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Peanut shell compost as an alternative to peat and its effect on growth indices and properties of *Viola* spp. grown outdoors

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Abstract

Peanut shells, leftover as wastes from peanut planting, in combination with considerable amount of compost can be used as an alternative source to replace with peat in cultivation of ornamental plants. In this experiment, five treatments in a completely randomized design with three replications were conducted outdoors at Lahijan ornamental plants research station. The treatments comprised of 2 peat + 1 perlite + 0 Shells Peanut composts (control), 1.5 Peat + 1 perlite + 0.5 Shells peanut compost, 1 peat + 1 perlite + 1 Shells Peanut composts, 0.5 Peat + 1 perlite + 1.5 peanut shells compost, 0 peat + 1 perlite + 2 peanut shells compost. The estimated parameters included number of flowers, plant height, fresh and dry weight of canopy, root length, fresh and dry weight of roots, and physical and chemical properties of substrates on *Viola* spp. that were cultivated on them. The results showed that replacement with peanut shells compost had a significant effect on number of flowers, plant height, dry weight of canopy and fresh as well as dry weight of roots in comparison to control. Increasing levels of peanut shells compost caused reduction in bulk density and an increase in total porosity, water capacity and air fill porosity.

Key words: Peanut shells, compost, bulk density, peat, organic material, total porosity, *Viola spp.*

Introduction

The Genus *Viola* belongs to the family Violaceae and contains about 500 species (Tamas, 1999). Violets have become the most popular annual plant for mid-fall to late-spring colour in the Southeast. In the past 50 years new violet colour such as shades of pink, rose, and orange have become available. Intensive breeding programs that have selected for unique flower colour, large flower size, greater flower number, and temperature tolerance have led to many new and exciting cultivars to select from for use in the landscape. Modern violet breeding is largely concentrated in Germany, the United States, and Japan (Derthick *et al.,* 1990). When soil is used as growth media for ornamental plants it is observed that there is recurrent problems with soil quality which affects growth of plants. Therefore, breeders are forced to use growth media that are characterized with soil-less culture. Using organic material is costly and difficult to use as growth media. There is an urgent need for materials which would successfully replace peat as a general organic matter (Benito *et al.,* 2005). Severe exploitation and overuse of peat may reduce the depth of the deep grasslands (70-160 cm). This not only causes loss of valuable vegetation, but also affects water drainage system. Possibility of rehabilitation of these lands (lands utilized by peat), to its original status or even close to it due to removal of the peat layer even in long term process, is beyond imagination. These factors have led to worldwide researchers looking for low priced and good quality alternative for growth media. Therefore using high quality materials but cheaper material instead of peat has been considered (Krumfolz *et al.,* 2000). With increasing awareness about environmental waste hazards with respect to disposing or recycling them, together with need to reduce the consumption of non-renewable resources such as peat, using more of the bio-solids in agriculture has been recommended (Bugbee, 2002; Papafotiou *et al.,* 2005). Some studies have shown that the peat can be replaced by organic wastes such as municipal wastes, sewage sludge, livestock manure, paper, waste of pruning and fungi beds and other organic wastes after composting (Gayasinghe *et al.,* 2010). Composting is an old developed technique which facilitated reapplication of organic residue (Anonymous, 1978). Composting entails decomposition of organic matter by means of micro-organism in a warm, damp and aerobic environment (Dalzell *et al.,* 1987), or biological degradation of mass organic residues under controlled conditions (Hartmann *et al.,* 1997). Compost having physical and chemical properties similar to peat could be substituted for peat (Sanchez-Monedero *et al.,* 2004). Some of the studies showed that organic residue such as urban residue, sewage ooze, animal fertilizer, paper; pruning residue and fungus bed and any green residue after composting can be substitute peat in growth media (Gayasinghe *et al.,* 2010). According to Chen *et al.* (1988) riddling animal fertilizer along with composted grape residues could be introduced as an alternative of peat for ornamental production. Baran *et al.* (2001) used grape residue instead of peat to cultivate Hypoestes plant and found that the optimum amount of grape residue compost should be 50 % in the growth media.

Aim of this research was to study the potential of peanut shells compost to replace peat in growth media without soil and its effect on media and growth of violet plant (*Viola* spp.) in outdoor conditions.

