Physical Control of Pests

Physical control refers to mechanical or hand controls where the pest is actually attacked and destroyed. Physical controls are used mostly in weed control. Tillage, fire, removal by hand, grazing and mowing are all used to destroy weeds and prevent reproduction. Some insects may also be destroyed by tillage, which destroys their eggs or overwinter stages of growth. Weeds are not controlled through a single operation.

Practices such as seedbed preparation, post-seeding tillage, post-harvest tillage and summer fallow are effective in combination against weed seedlings and perennial weeds. The choices will vary with the region, crop, degree of infestation, soil condition and availability of equipment.

Soil factors influence the selection of machinery. For example, stones may prevent mowing and moisture conservation may prevent the use of repeated tillage. Consider all factors before you develop an integrated control program.

Harvest Practices

Strip harvesting

Strip harvesting leaves an unharvested strip of crop in the field, which preserves natural enemies of pests, prevents mass migration of pests and improves snow management. The harvest of a whole field of an infested crop may force insects such as beet webworm, pea aphid, cutworms and grasshoppers to migrate to another field. If the crop harbors beneficial insects (as it almost certainly will if it is infested), the harvest often destroys them, their habitat and their insect food source. The next parasite generation may even be removed from the field with the harvested crop. Thus, the pest often moves to a new crop free of its natural enemies. Strip harvesting helps maintain a stable ecosystem.

Successful strip harvesting is practiced in alfalfa pest management. Alfalfa provides an ideal habitat for a variety of insects, ranging from pests (alfalfa weevil, lygus bugs, pea aphid and alfalfa plant bug) to beneficial insects (damsel bugs, lacewings, ladybird beetles, pirate bugs, wasps, spiders and leafcutter bees). Harvesting alfalfa causes winged pea aphids to migrate and settle on other crops, while many of the beneficial insects are destroyed. There are, for example, tiny wasps that sting and deposit eggs in aphids. These parasitized aphids will be destroyed with the harvested crop, but winged healthy aphids will migrate to new areas, free of an entire generation of wasps.

To strip harvest alfalfa, cut alternate rows. When the rows that were cut have undergone some re-growth, cut the remaining rows. Alternatively, simply leave some strips or patches unharvested. Strip harvesting also provides a deeper snow cover. This can reduce winter kill during severe winters and enhances spring soil moisture conditions.

Early swathing

Early swathing can sometimes save a crop. By the time wheat that is infested with sawfly reaches maturity, the stems may have collapsed, making harvest impossible. Badly infested fields may be saved from pests such as wheat stem sawfly (or weeds) by an early harvest or by the production of hay or silage.

Unless diseases or pests are suspected, or fast drying is required, grains should be straight combined whenever possible. Straight combining permits, a taller stubble and improves snow management.

The time of harvest may affect disease development and yield. Alternaria black spot of canola and mustard attacks pods late in the season. Early swathing of badly infested crops may reduce losses caused by shattering. Lay swaths so that air can circulate beneath the grain to encourage drying. If canola remains moist, sclerotinia white mold can continue to spread in the swath.

The grains of cereal crops that have lain overwinter in the swath, particularly under a snow cover, may become infected with fungi that can produce mycotoxins under certain conditions. Mycotoxins are poisonous chemicals that occur naturally as by-products of fungal species such as Cephaolosporium, Fusarium and Aspergillus. Fusarium can produce vomitoxin, which may be present in hay and grain and results in production losses in animals and illness in humans.

A group of mycotoxins, the ochratoxins, may be carcinogenic and may be found in trace amounts in grains that heat during storage on prairie farms. These mycotoxins are sometimes present in the meat of poultry and hogs that have consumed contaminated feed.

Mowing

Repeated mowing controls perennial weeds by depleting root reserves. It will also prevent seed production of annual and biennial weeds. Root reserves in perennial weeds are lowest when plants are in bud. If only one mowing is planned, it should be at this stage. Mowing is not effective for prostrate weeds such as field bindweed.

Mowing is often harmful to beneficial enemies of farm insect pests. Farmers need to know the life cycle and habitat needs of the beneficial species, so they can adjust mowing practices. One obvious example is the provision of habitat for birds. Birds consume huge quantities of insects and many of them nest in grass. Early mowing is one cause of nestling mortality. Wherever possible, the farmer should avoid mowing or heavy grazing until mid to late July.

