WEED CONTROL IN DEPTH By Tim Braun

Weed Systems By Tim Braun

When a weed is attacked by a farmer, the weed can only stand and take its punishment. Weeds can't run away from danger. Unlike animals who are mobile, weeds cannot move from one spot to another except for wild oar seeds that have awns or small rods on the sides of their seeds. When wild oat seeds are on the soil surface these awns can pick up moisture and swell causing the awns to push into the soil and twist the seed. This twisting action drive the seed into the soil away from birds that eat the wild oat seeds. If most of the weeds have this grave disability of no mobility, why are weeds such a problem? The answer is that stationary weeds possess many advantages that animals do not possess.

During this course we must remember that when I say weeds. I am also talking about plants. (1) A weed is often referred to as an unwanted plant "a plant out of place". A wanted plant is a crop. Weeds and crops are very much alike. Weeds and crops are often treated alike by farmers. This is one of the many advantages that weeds have. It's one reason why weeds are so hard to control. Applications of weed killers damage the non resistant crop if the weeds are located within the crop. (2) Cultivation to destroy weeds in a crop can cut crop roots and result in slow crop development. (3) Herbicides often kill or weaken growing crops when applied to kill weeds in herbicide susceptible crops.

If an animal has a leg or arm cut off, the animal can't replace the arm or leg by growing a new one. Cutting off a stem of a weed will result in the weed growing entirely new stems from cells. The same is true when the roots of weeds are cut off. They grow new roots. This ability of weeds to produce new growth throughout the life of the weed is one of the major differences between plants and animals.

When an animal is growing to maturity all the body parts grow in proportion to each other. The animal stops growing when it reaches a certain size. Some of the animal cells continue to divide. Even after the animal quits growing. This is true for blood cells and the internal and external cells of the surface membrane or the skin of the animal body and its organs. The division of animal cells occurs to replace or repair old or damaged cells. Animals do not grow new body parts by the division of their cells.

The division and growth of new cells of weeds do not replace or repair damaged or old weed cells. If a flower is removed or damaged, it isn't replaced or repaired. Instead completely new weed body parts emerge. The new weed body parts may be shoots, buds or new roots. Weeds contain areas of cell division, maturing cells and mature cells. All weed cells divide and multiply from basic meristem cells. The location of meristem tissue that contains basic meristem cells is in several areas of the weed.

- Apical meristems tissues are found in the tips of shoots and roots. Apical cells are responsible for up and down growth of the weed. The xylem and phloem vascular tissue are produced by these cells.
- The lateral or secondary meristem tissues are found between other mature tissues and in the outer edges of plants. These tissues are responsible for horizontal growth increasing the diameter of the plant parts.
- The intercalary meristems tissues are found in monocots (the grasses) at areas on leaf blade attachments and at internodes. Monocots have leaf blades. They do

not generally increase in width. They extend in length. The growth of cut or mowed grass is produced by meristem cells in the intercalary meristem tissues.

This advantage of the weed can be partially overcome by the use of contact weed killers to destroy meristem tissues.

All the weeds' genes that decide every part of development and growth are found in each living cell.

Meristem plant cells after they have started to divide and taken on a specific growth pattern can revert back to being a basic meristem cell. Depending on the environmental conditions at that period of growth. This basic meristem cell can re-differentiate itself and then start growing again by dividing and growing as another body tissue. It could become a root, bud or shoot.

An example of secondary stem node meristem cells reverting back to basic meristem cells and dividing as root cells is the purselane stem cutting caused by disking. When irrigation occurs after disking, the purselane stem cuttings grow new roots from basic meristem cells in the cut stems. In those conditions, cutting off stems by discing, the weed needs roots to survive not stems. Using a reliable contact weed killer, like Paraquat, before disking purslane will destroy many of the meristem tissues of the weed. After the weeds in these sprayed fields have died, these sprayed fields should be disked before any new growth occurs. Any missed living meristem tissue will produce new growth.

Weeds have cell walls that support and protect each individual cell. Animals don't have cell walls. Animals have cell membranes. This animal membrane holds the cell fluid and vital parts. The animal must depend on an interior or an exterior skeleton for support; whereas a weed uses its cell walls as support.

