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*Full Length Research Paper*

# Enhancing Mushroom Yield through Compost Supplementation with Locally Available Peats and Secondary Casing Materials

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**The study was conducted to investigate yields of mushroom (*Agaricus bisporus*) on wheat straw and waste tea leaves based composts. Mixtures (50:50, v/v) of some locally available peats including peat of Bolu (PB), peat of Agacbasi (PA), peat of Caykara (PC) and their mixture (80:20; v/v) with which piece of mosaic and sand were used. Also, some activator materials such as wheat bran, wheat chaff, chicken manure, pigeon manure, and poplar leaves were used for *A. bisporus* cultivation. The results on wheat straw based composts provided the highest mushroom yield (23.01%) that was obtained on wheat straw and pigeon manure based compost using a mixture of PA with PC (50+50; v/v) as casing material. For waste tea leaves based composts, the highest mushroom yield (24.90%) were recorded on wheat straw and pigeon manure based compost using a mixture of PC with sand (80+20; v/v) as casing material.**

**Key words:** Mushroom, waste tea leaves, wheat straw, activator materials, casing materials, yield.

## INTRODUCTION

*Agaricus bisporus* is the world's most widely grown culture mushroom species (Coδkuner and Ozdemir, 1997). It requires two different substrates to form its fruit bodies; the compost in which it grows vegetatively and the poor nutrient casing soil in which the suitable physic-cal, chemical and biological conditions stimulate the initiation process of fruit body production (Segula et al., 1987). The preparation of mushroom compost has for many years been divided into two distinct phases. During phase I raw material are mixed, wetted and stacked with considerable dry matter losses while phase II includes pasteurization and conditioning treatment to produce a selective and pathogen free substrate (Randle and Hayes, 1972; Ross and Harris, 1983; Bech, 1973).

Due to scarcity of horse manure, many efforts have been made by researchers to develop "synthetic compost" based on vegetable origin. Synthetic compost formulations remained standard for several years and various formulations have been recommended from different parts of the world depending upon their availability (Shandilya, 1979; Tewari and Sohi, 1976; Lambert, 1929; Sinden and Hauser, 1953).

Casing soil has an important role in the cultivation of *A. bisporus* (Gulser and Peksen, 2003). Although many different materials may adequately function as a casing layer, peat is generally used and recommended as a good casing medium. Peat has unique water holding and structural properties subsequently it is a widely accepted casing medium (Colak, 2004; Baysal 1999). But, there are no available sources of peat in many mushroom growing areas (Vedie, 1995). This has led to considerable research into the development of possible alternatives (Poppe, 2000). Baysal (1999) and Visscher (1988) studied peat and perlite mixture and peat and chalk or lime mixture as casing material, respectively. Further, Gulser and Peksen (2003) studied the possibility of using waste tea leaves as a new casing material in the cultivation of

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*A. bisporus.* Gulser and Peksen (2003) found that using waste tea leaves alone as a casing was not acceptable for optimum yield when it was compared with peat alone. But a mixture of waste tea leaves with peat (1:1; v/v) ratio increased the yield.

This study was aimed to determine yield response of *A. bisporus* by using wheat straw and waste tea leaves composts and their combination with some secondary casing materials including sand and piece of mosaic.

## MATERIALS AND METHODS

### Preparation of composts

Two composts were prepared based on wheat straw and waste tea leaves using wheat bran, wheat chaff, chicken manure, pigeon manure, and poplar leaves as activator materials. Percentage nitrogen (N) content of the composts was arranged to 2.5%. Composts used in this study are summarized in Tables 1 and 2. The composting of substrates was processed using the method of Shandilya (1982). The total outdoor composting process (Phase I) took 28 and 35 days for wheat straw and waste tea leaves based composts, respectively. Phase II was processed indoor for 7 days.

### Casing soil

Locally available casing materials including Peat of Bolu (PB), peat of Agacbasi (PA), and peat of Caykara (PC) were used as peats. Peat of Bolu, peat of Agacbasi, and peat of Caykara were supplied from Bolu district, Agacbasi district (Surmene-Trabzon), and Caykara district (Trabzon) in Turkey, respectively. Also, we used some secondary casing materials such as sand (S), and piece of mosaic (PM) with mixture of peat (20:80; v/ v) in volume.