Hand pulling

Although small patches of perennial weeds can be pulled up repeatedly, hand pulling is most effective for annual and biennial weeds. Pulling of annual weeds prevents seed production. If weeds are in flower, bag and burn them to prevent seed spread. Hand pulling is most feasible when you are trying to prevent the establishment of new species. Hand rouging is a routine practice on pedigreed seed farms and is practical even on large areas if the infestation is light.

Tillage

Tillage was one of the first methods of weed control. It is fundamental to integrated weed control. Annual weeds, biennial weeds without extensive tap roots, and perennial seedlings are readily destroyed by tillage. The younger the weed, the easier it is to control. Tillage effectiveness relates directly to the amount of soil disturbance. The greater the disturbance, the greater the effect of tillage is on weed control.

The choice of implement depends on residue cover, soil type, soil moisture, growing conditions and weed growth. Blade implements, such as the Noble or Victory blade cultivators, conserve trash but are not very effective under cool wet conditions. Implements that bury plant residues are effective in wet conditions but increase erosion potential. Reduced tillage is desirable in the Brown and Dark Brown soil zones, particularly on sandier soil and following dry years that produce little residue cover. Field cultivators and rod weeders are a good compromise.

Percentage of straw reduction by selected tillage operations:

Soil moisture conditions	Implement	Surface residue reduction

Moist	**Plow**	**100**
	Tandem-disc	**50-60**
	Rod weeder	**5-10**
	Field cultivator	**20-30**
	Chisel plow	**15-20***
Dry	**Blade cultivator**	**5-10***
***less residue loss with low crown sweeps.**		

Summer fallow is used to control weeds, conserve moisture and nutrients, and retain crop residue to protect against soil erosion. Summer fallow is most effective against perennial weeds. However, it is also helps deplete the supply of weed seeds in the soil because tillage promotes germination of weed seeds.

As flushes of weeds appear, they are controlled by tillage or with herbicides. Use herbicides when tillage is not effective or where soils are susceptible to erosion. Summer fallow contributes to erosion, salinity and organic matter loss and therefore should be used with care. Field cultivators with wide sweeps sever roots of annual and perennial weeds. After the soil has been loosened, a rod weeder will penetrate and provide good annual weed control with minimum moisture loss. Blade cultivators can be used in dry areas where minimal soil disturbance is desirable. Till during hot, dry but calm weather.

One year of summer fallow will reduce weed problems, but not eliminate them. Dormant weed seeds will remain to germinate and emerge in subsequent years.

Pre-seeding tillage

Shallow tillage (less than 7.5 cm) in early spring encourages germination of most weed seeds. A second shallow tillage will destroy the seedlings and prepare a seedbed. Use a disc-type implement if crop residue is heavy. A rod weeder or cultivator will work when less residue is present. This practice is most effective for weeds that germinate in cool soils such as wild oats, mustards and hemp nettle.

Post-seeding tillage

This practice will control weeds that emerge with or shortly after cereal crops, sunflowers and potatoes. In some instances post-seeding tillage can cause severe crop injury and should be done with caution. For example, inter-row cultivation of corn and vegetables is a less injurious form of post-seeding tillage than a blanket cultivation. However, rod weeding of cereal crop to destroy early emergent weeds when the crop sprouts are still below the depth of the rod weeder is a relatively safe practice. Well-established cereals, sunflowers and potatoes will survive cultivation with a harrow that kills delicate, shallow-rooted weed seedlings. Crop damage will vary with soil type, weather at the time of tillage, the kind of crop and the depth of seeding. Tillage will be most successful on moderately deep, firm soil where deeper seeding occurred.

Cereal crops seeded 8 to 10 cm deep, and at rates 25 per cent greater than normal can be cultivated with a harrow or rod weeder before crop emergence for the control of weed seedlings that have just emerged. This operation is risky and should be done only as a last resort. The concerns are crop injury and increased disease from deep seeding. Cereal seed should be treated with a fungicide to minimize seedling diseases. Tillage before crop emergence should be less than 5 cm deep and must be done before crop sprouts are 2 cm in length. This will usually be within three or four days of seeding. The best weed control occurs when the soil surface is dry. With post-seeding tillage, some crop loss is inevitable and should be accepted by the producer if this practice is followed.

Post-emergence tillage

Wheat and barley seeded 8 to 10 cm deep and up to 25 per cent heavier than normal can be harrowed after emergence. Till at the 1 to 4 leaf stage before tillers form. Light harrows can be pulled slowly and parallel to the seed rows. Post-emergent tillage with a harrow may delay crop maturity by a minimum two or three days. Check

crop plants during tillage. Irreparable damage will occur if crop roots are loosened, broken or damaged. Avoid tillage if the crop is under stress. In a dry spring, this operation will cause more damage than the potential damage caused by the weeds. Generally, barley is more susceptible to damage than wheat. Post-emergent harrowing in fields with heavy trash cover is not recommended because straw will clog the harrows and damage the crops excessively. Herbicides are a better alternative in most instances.