Weed cell walls are secreted and laid out by excretions from living cells. Aferte the new wall has hardened it is filled with the identically devided cell membrane and ingredients forming a new cell with a new nuclei. This division of cells is how weeds grow. Cell walls have various amounts of thickness which is determined by the stress placed upon the cells. If the plant is shaken as in the case of wind, the living cells can be stimulated to produce thicker walls for more support. Most plant cell walls contain cellulose and can stretch and lengthen during windy conditions.

The cell walls become dead tissue of the plant. Unlike animals a large portion of the plant consists of dead tissue. Within the plant body water can pass through the dead cell walls. Cells on the weeds' surface or epidermis have cuticle outside their cell walls. The cuticle on epidermal cells is a waxy material that prevents water loss from the weed. The cuticle on the epidermal cell walls is a barrier that prevents herbicides from entering the weed.

The cell walls have openings or holes, plasmodesma, through which the weed cell material inside its membrane is connected to the rest of the living cells of the plant. Water and other plant needs flow inside the membrane through these openings going from cell to cell. The living cells of the entire growing weed shares the same cell membrane with the entire weed's cells.

A living weed cell membrane of a plant or weed is similar to a rubber balloon containing fluid and with various materials in a building. The balloon skin can fill many rooms spreading from room to room through openings in the walls dividing the rooms.

The particles and fluid in the balloon can travel from room to room through these openings in the wall by staying inside the membrane or the balloon. The living cells in each room can build new walls for room additions to extend into.

These cells do separate functions for the plant.The apical procambium meristem tissue cells in new shoots and roots divide and become the vascular system of the plant. This system transports food, water and systemic weed killers throughout the weed. These dividing procambium meristem cells produce the two transporting tissues of the weed. The transporting system is called the xylem and the phloem.

While the cells of the new xylem are young and alive, they have no function. Once xylem cells mature and die their cell walls function as the carrier of water, minerals and herbicides from the roots to the top of the plant. The xylem of the plant is part of the dead tissue and is a vital part of the plant.

The xylem cell walls lose their top and bottom ends or have holes in them. This maturity resulting in the loss of end walls and dissolving of the living xylem cells, creates a continuous tube of dead cell walls from the roots to the top of the plant. The xylem walls contain rigid lignin which is a product in wood. The thick xylem walls must be strong enough to withstand the pressure exerted by the transfer of water to the top of the plant. These thick, rigid dead walls of the xylem become a means of support for large weeds and trees. Tree xylem cells mature and die in one year. Each ring of dead xylem cells counted on a cut tree stump indicates a year of age.

The weed gets all the available soil water it requires using very little if none of its own energy.

Water moves from wet areas to dry areas. This type of movement of water is called *diffusion*. The roots are in wet or high water areas. The surface of leaves are in dry or low water areas. The process of photosynthesis requires high amounts of water that is allowed to escape from the leaves to the atmosphere. This transpiration or evaporation of water creates a vacuum pull of water from the plant roots. Water moves from the roots to the transpiring leaf area by *diffusion* in the xylem.

Water molecules attract one another by cohesion. This magnetic attraction *cohesion* occurs in the tiny tubes of the xylem forming a column of water from root surface to the leaf.

Water molecules stack and adhere to the sides of the xylem tube counteracting the force of gravity by *adhesion*. The *adhesion* helps to lift the column of water formed by cohesion.

The *diffusion, cohesion and adhesion* of water molecules work together to move water up the xylem tubes. There are pores along the dead xylem tubes allowing the water and other materials to leave the xylem tubes at any level where water is needed by the plant. Movement of water from the xylem tubes to plant areas of need is called *diffusion.* Dead xylem tissues provide support for the veins, stems, limbs and trunks of growing plants.

The same vascular meristem tissue that produces the xylem also forms the phloem tissue. The phloem cells are formed with a cell wall around their membrane and cell contents. These long phloem cells inside their walls are formed end to end. The cell wall has openings in the ends to allow the cell membrane and contents to pass through. Phloem tissues are alive and form a living transfer system.