### Mushroom cultivation

Composts were spawned with 30 g mycelium (Type Horst U1) per kg then filled into plastic bags at 7 kg wet weight basis. During spawn run the temperature of the inlet air was automatically regulated by a cooling surface in the recirculation canal such that the compost temperature was maintained at 24 - 25°C with a minimum supply of fresh air. Spawning room was kept at 25°C temperature and 90% relative humidity without ventilation (Hayes and Shandilya, 1977). After mycelia growth, a 3 cm layer casing material was used to cover the compost. Before casing, chalk was added to give a pH of 7.5 - 8. After 7 days, the temperature was lowered to 16°C, with ventilation, for pinhead production. Watering after casing was done as suggested for commercial growth (Randle, 1984; Shandilya, 1986). After pinhead development, following picking periods of mushroom along with four flushes the yield data were recorded for 60 days below follow equation:

$$\text{Mushroom yield (\%)} = \frac{\text{Weight of mushroom harvested}}{\text{Weight of wet compost used}} \times 100$$

### Evaluation of test results

Test results were evaluated by a computerized statistical program composed of analysis of variance and following Duncan tests at the 95% confidence level. Statistical evaluations were made on homogeneity groups, of which different letters reflected statistical significance.

## RESULTS AND DISCUSSION

### Yields of *A. bisporus* on wheat straw based composts

Average yields of *A. bisporus* during a harvesting period of 60 days (4 flushes) on wheat straw based composts and using mixtures (50:50, v/v) of some locally available peats and their mixture (80:20, v/v) with piece of mosaic and sand are given in Table 3. The highest mushroom yield (23.01%) was obtained on wheat straw and pigeon manure based compost using a mixture of PA with PC as casing material. The lowest yield (11.22%) was recorded on wheat straw and wheat chaff based compost using a mixture of PA with sand as casing material. We found that mushroom yield of wheat straw based composts and mixtures of peats as casing material ranging 15.70 to 23.01%. Baysal (1999) found that mushroom yield of wheat straw and pigeon manure based compost using peat of Bolu, peat Agacbasi, and peat of Caykara as sole casing materials were 15.71, 23.28, and 21.44%, respectively. Also, Toker et al. (2007) reported that no significant difference was observed in yield when peats were used in combination with each other compared to their individual use. Mushroom yield of *A. bisporus* on wheat straw based composts and using mixtures of peats with PM and sand as casing materials ranged from 14.70 to 20.51% and 11.47 to 19.95% respectively.

### Yields of *A. bisporus* on waste tea leaves based composts

Average mushroom yields of *A. bisporus* a harvesting period of 60 days (4 flushes) on waste tea leaves based composts and using mixtures (50:50; v/v) of locally available peats and their mixture (80:20; v/v)with piece of mosaic and sand are given in Table 4.

Generally, mixtures of peats with PM gave higher mushroom yield compared to other casing mixtures. This higher yield may be attributed to high moisture holding capacity of piece of mosaic. Colak (2004) reported that a mixture of peat with perlite in 80:20 (v/v) and 70: 30 (v/v) ratios provided higher yield than sole peat using a casing material.

In this study, the highest mushroom yield (24.90%) was obtained on waste tea leaves and pigeon manure based compost using a mixture of PC with sand as casing material. The lowest yield (7.66%) was recorded on waste tea leaves and wheat chaff based compost using a mixture of PB with sand as casing material. Baysal (1999) studied average mushroom yield values of waste tea leaves based composts using some locally available peats and their mixture with perlite as casing material. He reported that the best mushroom (26.13%) yield was obtained on waste tea leaves and pigeon manure based compost and using peat of Caykara and perlite mixture as casing material. In the present study yield of waste tea