Inter-row tillage

Tillage can reduce weed populations in row crops such as potatoes and sugar beets. The first tillage should be early and shallow. Subsequent passes can be made if required. Take care to avoid crop injury.

Fall tillage

Seedlings of winter annuals and some perennial weeds can be controlled with early fall tillage. Use a blade cultivator in the Brown soil zones to maintain stubble. Field cultivators can be used in the other soil zones. If stubble is sparse, avoid fall tillage and till early in the following spring. The time of fall tillage varies with the weed species. In general, fall tillage is done between crop harvest and soil freeze-up. Both fall tillage and a fall application of herbicide are very effective on winter annuals and should be part of most weed control programs.

Grazing

Grazing serves the same purpose as mowing in weed control. The main reason for mowing weeds is to prevent seed production. To be effective, grazing must also prevent seed production. Therefore, the age of the target weed is an important consideration in a grazing program. Weeds are most palatable when they are young and become less palatable with age. Grazing should be initiated when weeds are still palatable and before seed formation.

There are few situations where grazing will accomplish as much as mowing. This will depend on the target weed, the grazing system and the grazing animal. Many grazing schemes do not provide effective weed control because grazing animals are not available at the appropriate time, and fencing and management are inadequate or inappropriate to ensure that top growth and seed production are curtailed.

Grazing system

The grazing system should reduce the grazing animal's choice as much as possible. Systems that employ herded sheep and goats and short-duration grazing with cattle have been used successfully. Short duration means a high number of animals per unit area for a short time.
Selectivity is governed by the palatability of weeds to the grazing animal. Palatability decreases with the age of the plant. Therefore, you should start to graze early in the season when weeds are most palatable.

Grazing animal

When choosing a grazing animal, consider the species of weed, the maturity of the weed, the availability of animals for grazing and the nutritional requirements of the animal. Each animal species tends to have a characteristic, preferred diet.

Generally, cattle and horses are grazers and select a diet dominated by grass and grass like plants. As an example, cattle and horses are ideal when the target weed is quackgrass or downy brome. Horses may select for quackgrass over Russian wild-rye. Horses avoid Russian wild-rye when other forage is available.

Goats are browsers and select a high percentage of woody material in their diet. Goats select 40 to 80 per cent shrubs in their diet on North American range lands. Alberta Public Lands have used goats on tame pasture to reduce sucker growth of aspen.

Sheep are intermediate feeders and select more broad-leaved plants, including many weedy plants. Sheep avoid tall plants, litter and tall grass. Sheep can modify their diet to include more browse or grass than other domestic

animals. Sheep are used more often than other species to harvest weedy plants, and may be the best animal to try on many problem weeds.

Trap Strips

Crops especially attractive to insects may be grown in strips around fields. Here the pest insects can be concentrated and killed with insecticides or cultural practices. These attractive crops may simply be the same crop seeded at a different time or may even be a volunteer crop or weed. For example, corn borer adults lay eggs in the tallest plants. Trap strips seeded earlier or to a faster maturing variety, or planted next to a grassy strip, tramline or headland, concentrate corn borers and provide efficient control for the rest of the field.

Trap strips are also effective against wheat stem sawfly. Sawflies will fly only as far as necessary to lay their eggs. If trap strips of a resistant, solid-stemmed variety are planted around the perimeter of a field, sawflies will lay their eggs in this strip. Larvae do not survive in the solid stem. Sow trap strips for sawflies earlier than the main crop so that the stems will be more mature and thus more attractive to egg-laying females.

Bromegrass provides a permanent trap for sawflies. Sawflies readily lay their eggs in bromegrass, but grass also harbors parasites that control sawflies.

Trap strips reduce erosion and increase soil moisture and overwinter survival of fall crops and perennial crops.

Fire

Pest control with fire is not recommended. It is often ineffective because the temperature at ground level is seldom high enough to affect pests in the soil. Fire destroys crop residue and organic matter that could be incorporated into the soil. The destruction of the crop residue with fire may leave the soil susceptible to erosion. Fire may be particularly destructive to beneficial insects. Fire may not kill healthy larva and pupa of pests that overwinter beneath the soil but may kill beneficial insects overwintering near the soil surface.