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A Botanical Briefing on Root Abnormalities and Non-Vegetative Propagation

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Abstract

Since field performance of nursery, commercial and garden plants are affected by environmental factors, there are many resultant features as a result of vegetative and non-vegetative propagation. In *Castanea sativa*, *Pinus patula* and *Eucalyptus spp*, these features are seen at the gravitropic, or root, level. Root abnormalities induced due to non-vegetative means affect field performance of all plants, even mesophytes. In this botanical briefing, root abnormalities and non-vegetative propagation in the mentioned plants would be touched on, and emphasis will be focussed on a more widely view that includes farming practices that could help improve productivity in the future (2050), as well as the commercial significance of non-vegetative propagation.

Keywords: hydraulic efficiency, gravitopic, rooting cavity, farming, fertilizers, ontogenic ageing, propagation, commercial.

WHAT ARE ROOT ABNORMALITIES?

Root abnormalities is when plant roots of a known shape and structure deviate from the normal shape and structure, or architecture, in that studied plant species (Singh, 2018). This means that root abnormalities are not conditions which plants experience, but rather which the roots experience in a given habitat. This implies that root abnormalities, are, in fact, induced situations and traits in different plant species (Singh, 2011). Therefore, root abnormalities can be induced due to non-vegetative propagation; however, it's possible for these to be an underlying genetic cause of the abnormality (Singh, 2018). Furthermore, this means that in different plant (or tree) species, root abnormalities can be beneficial as well as detrimental (Singh, 2011). Since root abnormalities are an induced, signal-induction-mediated, event in all plant species, it is definite that it has a profound effect on the hydraulic conductivity as well as efficiency in studied plant species (Singh, 2011; Mitchell et al., July 2004). However, since a root abnormality induced by non-vegetative propagation is a defect to the studied root, it's not possible for these root conditions to be reversed by plant hormones and vitamins (read Singh, 2011). Root abnormalities is therefore a trait that is more than

just a topological and morphological feature in plants, since the presence of these have an effect on the overall growth of plants.

THE USE OF NON-VEGETATIVE PROPAGATION METHODS TO PREVENT ROOT ABNORMALITIES

There are many methods of non-vegetative propagation to prevent root abnormalities. The first method is to use the correct amounts of constituents in fertilizers. This is because certain plant species, like in *Lycopersicum esculentum* for example, though not reported in the literature, unequal amounts of fertilizer and still has an impact on overall plant growth (Singh, 2018). However, it's uncertain if this is definitely true due to issues pertaining to hydraulic efficiency in this plant species (Singh, 2018). Another method involving the use of inserts for *Eucalyptus nitens* propagation, is a method that has been found to prevent root abnormalities, however, without the correct amounts of peat-perlite and vermiculite in the soil mixture, it's almost impossible to root this plant species (Singh, 2011). Here it is evident that soil non-vegetative propagation has an enormous impact on tree varieties in the field. In addition, greenhouse plants are also prone to root abnormalities if they don't receive optimum sunlight for gravitropism to take place (through phototropism). This means that the application of auxins to these housed plants would be more detrimental than beneficial to prevent root abnormalities (Singh, 2018). In *Castanea sativa* (chestnut) plants, it has been found that limiting root capacity (i.e. the increased possibility of preventing root abnormalities) *in vitro*, is not attributed to the production of high indole-3-acteric acid after root initiation (Ballester *et al*., 1999). This means that juvenile as well as mature shoots in chestnut doesn't play an important role in preventing the possibility of abnormal root formation using non-vegetative propagation (Singh, 2018). Furthermore, in commercial plants, such as *Pinus patula*, it has been found that non-vegetative propagation methods like in the use of containers can prevent root abnormalities; however, this doesn't occur when roots grow beyond the constraints of the rooting cavity (Mitchell et al., July 2005).

ROOT SHAPES AND THE COMMERCIAL SIGNIFICANCE OF USING NON-VEGETATIVE MEANS

There are many kinds/types of abnormal root shapes. Even if a root shape is symmetrical to the studied plant, like in *Zea mays* monocots, for example, there could be features of root abnormalities due to ontogenic ageing for example (Singh, 2018). The latter has been found to be especially true in conifer cuttings of *Pinus patula* plantations. Other abnormal root shapes are the sigmoid roots found in Eucalyptus plantations, the coiled roots in *Pinus patula*, and perhaps even triangular and square varieties depending on constraints imposed by containers and inserts (Singh, 2018). There is a commercial significance of using non-vegetative means in that once abnormal rooting has been eliminated using optimum nutrient concentrations and soil proportions, it would become cheaper to propagate plants with gravitropic roots (Singh, 2011; Singh, 2018). This means that the more expensive cost to treatment is, the better the overall plant yield would be for farming practices. Perhaps non-vegetative means of growing forestry species would help expedite farming in the future so that many tropical plant species, and fruit trees would be available until 2050 at least. However, a lot of uncertainty still lies in the commercial significance of using non-vegetative propagation methods.

CONCLUSIONS

In conclusion, this article is a botanical briefing and opinion about root abnormalities and non-vegetative propagation. This article has highlighted the significance and downfall of using non-vegetative means to stimulate plant growth. However, many plant species like *Pinus patula*, chestnut and eucalyptus, have shown great propagation successes using non-vegetative means. This means that *in vitro* and *ex vitro* acclimatisation practices can be optimised using non-vegetative means (Singh, 2018). Furthermore, the fact that forestry enterprises utilise non-vegetative propagation as a means to grow plants, highlights the significance of this methods of minimizing root abnormalities.

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