**Table 1.** Wheat straw based composts used in the study.

| Formula | Ingredient | Fresh weight (kg) | Moisture content (%) | Dry weight (kg) | Nitrogen | Nitrogen (kg) |
|---|---|---|---|---|---|---|
| I | Wheat straw | 460.0 | 15.0 | 400.0 | 0.5 | 2.00 |
| | Wheat bran | 137.00 | 17.00 | 113.00 | 2.40 | 2.71 |
| | Ammonium nitrate | 17.10 | 0.00 | 17.10 | 26.00 | 4.94 |
| | Urea | 10.10 | 0.00 | 10.10 | 44.00 | 4.84 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 672.2 | | 580.2 | | 14.69 |
| II | Wheat straw | 460.00 | 15.00 | 400.00 | 0.50 | 2.00 |
| | Chicken manure | 82.50 | 20.00 | 113.00 | 1.70 | 1.92 |
| | Ammonium nitrate | 20.00 | 0.00 | 20.00 | 26.00 | 5.20 |
| | Urea | 12.00 | 0.00 | 12.00 | 44.00 | 5.20 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.0 | 24.0 | 0.0 | 0.0 |
| | TOTAL | 622.5 | | 585.00 | | 14.32 |
| III | Wheat straw | 460.00 | 15.0 | 400.0 | 0.5 | 2.00 |
| | Pigeon manure | 133.00 | 18.00 | 113.00 | 3.50 | 3.95 |
| | Ammonium nitrate | 15.00 | 0.00 | 15.00 | 26.00 | 3.90 |
| | Urea | 10.00 | 0.00 | 10.00 | 44.00 | 4.40 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 666.00 | | 578.00 | | 14.45 |
| IV | Wheat straw | 460.00 | 15.0 | 400.0 | 0.5 | 2.00 |
| | Wheat chaff | 147.00 | 30.00 | 113.00 | 1.87 | 2.11 |
| | Ammonium nitrate | 20.00 | 0.00 | 20.00 | 26.00 | 5.20 |
| | Urea | 8.70 | 0.00 | 8.70 | 44.00 | 4.75 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 683.7 | | 573.00 | | 14.26 |
| V | Wheat straw | 460.00 | 15.0 | 400.0 | 0.5 | 2.00 |
| | Poplar leaves | 175.00 | 55.00 | 113.00 | 1.30 | 1.46 |
| | Ammonium nitrate | 21.00 | 0.00 | 21.00 | 26.00 | 5.46 |
| | Urea | 13.00 | 0.00 | 13.00 | 44.00 | 5.72 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.0 | 24.0 | 0.0 | 0.0 |
| | TOTAL | 717.00 | | 587.0 | | 14.84 |

leaves based composts and using mixtures of peats ranged from 12.36 to 22.34%. Mushroom yield of waste tea leaves composts on mixtures peats with PM and sand as casing materials ranged from 13.19 to 23.70%, and 7.66 to 24.90%, respectively.

## Conclusion

In this study, two types of composts (wheat straw and waste tea leaves) were prepared and locally available peats and theirs mixture (80:20; v/v) with piece of mosaic and sand were supplemented to grow *A. bisporus.*

