

## **Allelopathic Effects of Different Plant Species on Downy Brome (Cheat grass) and Wheat Seed Germination: Implications for Weed Control in Organic Farming.**

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**Summary.** Weed pressure is one of the major obstacles to the expansion of organic farming (OF). The most effective way to control weeds in OF is tillage, a practice that depletes organic matter, exposes the soil to wind and water erosion, and is labor intensive. To increase organic crop production, natural weed control methods should be developed.

The objective of this experiment was to find natural herbicides for the control of downy brome (*Bromus tectorum*), a major weed in winter wheat based cropping systems in the Pacific Northwest. To this end we looked at allelopathy, the ability of plants to inhibit or enhance the germination or growth of other plants. Forty seven plant species, meadowfoam seed meal, and pine oil were screened for allelopathy. Plants were grown in pots in a greenhouse. At flowering, the plants were harvested, separated into leaves and roots, dried and ground. Deionized water (100 ml) was added to 5 g of each sample and filtered after 2 hrs to obtain 5% extracts. Ten milliliters of extracts were then added to petri dishes containing 45 g of sand and 10 downy brome seeds each. The seeds were placed on a filter paper that was placed on top of the sand. Three filter papers were wetted with the extract and placed over the seeds. The Petri dishes were then closed and placed in a germination incubator set at 25°C for 72 hrs. The experiment was replicated 4 times with a deionized water control. The shoot and root length were then measured to determine allelopathic effects of the plants on downy brome. Extracts from selected plants were evaluated on Stephens wheat seed.

Meadowfoam seed meal, Yard-long bean leaves, Blue spruce and Austrian pine needles, Austrian pine bark, and pine oil completely inhibited the germination of downy brome. Leaf extracts of radishes, grain amaranth, mustard, marigolds, brown flax, sugar pea, and pegen pea, inhibited the germination of downy brome roots and shoots by 92 to 99% compared to the control. Root extracts of Lab Lab Rongai, radishes, sugar pea, Tepary bean, grain sorghum, grain amaranth, and hairy vetch inhibited the germination of roots and shoots of downy brome by 82 to 99%. In contrast, root extracts of annual rye grass, marigold petite mix, safflower, robust barley, and white Dutch clover enhanced the germination of downy brome roots by 0.01, 2.8, 4.5, 6.6, and 21.8% above the control. Leaf extracts of barley, white Dutch clover, Tepary bean Tohono, marigold cracker jack mix, marigold sparky mix enhanced the growth of downy brome shoot by 0.4, 0.9, 41, 52, 60, 90%, respectively, above the control. Of the selected extracts evaluated on wheat seed, meadowfoam inhibited wheat germination by 96%. The effect of radishes was variable and inhibited wheat germination by 45 to 81%.

The results obtained from this study have great implications for weed control, crop rotations, and residue management in both organic and traditional farming systems. The results clearly demonstrate that some of these plants are allelopathic to downy brome and wheat. Allelochemicals in these plants can be enhanced through breeding, stabilized

and used as herbicides. These plants can be used as companion crops that selectively interfere with the growth of certain weeds. The plants that enhanced the growth of weeds can be used to induce germination of weeds at a time when they won't survive.

Allelopathic plants can be used as cover crops and their residues can be incorporated or applied as mulch to control weeds. Timing of application should be chosen carefully since some of the crops inhibit wheat growth. More work, however, is necessary to determine the efficacy of these extracts under field conditions and to determine the allelochemicals involved. We are certain that allelopathy in meadowfoam, radishes, and mustard is attributed to a group of biomolecules called glucosinolates. Allelochemicals can be used to formulate natural herbicides and some of the plants we evaluated are potential sources. The development of natural herbicides may lead to the expansion of organic farming and, furthermore, pave the way for the development of direct seed organic farming, a system that combines direct seeding and organic farming.