Design of a System for the Mechanization of Subsoil Compost Tea Distribution

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**Abstract.** Compost tea is an aqueous mixture of organic and inorganic compounds obtained by the compost itself and subsequently fermented with possible air blowing. Although several authors have highlighted how these extracts positively affect the control of pathogens and as a promoter of plant growth, the biological mechanism underlying the effects remains unclear. Similarly, no mechanized agricultural system or machine is designed for their distribution. The application of compost tea is commonly carried out on soil (to support soil microbiota) or less frequently on leaves and foliage (for pathogen control). The distribution of these extracts usually occurs on small surfaces due to their localized but emerging application. Generally, compost tea is distributed on the soil's subsurface to avoid stress to the microbiota of the extract, while foliar distribution is carried out through sprayers. The two critical factors in distribution are represented by: the pressure, which cannot be too high to preserve the microbiota, and the formation of organic films, which can hinder or seal the distribution systems. This study aims to design and test the mechanics of the machine in soil processing sizing in relation to the traction efforts. The project is an implementation of the machine already used in the trials and courses of the Tree Yo educational program. The device was developed from a Keyline plow equipped with four vertical shanks, disk coulters, and a fixed crumbler drum. The basic model was coupled with a broadcasting system (Hatzenbichler Exaktor) and a compost tea distribution system which includes a tank with a single polyethylene pipe that carries the liquid to each coulter by splitting the line (the distribution presumably takes place through a small submersible pump). The machine designed employs the basic structure of a 5-shank ripper. The whole machine has a footprint of 2.5 meters x 8 meters and includes the tow hitch with hydraulic tilt piston, the mainframe, a rear trolley with 500/50 R17 wheels, and a regulating piston built-in C40 steel. The anchors in the central frame have been sized to withstand forces of 30 kN applied to the edge of the tips (front towing effort) and on the lateral face (lateral steering effort), which can occur in steering operations. The processing elements are arranged in two rows at a distance of 48 cm. The maximum working depth is 70 cm, and the anchors (Hardox 600) have a thickness of 35 mm and a depth of 20-12 cm. In aisi 440 stainless steel, the distribution system includes two 300-liter tanks coupled to a 6-element membrane pump that distribute the compost tea on five tubes with a diameter of 40 mm (20 mm internal lumen). The distribution system has been designed to house flowmeters, nephelometer, biofilm monitoring, and capacitive sensors to measure salinity and conductivity of tea compost useful for variable rate distribution.