Generally, when peats are used in combination with each other, mushroom yields were higher compared to other casing mixture for wheat straw based composts. PM affected the yield values in a positive way for waste tea leaves based composts.

For wheat straw based compost, the highest yield (23.01%) was obtained by mixtures of PA with PC as

**Table 2.** Waste tea leaves based composts used in the study.

| Formula | Ingredient | Fresh weight (kg) | Moisture content (%) | Dry weight (kg) | Nitrogen | Nitrogen (kg) |
|---|---|---|---|---|---|---|
| I | Waste tea leaves | 448.00 | 12.0 | 400.0 | 2.3 | 9.20 |
| | Wheat bran | 132.00 | 17.00 | 113.00 | 2.40 | 2.71 |
| | Ammonium nitrate | 3.67 | 0.0 | 3.67 | 26 | 0.95 |
| | Urea | 2.17 | 0.00 | 2.17 | 44.00 | 0.95 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 631.84 | | 559.80 | | 14.01 |
| II | Waste tea leaves | 448.00 | 12.00 | 400.00 | 2.30 | 9.20 |
| | Chicken manure | 135.00 | 20.00 | 113.00 | 1.70 | 1.92 |
| | Ammonium nitrate | 5.00 | 0.00 | 5.00 | 26.00 | 1.30 |
| | Urea | 3.00 | 0.00 | 3.00 | 44.00 | 1.32 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 639.00 | | 561.00 | | 13.94 |
| III | Waste tea leaves | 448.00 | 12.00 | 400.00 | 2.30 | 9.20 |
| | Pigeon manure | 134.00 | 18.00 | 113.00 | 3.50 | 3.95 |
| | Ammonium nitrate | 1.00 | 0.00 | 15.00 | 26.00 | 0.26 |
| | Urea | 0.60 | 0.00 | 10.00 | 44.00 | 0.26 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 631.6 | | 578.00 | | 13.87 |
| IV | Waste tea leaves | 448.00 | 12.00 | 400.00 | 2.30 | 9.20 |
| | Wheat chaff | 175.00 | 55.00 | 113.00 | 1.30 | 1.46 |
| | Ammonium nitrate | 6.00 | 0.00 | 6.00 | 26.00 | 1.69 |
| | Urea | 3.00 | 0.00 | 3.00 | 44.00 | 1.32 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 680.00 | | 562.00 | | 13.93 |
| V | Waste tea leaves | 448.00 | 12.00 | 400.00 | 2.30 | 9.20 |
| | Poplar leaves | 175.00 | 55.00 | 113.00 | 1.30 | 1.46 |
| | Ammonium nitrate | 6.00 | 0.00 | 6.00 | 26.00 | 1.69 |
| | Urea | 3.00 | 0.00 | 3.00 | 44.00 | 1.32 |
| | Mollasses | 24.00 | 50.00 | 16.00 | 1.30 | 0.20 |
| | Gypsum | 24.00 | 0.00 | 24.00 | 0.00 | 0.00 |
| | TOTAL | 680.00 | | 562.00 | | 13.93 |