The phloem tissue is situated on the outside of the xylem tissue. This vascular system with the xylem inside and the phloem outside forms a visible ring when a stem is cut horizontally on dicot plants like cotton.

The monocot plants like corn and grasses have scattered bundles of vacular tissues in their stems. Both monocot and dicot plants have the xylem on the inside and the phloem on the outside of the roots, stems, shoots and veins.

Products in the phloem move up, down and across the plant. When you put a herbicide into a leaf that you want to get to the roots you will use the phloem to get it there.. The living phloem is used by the plant to move sugars from where they are produced to plant locations where these sugars are used by the plant. Weed nutrients, proteins and other molecules are also moved in the phloem to areas where they are needed.

The place in the weed producing the sugar is called the "source". The area where the sugar is being used is called the "sink". The "sinks" can be new shoots, new bud formations, fruiting areas, new root growth or storage areas in the weed. The sugar produced through the process of photosynthesis enters the phloem. In the confined phloem tube the mixture of water and sugar swells up. This swelling causes pressure build up. The pressure caused by combining sugar and water pushes the sugar and water to the place where the food is used by the weed. This is called " the sink". When the sugar reaches a "sink" like a growing shoot, the sugar or food is used in the growth of the shoot. The water is diffused to the other areas of the plant where it is needed.

When the sugar reaches a storage area like the roots an enzyme causes the water soluble sugar to form molecular long chains. The chains of sugar molecules are called starch which is not water soluble. Because of this insolubility of starch the water diffuses away from the storage area to an area in the plant where it's needed. When food is needed by the weed in another area of the weed an enzyme causes the starch's long chains of sugar to separate. The sugar is water soluble again and this area becomes a "source" and the phloem is used again to carry the sugar and combined water to the new "sink" or use area.

The phloem cells remain alive with living cytoplasm and cell membranes as long as they function. When phloem cells die, the cells and their cell walls dissolve unlike the xylem cells that become dead tissue water transferring tubes. New phloem is produced in the vascular system from procambium meristematic cells. Unlike the xylem tissues that are dead and used by the plant as transporting tubes the phloem cells completely dissolve when they die.

Fluids in the xylem travel 15 times as fast as fluids in the phloem.

When applying systemic herbicides like Round Up the application is more efficient under certain growth conditions.

1. If the shoots have recently started to grow these young shoots are in the "sink" stage of growth. They are receiving food; therefore they will not move the herbicide to other locations in the plant. Applications of Round Up to very young shoots will only kill the shoots.
2. Apply herbicides when shoots have matured and have become "sources". Mature shoots will be pushing food to other parts of the weed that you want to kill.
3. Parts of the plant that are budding and flowering are "sinks". They are receiving food along with your herbicides just like the young shoots and storage areas like the roots.
4. Sunlight is used by the weed as a source of energy that the weeds use to make sugars.

The sugars are moved from leaves to other parts of the weed. Apply post emergent herbicides like Round Up during sunny conditions in the morning .

5. Weeds that are stressed or wilting reduce their photosynthesis process that makes and sends sugars to the rest of the weed. Hot midday weather is not a good time to apply systemic herbicides.
6. As cool winter weather approaches perennial and biennial weeds tend to manufacture and store sugars. There is a movement of materials in the phloem to the roots. Apply systemic herbicides to the mature leaves of these weeds in the late summer and fall months.

Animals are secondary receivers of energy. Weeds are primary receivers of energy. Because weeds have plastids and animals don't. Weeds get their food needs for energy directly from the sun. In the living weed cells, plastids store molecules of several different types. Animals do not have plastids or chloroplasts.

One of the most important molecules stored in plastids are the chloroplasts. The chloroplasts are the site where photosynthesis takes place. This is where sunlight energy, carbon dioxide and water are combined to produce food for weeds.

Weeds can stay in one place, sit back to get all their energy, nutrient and water needs served to them. Animals have to run around growing food, killing and eating plants and other animals to stay alive. If the weeds are growing in a farmers crop, the farmer is probably supplying fertilizer and water to the lazy old weed. Their food comes from the sun and their other nutrients from their roots that allows them to stay in one spot.