Material and methods

To determine the effect of the amount of peanut shells on growth, physical and chemical properties of growth media on Violet plant, peanut shells were procured from the Stripper factory in Astaneh city. The peanuts shells were soaked and added with 1.5 kg urea per cubic meter of shells and poured in wooden boxes with dimensions 1 × 1 × 1 m, having pores to facilitate aerobic conditions and accelerate microbial fermentation. Composting process lasted four months. Peanut shells compost served as an alternative bed to replace peat for growing violets plants. The experimental setups based on completely randomized design with five treatments and three replicates was situated outdoors at Lahijan Ornamental Plants Research Station with geographical specifications 37º, 11′, 44″ North and 50º, 1′, 3″ South. Violets seedlings (*Viola* spp) were provided by Mr. Ali Keyvani, who maintained a greenhouse located in Roudsar. The seedings were similar in terms of height and number of leaves. Peat was purchased readymade from Kikila Company in Finland. About 1-2 mm perlite used in the experiment. Basic test growth media consisting of peat-perlite was provided in a ratio of 2:1. Peanut Shells compost waspassed through a 20 mm width sieve. Throughout the treatment, the proportion of perlite was constant, however, peanut shells compost replaced 0, 25, 50, 75 or 100% proportion of peat (by volume), thereby maintaining the final ratio to 2:1 (Table 1)

Table 1. Characteristics of treatments used in the experiment

Treatment	Compost peanut shells (%)	Characteristics
1	0%	2 peat + 1 perlite + 0 shells peanut composts (control)
2	25%	1.5 peat + 1 perlite + 0.5 shells peanut composts
3	50%	1 peat + 1 perlite + 1 shells peanut composts
4	75%	0.5 peat + 1 perlite + 1.5 shells peanut composts
5	100%	0 peat + 1 perlite + 2 shells peanut composts

After preparing growth media as per specific treatments, the next step involved transplantation of violet seedlings. Transplanted seedlings were transferred into pots of box with length, width and height of 40 cm. before being transplanted, the seedling roots were washed with water until they were completely free of previous growth media. Each treatment consisted of four replicates (1 plant/pot) and cultivated until five months of growth was completed, at the end of which characters such as flower number, plant height, fresh and dry weight of canopy, root length, root fresh and dry weight and physical and chemical properties of the growth media were measured. To measure the physical properties of the growth media, Fonteno method was used (Fonteno, 1996). To measure total nitrogen in cultivated bed, Kjeldah's method was followed using Kjltak (Goss, 1995). To measure phosphorus in the growth media, method given by Page *et al* (1982) was used. Phosphorus was determined using spectrophotometer (Apel-PD-303UV model) at a wavelength of 880 nm . Potassium was read by a flame photometer device. Fe and Zn were measured by atomic absorption. To measure organic carbon, the method given by Walky and Black was used (Paye *et al.,* 1984) and for measuring pH and EC on growth media, the method suggested by Verdonck and Gabriel (Verdonck and Gabriels, 1992) was used. of the obtained data were subjected to statistical analysis using SAS 9.1 (statistical programs) and mean comparison was performed by Duncan's multiple range test.

Results and discussion

Analysis of variance indicated significant indices for number of flowers, plant height, dry weight of the canopy and root dry weight at a level of 1%. and root fresh weight was estimated at level of 5 % (Table 2). The mean of comparitive application of different proportions of peanut shells compost showed significant effect on number of flower, plant height, dry weight of the canopy, root fresh and dry weight than to the control. Replacement of peat with 50% peanut shells compost resulted in highest number of flowers (33.33 flower), fresh weight of canopy (35.18 g), dry weight of canopy (8.91 g), root length (11.17 cm), fresh weight of roots (10.83 g) and dry root weight (2.37 g) and replacement with 100% of peanut shells compost observed maximum plant height (21.25 cm) (Table 3).

Gayasinghe *et al.* (2010) used synthetic compounds of manure fertilizers compost as an alternative of peat for growing ornamental plant of Tagetes which resulted in increase in plant height, number of flowers per plant, weight of wet and dry canopy, root length, fresh weight and dry root weight. as shown in Table 4, the bulk density of growth media decreased by addition of peanut

Table 2. Analysis of variance analyses for violet plant growth

Source of variation	Degrees of freedom	Number of flower	Plant height	Fresh weight of canopy	Dry weight of canopy	Root length	Root fresh weight	Root Dry weight
Treatment	4	71.56**	17.54**	135.73ns	8.00**	2.13ns	25.80*	1.60**
Error	10	3.46	1.92	56.94	0.72	1.46	6.21	0.08
C. V (%)		7.43	7.67	28.37	13.58	11.93	43.95	26.40

**, * and ns were significant at level 1% respectively, 5% and were non - significant

Table 3. Mean comparison of growth indices of violet plant under different composting levels

Treatment	Number of flower	Plant height (cm)	Fresh weight of canopy (g)	Dry weight of canopy (g)	Root length (cm)	Root fresh weigh (g)	Root dry weight (g)
1	25.00 b	17.41 bc	30.06 a	4.75 b	10.49 a	4.36 b	0.63 b
2	22.00 b	17.31 bc	26.32 a	6.61 b	9.93 a	3.72 b	0.64 b
3	33.33 a	19.47 ab	35.18 a	8.91 a	11.17 a	10.83 a	2.37a
4	21.00 b	14.85 c	24.32 a	5.68 b	10.25 a	5.58 ab	0.94 b
5	24.00 b	21.25 a	17.11 a	5.30 b	8.88 a	4.15 b	0.83 b

