# Processed Corncob as an Alternative to Perlite in the Production of Greenhouse Grown Annuals©[1]

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## INTRODUCTION

Topsoil was used in container plants in the greenhouse and nursery industry until the 1960s when new soilless substrate alternatives were developed. One of the pioneers in this new soilless substrate was Cornell University with their peat-lite mixes. The peat-lite mix was a combination of peatmoss, used for its fine particles to hold water, and perlite and vermiculite were used to create air spaces in the substrate (Boodle and Sheldrake, 1977). Peatmoss is derived from the decomposition of mosses, sedges and sphagnum's under acidic and wet conditions (Bunt, 1987). Vermiculite, an aluminum-iron-magnesium silicate is produced by heating the rock to 1,000 °C (Bunt, 1987). Perlite an igneous glassy rock that is mined and heated to 1,600 °C to remove all water and expand the rock (Moore, 1987). While perlite has no known health hazards it is considered a nuisance causing lung and eye irritation (Evans and Gachukia, 2004).

Growers are interested in alternatives to perlite that provide the same functions without the nuisance of the fine dust particles. Some of these alternatives have included pumice, parboiled rice hulls, and expanded polystyrene. Pumice is a naturally occurring mineral from aluminum silicate, potassium, and sodium oxides often developed from volcanic eruptions. When compared to perlite pumice was found to have similar chemical and physical characteristics (Noland et al., 1992).

In one study parboiled rice hulls (a byproduct of the rice milling industry) and perlite were mixed with peat at rates of 10% 15%, 20%, 25%, 30%, and 35%. In the growth of impatiens, marigold, vinca, and geranium there was no significant difference between root-dry weight and shoot-dry-weight (Evans and Gachukia, 2004).

Polystyrene beads (PSB) are a byproduct of the polystyrene industry. In a study by Cole and Dunn (2002) a substrate containing PSB was found to produce similar plants to those grown in similar mix containing perlite.

Another possible alternative to perlite is processed corncobs. Corncobs are often left over from the harvesting of corn seed and are used for many different products. There are four main parts of cob that are processed and used commercially; the three outer parts of the cob are the beeswing, chaff, and the woody ring which are considered to be the most absorbent part of the cob. These outer parts are often pelletized and used for absorbent tasks including chemical waste, oil, grease, animal bedding, and litter and sweeping compounds. The inner part of the cob is considered the pith and it is often used as an abrasive material in tasks such as sand blasting, metal finishing, polishing, and carriers for pesticides.

Corncob is a waste byproduct of the corn feed and seed industry and requires less energy to produce than perlite. Because it is a byproduct, no rise in the feed and seed market prices would be anticipated. Corncob is a product of the United States and does not have to be imported; therefore decreasing transportation cost. Because of these and other potential advantages of using corncob as a perlite alter-

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native, this study was conducted to determine the effects on container grown annuals when grown in a substrate mixed with corncob and compared to the industry standard perlite.

## MATERIALS AND METHODS

This study was conducted at the Paterson Greenhouse Complex, Auburn University, Auburn, Alabama. Processed corncob was obtained from The Andersons Inc., Maumee, Ohio. A base substrate was blended containing 70 pine bark : 30 peat (v/v) (PBP). This base substrate was mixed with either corncob (CC) or perlite (PL). Treatments were 9 PBP : 1 CC (v/v), 8 PBP : 2 CC (v/v), 7 PBP : 3 CC (v/v), 9 PBP : 1 PL (v:v), 8 PBP : 2 PL (v/v), 7 PBP : 3 PL (v/v). Substrates were amended with 1.4 $kg \cdot m^{-3}$ nitrogen (Sta-Green 12-6-6 Pursell Industries, Inc. Sylacauga, Alabama), 2.9 $kg \cdot m^{-3}$ of dolomitic lime and 0.8 $kg \cdot m^{-3}$ of Micromax (The Scotts Company, Marysville, Ohio). On 18 June 2010 1.96 L containers (Dillen Products. Middlefield, Ohio) were filled to capacity, tamped and filled to capacity again. Two plugs from 200-cell flats of either impatiens (*Impatiens walleriana* 'Dazzler Cranberry'; 5 weeks from sowing), or petunia (*Petunia* 'Dream Rose'; 4 weeks from sowing) were planted in each container. Containers were placed in a twin-wall polycarbonate greenhouse on elevated benches and hand watered as needed.

