Understanding Weed Dormancy, Weed Control with Hot Foam and in Yardwaste Mulch

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Dormancy is defined as a temporary failure to germinate under favorable environmental conditions. It is often referred to as a dispersal in time. Physiological dormancy is controlled by the physiological processes in a propagule (hormonal balance, embryo development, etc). Physical dormancy occurs when environmental factors favorable for germination are excluded by certain morphological characteristics (hard seed coat, waxes, etc). Dormancy that combines both physiological and physical mechanisms is considered combinational (for example, impermeable seed coat and dormant embryo - a drought induced dormancy in some legumes).

Dormancy may be regulated by plant or by environmental conditions. Many plant species produce seed different in morphology, amount and dormancy level, a variation known as 'somatic polymorphism'. For example, the same common lambsquarter plant can produce a lot of black, large seed with high dormancy and few larger brown seed with low dormancy. This mechanism ensures that the majority of seed will remain in the soil seed bank and germinate over time, thus, escaping the immediate competition from the mother plant and having a chance to germinate when conditions are favorable in the future. Larger lambsquarter seed, in turn, may insure immediate re-establishment of the species on a site, and being fewer would likely experience less competition.

Environmental conditions that break dormancy include but are not limited to: scarification (destruction of hard seed coats), light exposure, increase in nitrogen level, increase in temperature and other propagule disturbances. Knowledge and understanding of species specific dormancy coupled with accurate record keeping allows for more precise long-term weed management through seed bank disturbances and timely weed control. However, in an attempt to rapidly and drastically deplete weed seed bank, soil fumigation is often undertaken. Neither methyl bromide nor alternative fumigants destroy propagules of such weeds as little mallow (*Malva parviflora*) or California burclover (*Medicago polymorpha*) (Fennimore 2002, personal communication). Alternative control of these troublesome weeds with hot foam and their survival in yardwaste mulch (targeted to be weed-free material) are described below.

An experiment conducted near Santa Paula, CA, evaluated seed survival of California burclover, little mallow and perennial ryegrass (*Lolium perenne*) after application of heated organic foam (mixture of coconut syrup and water) and the effect of foam on existing weed vegetation. Existing vegetation consisted of little mallow at >100 plants m^{-2} and bernudagrass (*Cynodon dactylon*) at > 100 plants m^{-2}. Heat and gas permeable bags with weed seed were placed at 0, 3, 6 and 9 cm depth in soil and hot foam was applied at 950 L h^{-1} with the "Waipuna"[1] system at about 1 m^2 min^{-1}. Weed seeds were recovered 1 day after treatment (DAT) and germinated in laboratory.

Aboveground biomass of little mallow and bermudagrass was destroyed 1 d after application, however, bermudagrass resumed growth at 14 DAT and achieved plant density similar to the initial at 31 DAT. At 0 cm (surface) seed germination of little mallow was reduced 57% and ryegrass 82%, but germination of California burclover was not affected. At all other soil depths weed seed of the three species were not affected by treatment. These results indicate effectiveness of hot foam for above-ground weed control. However, the treatment failed to

control rhizomes of a perennial weed and seed in soil, likely due to poor heat conductivity of soil.
The ‘Waipuna’ hot foam treatment shows potential effect on a weed seed on the surface, an area were the vast majority of weed seed is situated in no-till (no-disturbance) systems.

An experiment conducted at Oxnard, CA compared survival of seed of little mallow and California burclover in 7.6 m^3 static piles of freshly ground mulch and 18 mo old mulch. Heat resistant permeable bags with weed seed were placed at 0, 0.15, 0.3 and 1 m depths in the mulch piles and removed at 0.25, 1, 2, 4, 7, 14, 21, 28 and 56 d. Survival of propagules differed among the weed species. However, all weed seed were killed in freshly ground mulch after 2 d at 1 m and after 7 d at 0.3 m, while germination and viability were variable at 0.15 m and not affected at 0 m. Weed seed germination and viability at all depths and removal times were not affected in 18 mo old mulch. Temperatures greater than 60 C generated at depths greater than 0.3 m in freshly ground mulch were most likely responsible for destruction of weed propagules. This experiment indicates that the two troublesome weeds, commonly surviving chemical fumigation may be effectively destroyed in fresh mulch, however, they are likely to survive on the surface or at depth less than 0.3 m. It is essential, therefore, to mix the mulch and expose the initially surviving weeds to lethal temperatures normally existing at depths greater than 0.3 m.

[1] Waipuna Systems Ltd. P. O. Box 62-158, Mt Wellington, Auckland, New Zealand.