Weed Management and Allelopathy in the Greenhouse©

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INTRODUCTION

In conventional plant production systems, single-species planting has often been used to obtain optimal biomass production, with concomitant high reliance on fertilizers, water, and high light intensity. Continuous single-cropping, however, can lead to soil conditions that cause an imbalance of soil microorganisms or an accumulation of toxins released from decomposing plant residues. Intercropping and crop rotation are promoted in attempts to alleviate problems associated with monoculture. Whatever the plant production system used, modern cropping practices are often perceived to involve excessive inputs of fertilizer, herbicides, fungicides, insecticides, etc., which supposedly result in increased risk to the physical properties of the soil and pollution of the environment. It is in this context that the concepts of organic farming and biological control are being promoted as alternatives to agrochemicals, and consequently receive a lot of public, financial, and research support. Public perception and legislation aimed at environmental protection have placed agrochemicals under severe strain in recent years, and this pressure is likely to increase in future.

WEED MANAGEMENT

Weed management involves three levels of human intervention and all depend on specific practices for keeping weeds in check, namely: prevention, control, and eradication. Although hand-weeding is probably a very important method for weed management in nurseries, it is such a tedious and relatively unproductive method that it may prove to be a disadvantage in some instances. As it is such a basic and logical practice it will not be discussed further, suffice to emphasize that it could have economic disadvantages if too many workers spend too much time doing it. Herbicides will clearly be more cost- and time-effective than any labour-intensive practice. Amongst the herbicides used in nurseries are the soil sterilants dazomet, metham sodium, and methyl bromide. The former two products are still registered for use in South Africa. Due to environmental protection considerations, according to the Montreal Protocol, methyl bromide use levels would by 1995 be frozen at 1991 levels, and be totally phased out by 2010 in developed countries with possible extension under certain conditions to 2015 in developing countries. It is expected that a compound with low or no environmental impact such as dazomet could increase in importance with the demise of methyl bromide. Steam sterilization is an alternative to all three herbicides, provided costs and facilities are not prohibitive. Also, potential negative impacts of this practice on the physico-chemical and biotic characteristics of the treated growth medium need to be considered.

Assuming that the selection of a herbicide is based on its registration for a particular crop, the most critical characteristics of any such compound as far as the risk of damage in nurseries is concerned are herbicide volatility and persistence. The latter characteristics apply to herbicides used both inside and outside nursery

structures. If a herbicide is volatile it can reach sensitive species through vapor drift. Inside a particular structure, spray and/or vapour drift to sensitive crop species is likely to result in damage. Vapor drift usually implies movement over longer distances than is the case with spray drift, and in the former instance vapour can easily enter or exit a structure through air vents. For this reason, use of a volatile herbicide for weed control along paths, roads, fencelines, etc. is particularly hazardous. Conditions that increase the volatility of an inherently volatile compound are: high soil moisture, high temperature, and weak adsorption to the colloidal fraction (clay and organic particles) in the growth medium. Herbicide persistence, especially when conditions promote persistence beyond the time the compound is expected to remain biologically active for, may constitute a serious risk to sensitive crops grown subsequently on the same growth medium. Therefore, herbicides that are known to persist for long periods, e.g., if half-lives are measured in months, should rather be avoided in nurseries, unless of course the same medium is to be used repeatedly for the same crop. Even in the latter case problems may arise if the herbicide accumulates in the medium to the extent that the threshold concentration for damage to the crop is reached at some stage. Conditions that promote persistence of herbicides include: low temperatures, low moisture, low microbial activity, strong adsorption to the colloidal fraction, and pH levels that are compound-specific.

ALLELOPATHY AND ITS POSSIBLE ROLE IN NURSERIES

The term refers to plant biochemical interactions which could involve the inhibition, or stimulation, of either one or both the interacting partners. Auto-intoxication is regarded as a type of allelopathy where an organism releases a toxic chemical that suppresses its own growth. Many reports cite the release of biologically active compounds (allelochemicals) from living plants and/or from decomposing plant material. The release of allelochemicals from plant litter is an important aspect which separates competition for growth resources (light, nutrients, and water) from allelopathy, but both phenomena are included under the broader term of "plant-plant interference." Numerous allelochemicals have been reported to exert a range of biochemical/physiological effects on plant species. Often the same plant processes that are affected by herbicides are also inhibited or suppressed by allelochemicals. Notable differences between allelochemicals and herbicides are that the former compounds are probably less active and of much shorter persistence in the environment than herbicides generally are.

Apart from direct negative effects on plant growth, allelochemicals may adversely affect plant growth and development indirectly through suppression of beneficial fungi (e.g., mycorrhizae) and/or bacteria. It is possible that plant material of some of the proven allelopathic species (e.g., *Pinus* species) is used in growth media for nurseries. Growth media containing plant material should be screened in terms of potential allelopathic effects that may constrain the growth and development of nursery species, and effects should not only be assessed on the crop directly, but also on associated microorganisms (disease and beneficial). Furthermore, auto-intoxication (plant allelopathic to itself) should be considered where particular crops are grown in hydroponic systems.