ABSTRACT

The present study aims to develop a new route of paddy straw (PS) utilization in horticulture. In the first half of the study, we aimed to develop PS-based biocomposites (PS-BC) and their use in developing pots for horticultural applications. Six different BCs were developed using PS (treated/untreated) as filler, corn starch (native/cross-linked) and glycerol as matrix and plasticizer, respectively. BC4 had recorded the highest mechanical strength (6.82 MPa tensile strength), followed by BC3 > BC6 > BC5 > BC2 > BC1. Among them, the highest density (2.83 g/cm^3) and least porosity (31.03%) were recorded by BC4. None of the BCs was found to be antimicrobial in nature. Soil burial tests under field conditions recorded a maximum weight loss of 79.32% in 20 days for BC1, indicating higher susceptibility for degradation. Whereas BC4 (57.43%), BC5 (60.30%), and BC6 (60.48%) marked the least weight loss in the same burial period, which were comparatively resistant to degradation. Fourier transform infrared spectroscopy (FTIR) indicated a diminished peak corresponding to the –OH group revealing their susceptibility to microbial degradation. These BCs were moulded into pots and tested with standard potting mixture and cucumber seedlings under greenhouse and field conditions. Under greenhouse conditions, 4 BCs (BC3, BC4, BC5, and BC6) pots were found physically stable up to 28 - 30 days, and the growth parameters of the test plant were normal. By considering the ease of preparation, BC3 and BC4 were used for field testing. It was shown that water loss through the walls of the BC3 and BC4 pots was up to 47 and 44%, respectively, compared to the plastic pot (0.72%). Upon transplantation into the field, the disintegration of the BCs and penetration of the developing roots out of the pots without affecting the normal growth of the plant were observed. The cost analysis of BC3 pots was found to be in the range of 3-4 Rs./pot. The pot making technology was demonstrated to farmers by organizing a workshop at the village level, and pots were distributed for testing at fields. Most of the farmers were satisfied with the pot performance, and some of them even showed interest in the pot making technology as an income-generating activity. In the second half of the study, the potential of PS (in different volumes) and six de-oiled cakes (DOCs) (2.50, 5, 7.50 and 10% (v/v)) as potting media (PM) amendments were studied. Further, its subsequent effect on the physical and nutritional properties of the PM and plant (cucumber (*Cucumis sativus* L.) and tomato (*Solanum lycopersicum* L.)) growth were analyzed. Among 6 DOCs tested, neem (2.50%) and niger cake (5%) were found to improve the plant growth of both crops. Further, PS powder amendment to selected PM improved the plant growth, up to 10% (v/v). Beyond

that, there was a significant growth reduction observed in terms of root length (RL), shoot length (SL), fresh weight (FW), dry weight (DW), leaf area (LA) and seedling vigour index (SVI). Two optimized potting media, Developed potting media -1 (DPM-1) (Coir pith+Vermicompost+Neem cake+PS:77.50+10+2.50+10% (v/v)) and Developed potting media-2 (DPM-2) (Coirpith+Vermicompost+Niger cake+PS:75+10+5+10% (v/v)) were evaluated in comparison to peat-based two commercial potting media (CPM-1 and CPM-2). DPM-1 and DPM-2 recorded, bulk density (0.29 and 0.28 g/cm^3), water holding capacity (59.87 and 59.02%), air porosity (23.50 and 25.61%), total porosity (83.37 and 84.63%), electrical conductivity (2.64 and 2.76 mS/cm), and pH (6.56 and 6.40), respectively. However, all these parameters were within the recommended range of ideal PM. Tomato and cucumber seedlings grown in both DPMs showed significant improvement in growth and accumulation of macro and micronutrients compared to CPMs and control. The cost of DPM-1 and DPM-2 was calculated as around 13 and 22 Rs/kg, respectively. After testing DPMs at local nurseries, the owners were satisfied with their performance and have shown willingness to develop the same if the technology is available or purchase if DPMs are available in the market. By analyzing the results obtained from the present study and data collected from the survey, it could be concluded that the PS is a potential source to use in the horticulture sector as a replacement to plastic pots and PM by employing the methodology developed. Also, the study opened a new avenue to develop PS based small scale industries at the rural level, which empowers the rural economy.