Before planting, pH and EC of the treatments were determined (Accumet Excel XL50; Fisher Scientific, Pittsburgh, Pennsylvania) using the pour-through method (Wright, 1986). Subsequently pH and EC of petunias were taken at 14, 21, 28, and 35 days after potting (DAP). At 35 DAP all plants were measured for growth index (GI) [(height + width + perpendicular width)/three (cm)], and bloom count (BC) (open flowers and unopened buds showing color). Roots were visually inspected and rated on a scale of 0 to 5 with 0 indicating no roots present at the container substrate interface and 5 indicating roots visible at all portions of the container substrate interface. At 35 DAP, petunia and impatiens shoots were removed at the substrate surface and oven dried at 70 °C for 72 h and weighed. Containers were arranged in a randomized complete block with 12 single-plant replicates. Each plant species was treated as a separate experiment. Total porosity (TP), container capacity (CNC), air space (AS), and bulk density (BD) were determined using the NCSU porometer method (Fonteno and Harden, 1995). Data were subjected to analysis of variance using the general linear models procedure and a multiple comparison of means was conducted using Duncan's Multiple Range Test (Version 9.1; SAS Institute, Cary, North Carolina).

## RESULTS

Substrates containing corncob had greater AS and TP than those containing perlite (Table 1). The reason for the higher TP and AS could be a result of the particle size of the corncob. Particle size distributions (PSD) showed that corncob had a consistent particle size while perlite had a wide range of sizes (data not shown). The consistent PSD of the corncob relative to the variability in PSD of the perlite could be the reason for greater AS and TP.

Substrate pH was highest for treatments containing perlite throughout the experiment. There was little difference in EC among any treatments except for the 28 DAP readings where EC for the 9 : 1 and 7 : 3 PBP : PL treatments ranged from 31% to 49% higher than any treatment containing CC.

**Table 1.** Physical Properties of Substrates.[z]

| | Air Space | Container capacity | Total porosity | | Bulk density |
|---|---|---|---|---|---|
| Substrates | ---------------- | (% vol) | ---------------- | | ($g/cm^3$) |
| 90:10 PBP[y]:corncob | 24.2 | 55.0 | 79.2 | | 0.8 |
| 80:20 PBP:corncob | 26.5 | 51.6 | 78.0 | | 0.8 |
| 70:30 PBP:corncob | 29.6 | 52.0 | 81.6 | | 0.8 |
| 90:10 PBP:perlite | 19.3 | 55.4 | 74.7 | | 0.7 |
| 80:20 PBP:perlite | 19.9 | 52.7 | 72.6 | | 0.7 |
| 70:30 PBP:perlite | 25.9 | 49.9 | 75.8 | | 0.7 |

[z]Analysis performed using the NCSU porometer.
[y]PBP = pinebark:peat, 70:30 (v:v).

**Table 2.** Effects of substrate on pH and electrical conductivity of greenhouse-grown *Petunia* x*hybrida.*

| | 14 DAP | | 21 DAP | | 28 DAP | | 35 DAP | |
|---|---|---|---|---|---|---|---|---|
| Substrates | pH | EC[y] | pH | EC | pH | EC | pH | EC |
| 90:10 PBP[x]:corncob | 7.0bc[w] | 3.96a | 7.1c | 1.50a | 7.1ab | 1.01c | 6.1b | 0.44a |
| 80:20 PBP:corncob | 6.9c | 4.32a | 6.9d | 1.78a | 7.1ab | 1.20c | 6.1b | 0.86a |
| 70:30 PBP:corncob | 6.5d | 4.06a | 6.7e | 1.76a | 6.8bc | 0.99c | 6.2b | 1.07a |
| 90:10 PBP:perlite | 7.2b | 3.33a | 7.2b | 2.22a | 7.1ab | 1.73ab | 6.7a | 0.78a |
| 80:20 PBP:perlite | 7.5a | 2.84a | 7.5a | 2.16a | 7.3a | 1.26bc | 6.9a | 0.44a |
| 70:30 PBP:perlite | 7.4a | 3.04a | 7.3b | 2.21a | 6.6c | 1.94a | 6.2b | 0.75a |

[z]Days after potting.
[y]Electrical conductivity (dS cm) of substrate solution using the pourthrough method.
[x]PBP = pinebark:peat, 70:30 (v:v).
[w]Duncans Multiple Range Test ($P \leq 0.05$, n = 4).

