1).

The sphagnum moss peat-perlite mix had a bulk density (g/ml) of .48 compared to .83 of the black peat-haydite (Table 3). The pore space of the four media range from 36% in the sphagnum moss peat-perlite to 42% in the black peat-haydite. Particle size distribution was similar in the four media. Similarties in the physical properties of the media lead to the conclusion that crop response was due to the initial nutrient content of the peats.

In summary, tomatoes and pepper transplants grown in sphagnum moss peat were larger than those in black peat. However, petunia and salvia transplants grown in black peat

Table 3. Physical properties of media.

Medium	Bulk Density (b/ml)	Pore Space (%)	(%) Particle Size Fine (<2mm)	Medium (2-5mm)	Coarse (>5mm)
Soil Sphagnum peat moss haydite	.75	40	29	34	37
Soil Sphagnum peat moss haydite	.48	36	47	32	21
Soil Black peat haydite	.83	42	28	31	41
Soil Black peat perlite	.70	40	26	38	36

were taller while ageratums were not affected by the type of amendments. Bedding plants grown in either haydite or perlite have generally similar growth characteristics.

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APPENDIX

EXPERIMENTAL PROCEDURES

Greenhouse

The experiment was conducted concurrently with a commercial bedding plant operation during the spring of 1973 at Turner's Greenhouse, R. R. #2, Ottawa, Kansas. Repetitions were randomly placed throughout the 34 x 17 meter polyethylene greenhouse on a black plastic covered floor.

Source of Material

'Bigboy' tomato and 'California Wonder' pepper seed were purchased from the Atlee Burpee Seed Company. 'Starkist' petunia, 'Blue Blazer' ageratum, and 'Red Piller' salvia seed were purchased from Harris Seed Company. The peats and aggregates were obtained from local jobbers. Plastic market paks size A-8 were used. The soil, a brown silty-clay loam from central Franklin County, Kansas, was sterilized with dry heat.

Culture

The soil components were measured by volume and the various mixtures were thoroughly mixed by hand. The paks were loosely filled level full for transplanting. Seed was planted February 2, 1973 in 30 x 60 cm flats of 1:1:1 soil, peat, and haydite and transplanted into paks of the various media three weeks later. Flowers were transplanted in half dozens and vegetable seedlings in dozens. Paks containing each medium were color coded for ease of distribution into repetitions and collection of soil samples:

Pink = Soil - Sphagnum moss peat - Haydite

Blue = Soil = Black peat - Perlite

Yellow = Soil - Sphagnum moss peat - Perlite

Black = Soil - Black peat - Haydite

Hyponex, 20-20-20 soluble fertilizer was applied biweekly at approximately 200 ppm to the crops by means of a 'Hose-on.' Plants were sprayed twice with malathion as a preventative measure against insects.

Collection of Data

Soil samples were collected at the day of transplanging and twice again at 3 week intervals after transplanging. Soil samples were taken from the soil ball in such a way as to minimize disturbance of the crop. Measurements of height were taken from the soil surface to the top of the average sized plant in each pak.

Statistics

Analysis of variance was determined by the AARDVARK program of the computer system of the Department of Statistics and the Statistical Laboratory, Kansas State Universtiy.

Table 4. Analysis of variance of stem diameter

Source of Variance	Degrees of Freedom	Mean Square	F Value
Crop	1	0.2813	2.19n.s.
Media	3	1.4479	11.27**
Crop x Media	3	2.0313	15.81**
Error	18	0.1285	

** highly significant at 1% level

Table 5. Analysis of variance of potassium content

Source of Variance	Degrees of Freedom	Mean Square	F Value
Crop	1	10.1250	9.46**
Media	3	17.2083	16.09**
Crop x Media	3	1.2083	1.13n.s.
Error	18	1.0694	

** highly significant at 1% level

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'Starkist' petunia, 'Bigboy' tomato, 'Red Piller' salvia, 'Blue Blazer' ageratum, and 'California Wonder' pepper seedlings were grown in silty clay loam soil amended with equal parts organic matter (sphagnum moss peat or black peat) and aggregate (perlite or haydite).

After six weeks petunia and salvia transplants grown in black peat mixtures were taller than those grown in sphagnum moss peat mixtures, tomatoes and peppers grown in sphagnum moss peat and perlite were significantly taller than those in any other media studied. Ageratum responded similarly to all media. Total dry weights of the bedding plants were similar in all four media studied.

The black peat mixtures contained significantly more nitrates, calcium and total soluble salts, and less ammonium, phosphates and potassium than the sphagnum moss peat mixtures. Seedling responses were due to the initial nutrient content of the organic amendments rather than the variation in aggregates or physical characteristics of the media.