Average per column having at least one similar letter according to Duncan's test at 5%, has no significant difference

Table 4. Effect of peanut shells compost on the physical properties of the growth media

Treatment	Peanut shells compost (%)	Bulk density (g/cm^3)	Total porosity (%)	Water capacity (%)	Air fill porosity (%)
1	0	0.64	36.43	14.78	21.65
2	25	0.53	40.76	14.54	26.22
3	50	0.48	53.86	15.95	37.91
4	75	0.43	60.31	15.65	44.66
5	100	0.32	72.19	18.35	53.84

shells compost as compared to the control. Maximum bulk density 0.64 g/cm^3 corresponded to control and the lowest bulk density 0.32 g/cm^3 was obtained when there was 100 % replacement of peat with peanut shells compost (Gayasinghe *et al.,* 2010). It seems that cellulose tissue of peanuts shells and particle size of the compost was responsible for development of by developing high porosity which decreased the bulk density as compared to the control. The highest porosity value of 72.19% was obtained when there was 100 % replacement of peat with peanut shells compost; and the lowest total porosity value of 36.43% was observed in control setup. the volume of peanut shells compost inversely impacted the bulk density of the growth media. So by increasing the volume ratio of compost, the rate of bulk density of the growth media decreased, and subsequently the rate of porosity increased. Water Percentage capacity of growth media was less than of ideal area for plant cultivation. According to Nappi and Barberis (1993) the capacity of aqueous content in ideal growth media was 55 to 85 per cent. With increasing proportions of peanut shells compost in growth media, air fill porosity increased. The highest air fill porosity was 53.84% when 100% of compost replaced peat; while the least air fill porosity was 21.65% as observed in control. According to Abad *et al.* (2001), the value of ideal air fill porosity in the growth media for growing plants was between 20-30 % (Table 4).

Table 5. Chemical analysis of growth media

No	Compost (%)	OC (%)	N (%)	pH	EC (dS/m)	P (Mg/kg)	K (Mg/kg)	Fe (Mg/kg)	Zn (Mg/kg)
1	0%	28.86	2.43	5.84	0.98	564.33	278.88	421.68	7.68
2	25%	25.35	2.13	5.85	1.17	482.01	418.33	709.53	9.14
3	50%	18.33	1.54	5.99	0.87	427.13	398.41	808.00	9.95
4	75%	19.11	1.61	6.19	0.84	405.79	637.45	825.14	14.19
5	100%	10.92	0.92	6.48	0.36	177.13	338.65	794.84	9.54

The optimal range of pH of growth media was determined for growing of ornamental plants. According to previous studies (Abad *et al.*, 2001) pH for optimum plant growth was determined to be 5.3-6.5. Maximum EC (1.17dS/m) in growth media was obtained by replacing 25% of the compost. The amount of nitrogen in growth media decreased by increase in replacement with peanut shells compost in comparison to control. Maximum nitrogen (2.43 %) was observed in control. Phosphorus content decreased with increasing peanut shells compost. Maximum phosphorus observed in control board was 564.33 mg/kg. Potassium content increased with increasing replacement of peanut shells compost. Highest level of potassium (637.45) was recorded with 75% compost application . It seems that the absorption rate and material ingredient density of plant tissues depends on different factors such as plant species, temperature and salinity rate in growth media (Grigatti *et al.,* 2007). Amounts of micronutrients (iron and zinc) in growth media increased by increasing proportions of peanut shells compost as compared to control. Highest levels of iron (825.14 mg/kg) and zinc (14.19 mg/kg) were obtained with 75 % compost. The amount of organic carbon of growth media showed a decreasing trend with increase in levels of peanut shells compost and the highest amount of organic carbon in control board was 28.86 percent (Table 5). Using of organic waste not only increases the organic matter, but also increases micronutrients (such as iron and zinc) in soils leading to improved soil fertility (Nyamangara and Mzezewa, 2001).

Replacing of peat with peanut shells compost in growth media, led to improved plant growth indices of Violet in comparison to control. 50 % peanut shells compost had the greatest effect on all the growth parameters measured. It seems that cellulose tissue and size of peanut shells compost particle, created high porosity which decreased bulk density and increased total porosity which resulted in improved growth indices in comparison to control. Considering that the horticulture industry is on a lookout for an alternative to expensive organic material to be used in growth media, the result of this study are promising. The results showed that preparing compost from peanut shells waste is an appropriate method and in accordance with standards, and it may be recommended that peanut shells be recycled to produce suitable growth media. Further studies may deal with processing of peanut shells compost to achieve the best compost particle size for better activity of microorganisms in plant growth media.