casing material, for waste tea leaves based compost, the highest yield (24.90%) was recorded by mixtures of PC with sand as casing material.

In conclusion, it was revealed that two composts (wheat straw and waste tea leaves based) and some activator materials (wheat bran, wheat chaff, chicken ma-nure, pigeon manure, and polar leaves) could be succes-sfully used for cultivation of *A. bisporus.* In many mush-room growing areas of the world, there were no available sources of peat (Noble and Pennington, 2005). There-fore, locally available casing media is a very important factor to obtain a right maximum and assure increased yield in the cultivation of mushroom (Gulser and Peksen, 2003). Mixtures of peats with some secondary casing materials could be used as effective for cultivation of *A. bisporus* when mixture ratio was adjusted.

**Table 3.** Average mushroom yields of *Agaricus bisporus* on wheat straw based composts.

| Compost and activator materials | Mixtures of casing media | Mixture Ratio% | Yield[a] (g/7 kg bag) mean ± SD | Yield[a] (%) |
|---|---|---|---|---|
| | PB+PA | 50+50 | 1506.7±116.7$^{st}$ | 21.51 |
| | PB +PC | 50+50 | 1497.7±118.1$^{stu}$ | 21.34 |
| | PA+PC | 50+50 | 1603.2±105.2$^{tu}$ | 22.90 |
| | PB+Sand | 80+20 | 998.5± 93.9$^{bcde}$ | 14.26 |
| Wheat straw and wheat bran | PB+PM | 80+20 | 1282.2±232.7$^{jklmno}$ | 18.31 |
| | PA+Sand | 80+20 | 1093.7±57.06$^{efgh}$ | 15.61 |
| | PA+PM | 80+20 | 1084.0±107.1$^{defgh}$ | 15.49 |
| | PC+Sand | 80+20 | 1232.5±123.8$^{ijklm}$ | 17.60 |
| | PC+PM | 80+20 | 1318.5±68.7$^{lmnop}$ | 18.83 |
| | PB+PA | 50+50 | 1593.7±150.9$^{tu}$ | 22.75 |
| | PB +PC | 50+50 | 1154.5±166.8$^{ghijk}$ | 16.48 |
| | PA+PC | 50+50 | 1298.5±101.4$^{klmnop}$ | 18.29 |
| | PB+Sand | 80+20 | 1012.2±96.4$^{cdef}$ | 14.46 |
| Wheat straw and wheat chaff | PB+PM | 80+20 | 1283.7±157.5$^{lmnop}$ | 18.34 |
| | PA+Sand | 80+20 | 977.0±96.1$^{bcde}$ | 13.96 |
| | PA+PM | 80+20 | 1171.7±143.4$^{ghijk}$ | 16.72 |
| | PC+Sand | 80+20 | 1182.2±173.9$^{hijkl}$ | 16.89 |
| | PC+PM | 80+20 | 1264.0±53.0$^{jklmn}$ | 18.06 |
| | PB+PA | 50+50 | 1457.5±135.7$^{rs}$ | 20.81 |
| | PB +PC | 50+50 | 1231.7±58.6$^{ghij}$ | 22.59 |
| | PA+PC | 50+50 | 1255.5±146.8$^{jklmn}$ | 17.95 |
| | PB+Sand | 80+20 | 885.2±69.07$^{ab}$ | 12.64 |
| Wheat straw and chicken manure | PB+PM | 80+20 | 1196.2±108.8$^{hijkl}$ | 17.09 |
| | PA+Sand | 80+20 | 934.7±32.0$^{bc}$ | 13.35 |
| | PA+PM | 80+20 | 1436.0±94.8$^{prs}$ | 20.51 |
| | PC+Sand | 80+20 | 1123.7±62.3$^{fghi}$ | 16.06 |
| | PC+PM | 80+20 | 1065.5±164.6$^{cdefg}$ | 15.21 |
| | PB+PA | 50+50 | 1496.2±110.1$^{stu}$ | 21.37 |
| | PB +PC | 50+50 | 1099.7±94.8$^{efgh}$ | 15.70 |
| | PA+PC | 50+50 | 1611.5±112.5$^{u}$ | 23.01 |
| | PB+Sand | 80+20 | 1006.0±106.8$^{bcdef}$ | 14.37 |
| Wheat straw and pigeon manure | PB+PM | 80+20 | 1322.7±88.9$^{lmnop}$ | 18.85 |
| | PA+Sand | 80+20 | 803.5±167.2$^{a}$ | 11.47 |
| | PA+PM | 80+20 | 1221.5±111.8$^{ijklm}$ | 17.45 |
| | PC+Sand | 80+20 | 1366.7±109.0$^{nopr}$ | 19.51 |
| | PC+PM | 80+20 | 1397.0±387.0$^{oprs}$ | 19.95 |
| | PB+PA | 50+50 | 1351.0± 61.9$^{nopr}$ | 19.30 |
| | PB +PC | 50+50 | 1364.5±172.3$^{nopr}$ | 19.48 |
| | PA+PC | 50+50 | 1251.2±162.8$^{klmnop}$ | 17.87 |
| | PB+Sand | 80+20 | 952.0±119.9$^{bcd}$ | 13.60 |
| Wheat straw and poplar leaves | PB+PM | 80+20 | 1088±86.3$^{efgh}$ | 16.97 |
| | PA+Sand | 80+20 | 786.2±99.3$^{a}$ | 11.22 |
| | PA+PM | 80+20 | 1074.0±132.9$^{defgh}$ | 15.54 |
| | PC+Sand | 80+20 | 947.2±97.6$^{bc}$ | 13.52 |
| | PC+PM | 80+20 | 1029.5±78.1$^{cdef}$ | 14.70 |

Small letters given as superscript over yield represent homogeneity groups obtained by statistical analysis with similar letters reflecting statistical insignificance at the 95% confidence level.

[a]Results reflect observations of four plastic bags.

SD = Standard deviation.