Growth indices for impatiens were similar for all treatments except for the 7 PBP : 3 CC which was smaller than all other treatments. Bloom counts for impatiens were similar among all treatments while petunia in 9 PBP : 1 CC had twice the number of blooms compared with BC in 7 PBP : 3 PL. Shoot dry weights in impatiens were similar among all treatments containing 10% or 20% CC or PL. Similar results were found in parboiled rich hulls where no difference was found between treatments comprised with the same amount of perlite and rice hulls (Evans and Gachukia, 2004). Petunia grown in 7 PBP : 3 PL were one third smaller than the average of all other treatments with respect to SDW. There was great variability within treatments with root rating, however the general trend, especially among petunia, were that root ratings were lower in treatments containing PL (Table 3). This lower root rating could possibly be a result of lower substrate airspace for those treatments with less PL.

## DISCUSSION

In conclusion, the data presented here indicate that processed corncob is a possible organic substitute for perlite in greenhouse production. Growth of both impatiens and petunia in substrates containing 10% or 20% corncob were equal to those grown

**Table 3.** Effects of substrate on growth of greenhouse-grown *Impatiens walleriana* and *Petunia* x*hybrida*.

| Substrates | Growth index[z] | Bloom count[y] | Shoot dry weight[x] | Root rating[w] |
|---|---|---|---|---|
| | *Impatiens walleriana* 'Dazzler Cranberry' | | | |
| 9:1 PBP[v]:corncob | 28.1a[u] | 18.7a | 12.2abc | 3.5ab |
| 8:2 PBP:corncob | 27.4a | 17.8a | 11.8abc | 3.8a |
| 7:3 PBP:corncob | 24.0b | 16.7a | 7.9c | 3.5ab |
| 9:1 PBP:perlite | 28.5a | 18.4a | 13.4ab | 2.8bc |
| 8:2 PBP:perlite | 28.3a | 21.8a | 13.8a | 2.5bc |
| 7:3 PBP:perlite | 25.5ab | 14.5a | 9.3bc | 1.8bc |
| | *Petunia* x*hybrida* 'Dream Rose' | | | |
| 9:1 PBP:corncob | 35.2ab | 26.8a | 13.7a | 2.7ab |
| 8:2 PBP:corncob | 36.0a | 22.8ab | 13.2a | 2.8ab |
| 7:3 PBP:corncob | 33.3abc | 21.1bc | 11.2a | 3.5a |
| 9:1 PBP:perlite | 29.6c | 17.4cd | 12.5a | 1.7bc |
| 8:2 PBP:perlite | 30.9abc | 17.7bcd | 11.6a | 1.7bc |
| 7:3 PBP:perlite | 30.7bc | 13.2d | 8.4b | 1.3bc |

[z]Growth index[(height + widht1 + withdth2)/3].
[y]Bloom count = number of blooms or buds showing color at 35 days after potting.
[x]Shoot dry weight measured in grams.
[w]Root ratings 0-5 scale (0 = no visible roots and 5 = roots visable on the entire container substrate interface).
[v]PBP = pinebark:peat, 70:30 (v:v).
[u]Duncans Multiple Range Test ($P < 0.05$, $n = 12$).

in equal amounts of perlite. However, it has been reported by others that the use of ground corncob as an amendment can cause nitrogen depletion (Jozwik, 1993). While no nitrogen deficiency was noted in this study, the authors acknowledge that this could likely be due to the high nitrogen rate used. Further investigation using multiple nitrogen rates and fertilizer sources is warranted. Processed corncob could be a more sustainable and "greener" alternative to perlite.

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