References

Abad, M., P. Noguera and S. Bures, 2001. National inventory of organic wastes for use as growing media for ornamental potted plant production: case study in Spain. *Biores. Technol*., 77: 197-200.

Anonymous, 1978, Soil Management: Organic Recycling in Asia. *FAO Soil Bul*., No. 36.

Baran, A., G. Gayci, C. Kutuk and R. Hartmann, 2001. Composted grape mare as growing medium for Hypostases (*Hypostases phyllostagya*). *Boores. Technol*., 78: 103-106.

Benito, M., A. Masaguer, R. De Antonio, and A, Moliner, 2005. Use of pruning waste compost as a component in soilless growing media. *Biores Technol*., 96: 597-603.

Bugbee, J.G. 2002, Growth of ornamental plants in container media amended with biosolids compost. *Compost. Sci. andUtiliz.,* 10: 92-98.

Chen, Y., Y. Inbar and Y. Harda, 1988. Composted agricultural wastes as potting media for ornamental plants. *Soil Sci*., 145 (4): 298-303.

Dalzell, H.W., Biddlestone, A.j., Gray, K.R., and Thurairrajan, K, 1987. Soil Management, Compost Production and Use in Tropical and Subtropical Environments. *FAO Soil Bul*., No.56.

Derthick, S., W.H. Carlson, and L. Ewart, 1990, *Producing violets for profit*. Mich. State Univ. Coop. Ext. Serv. Bull.

Fonteno, W.C, 1996, Growing media: Types and Physical/Chemical Properties. In D.W. Reed (Ed) Water, Media, and Nutrition of Greenhouse Crops. Ball Publications, Batavia, IL. pp. 93-122.

Gayasinghe. G.Y., Liyana, I., Arachchi, D., and Tokashiki, Y. 2010, Evaluation of containerized substrates developed from cattle manure compost and synthetic aggregates for ornamental plant production as a peat alternative. *Resources Conserv. and Recycl*., 54: 1412-1418.

Goos, R.J., 1995, A laboratory exercise to demonstrate nitrogen mineralization and immobilization*, J. Nat. Resour. Life Sci. Educ*., 24: 68-70.

Grigatti, M., Giorgoni, M.E., Cavani, L., and Ciavatta, C, 2007, Vactor analysis in the study of the nutritional status of philodendron cultivatedin compost-based media. *Scientia Hort*., 112: 448-455.

Hartmann, H. T., Kester, D.E., Davies, F.T., and Geneve, R.L, 1997, *Plant Propagation Principles and Practices*. 6th Prentice, Hall, Inc, USA. 710 pp.

Krumfolz, L.A., S.B. Wilsonand and P.J. Stoffella, 2000, Use of compost as amedia amendment for containerized production of perennial cat whishkers. *SNA Res. Con.,* 45: 69-72.

Nappi. P and R. Barberis, 1993, Compost as growing medium: chemical, physical and biological aspects*. Acta Hort*., 342: 249-256.

Nyamangara, J. and J. Mzezewa, 2001, Effect of long-term application of sewage sludge to a grazed pasture on organic carbon and nutrients if clay soil in Zimbabwe*. Nutr. Cycl. Agroe*., 59: 13-18.

Page, A.L., R.H. Miller and D.R. Keeney, 1982. Methods of soill Analysis, Part 2, *Chemical and microbiological properties*. American society of Agronomy, Inc. Soil Sci. of America, Inc. Madison, Wisconsin, USA.

Papafotiou, M., M. Phsyhalou, G. Kargas, I. Chatzipavlidis and J. Chronopoulos, 2005, Olive-mill waste compost as growth medium component for the production of poinsettia. *Hort. Sci*., 102: 167-175.

Paye, A.L., R.H. Miller and D.R. Keeny, 1984, Method of soil analysis. Part II. *SSSA Inc*.

Sanchez-Monedero, M., A. Roig, J. Cegarra, M.P. Bernal, P. Noguera and M. Abad, 2004, Composts as media constituents for vegetable transplant production. *Comp. Sci. Utiliz*., 12: 161-168.

Tamas, M. 1999. Botanica farmaceutica . Vol III. Sistematica-Cormobionta, Ed. Medicala Universitara *" Iuliu Hatieganu", Cluj-Napoca*., p. 137-138.

Verdonck, O and R. Gabriels, 1992. I. Reference method for the determination of physical properties of plant substrates. II. Reference method for the determination of chemical properties of plant substrates. *Acta Hort*., 302: 169-179.

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