**Table 4.** Average mushroom yields of *A. bisporus* on waste tea leaves based composts.

| Compost and activator materials | Mixtures of casing media | Mixture ratio | Yield[a] (g/7 kg bag) mean ± SD | Yield[a] (%) |
|---|---|---|---|---|
| Waste tea leaves and wheat bran | PB+PA | 50+50 | $1239.5 \pm 69.5^{ghijk}$ | 17.70 |
| | PB +PC | 50+50 | $1364.0 \pm 63.7^{jklm}$ | 19.49 |
| | PA+PC | 50+50 | $1081.5 \pm 104.2^{defghi}$ | 15.44 |
| | PB+Sand | 80+20 | $711.0 \pm 68.9^{ab}$ | 10.16 |
| | PB+PM | 80+20 | $1283.0 \pm 96.5^{ijkl}$ | 13.19 |
| | PA+Sand | 80+20 | $1304.2 \pm 82.2^{ijkl}$ | 18.63 |
| | PA+PM | 80+20 | $1658.5 \pm 55.8^{op}$ | 23.69 |
| | PC+Sand | 80+20 | $1610.5 \pm 385.8^{nop}$ | 23.00 |
| | PC+PM | 80+20 | $1659.2 \pm 372.8^{op}$ | 23.70 |
| Waste tea leaves and wheat chaff | PB+PA | 50+50 | $1217.0 \pm 164.9^{fghijk}$ | 17.39 |
| | PB +PC | 50+50 | $1242.0 \pm 116.7^{ghijk}$ | 17.74 |
| | PA+PC | 50+50 | $1301.0 \pm 157.3^{ijkl}$ | 18.58 |
| | PB+Sand | 80+20 | $536.2 \pm 114.3^{a}$ | 7.66 |
| | PB+PM | 80+20 | $986.6 \pm 85.6^{cde}$ | 20.81 |
| | PA+Sand | 80+20 | $1192.2 \pm 172.9^{efghij}$ | 17.03 |
| | PA+PM | 80+20 | $1552.5 \pm 173.7^{mnop}$ | 22.17 |
| | PC+Sand | 80+20 | $1420.5 \pm 135.4^{jklmn}$ | 20.28 |
| | PC+PM | 80+20 | $1407.7 \pm 81.2^{jklmn}$ | 20.10 |
| Waste tea leaves and chicken manure | PB+PA | 50+50 | $1379.3 \pm 177.0^{jklmn}$ | 19.70 |
| | PB +PC | 50+50 | $1259.0 \pm 176.6^{hijk}$ | 17.98 |
| | PA+PC | 50+50 | $1016.0 \pm 72.0^{cdefg}$ | 14.51 |
| | PB+Sand | 80+20 | $908.7 \pm 68.6^{bcd}$ | 12.97 |
| | PB+PM | 80+20 | $1288.2 \pm 60.0^{ijkl}$ | 14.47 |
| | PA+Sand | 80+20 | $1128.2 \pm 81.7^{efghi}$ | 16.11 |
| | PA+PM | 80+20 | $1241.0 \pm 175.7^{ghijk}$ | 17.72 |
| | PC+Sand | 80+20 | $1512.2 \pm 169.8^{lmnop}$ | 21.6 |
| | PC+PM | 80+20 | $1516.0 \pm 38.8^{lmnop}$ | 21.65 |
| Waste tea leaves and pigeon manure | PB+PA | 50+50 | $1564.5 \pm 55.4^{mnop}$ | 22.34 |
| | PB +PC | 50+50 | $1246.5 \pm 121.6^{ghijk}$ | 17.80 |
| | PA+PC | 50+50 | $1362.7 \pm 122.9^{jklm}$ | 19.45 |
| | PB+Sand | 80+20 | $887.0 \pm 106.9^{bcd}$ | 12.97 |
| | PB+PM | 80+20 | $1539.2 \pm 148.9^{lmnop}$ | 21.27 |
| | PA+Sand | 80+20 | $860.0 \pm 55.8^{bc}$ | 12.29 |
| | PA+PM | 80+20 | $1457.2 \pm 64.4^{klmno}$ | 20.81 |
| | PC+Sand | 80+20 | $1716.7 \pm 126.0^{p}$ | 24.9 |
| | PC+PM | 80+20 | $1386.7 \pm 121.3^{jklmn}$ | 19.8 |
| Waste tea leaves and poplar leaves | PB+PA | 50+50 | $1176.5 \pm 139.4^{bc}$ | 16.80 |
| | PB +PC | 50+50 | $865.5 \pm 71.3^{bcd}$ | 12.36 |
| | PA+PC | 50+50 | $1024.2 \pm 85.2^{cdefgh}$ | 14.63 |
| | PB+Sand | 80+20 | $874.0 \pm 82.5^{bcd}$ | 12.48 |
| | PB+PM | 80+20 | $1245.5 \pm 86.7^{ghijk}$ | 17.79 |
| | PA+Sand | 80+20 | $1008.7 \pm 97.6^{cdef}$ | 14.40 |
| | PA+PM | 80+20 | $1403.7 \pm 119.1^{jklmn}$ | 20.04 |
| | PC+Sand | 80+20 | $1200.7 \pm 144.7^{efghij}$ | 17.14 |
| | PC+PM | 80+20 | $1272.5 \pm 25.4^{ijk}$ | 18.18 |

Small letters given as superscript over yield represent homogeneity groups obtained by statistical analysis with similar letters reflecting statistical insignificance at the 95% confidence level.
[a]Results reflect observations of four plastic bags.
SD = Standard deviation.

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