Weeds and animals both have vacuoles in their living cells. The vacuole in a weed is much larger then in an animal and many species of animals do not have cell vacuoles. The weed vacuole can occupy up to 80% of the inside space of a living weed cell. The vacuole is used for support, storage and waste recycling. Some weeds are herbicide resistant because of chemical breakdown in the weed cell vacuole .

Weeds do not excrete their internal waste products. (I'd rather walk a weed than my dog). The recycling of weed waste products results in the production of many materials. Some of the substances are poisonous and unpleasant to animals and insects. Other substances are used by the weed. Other materials put out pleasant odors. The main function of the vacuole is to provide structural support for the plant. The vacuole fills with water and exerts pressure against the cell walls. Wilting of weeds is caused by a reduction in amount of water held in the cell vacuoles.

Another barrier to herbicides is the large amount of dead tissue that exists in a weed. Herbicides can enter the dead areas of a weed and become tied up and breakdown. One of the herbicides that is tied up by dead tissue in living weeds is Paraquat.

Weeds use all of these advantages that I have written about to survive and compete with growing crops. The perennial weeds have crowns, roots, rhizomes and stolons as well as seeds full of meristem cells which produce new weed body parts. Annual weeds produce seeds full of meristem cells eager to start growing new body parts

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

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Weed Herbicide Barriers By Tim Braun

Most of the physical barriers against herbicides are part of the weed's structure to keep moisture inside the weed. These water saving barriers have evolved in weed species that survived throughout the ages. Weed scientists have developed herbicides and application techniques that when applied properly will penetrate most of these barriers.

When herbicides are applied to weeds they have to pass various barriers that block their access to the weed's vital organs. These barriers include: (1.) The soil environment for soil applied herbicides, (2.) The air around growing weeds for post emergence applied herbicides.(3.) The weed seed coat for soil applied herbicides. (4) The skin or epidermis of the weed's root system for soil applied herbicides. (5.) The endodermis of the weed for soil applied herbicides. (6.) The epidermis of the weed above the roots for plant surface applied herbicides.(7.) The weeds internal physiology for soil and plant surface applied herbicides.

Several herbicides accomplish these barrier penetrations without upsetting the weeds ability to maintain its needed moisture. Herbicide efficiency depends on vigorously growing weeds that can move the herbicide to the vital organs of the weed.

Environment Of The Soil As A Barrier

Preplant soil applied herbicides are manufactured to react positively to the soil environment that it encounters. The herbicide attributes that make the herbicide react positively to the soil environment includes: the site of herbicide uptake; water solubility of the herbicide; and the herbicide's capacity for adsorption, persistence, leaching potential, volatility and anti-photodecomposition.

In the soil environment the following factors have a pronounced affect on the use of herbicides: the water table level, the cation exchange capacity, organic matter, soil type, pH, temperature and the soil moisture level.

Soil applied herbicides are incorporated at a depth of 0 to 3 inches to enter the weed seed, shoot or root.

A herbicide will not be activated and kill the weeds unless it is dissolved. The solubility of the herbicide doesn't affect the leaching as much as the adsorption on soil clay and organic matter.

In most cases when the herbicide is soluble in water, adsorption to soil colloids by the herbicide decreases. Leaching increases. The high solubility of a herbicide doesn't always mean that the herbicide will not adsorb to soil colloids. Paraquat (Gramoxone) and Round-Up (glyphosate) are highly soluble in soil water, but they are very tightly adsorbed to soil colloids. The highly soluble Paraquat and Round Up are not considered to be a concern for leaching to the ground water table of the soil that they are applied in.

Neither Paraquat nor Round Up are soil applied herbicides.

Absorption occurs when one substance enters another structure. The roots, shoots and seeds of weeds absorb soil water. The absorption of water soluble herbicides is a passive process. When herbicides are dissolved in the soil water they enter the weed seedling and seeds when absorbed along with the soil water.

The herbicide that stays in the soil environment is partially in the soil water and partially bound or adsorbed to the soil colloids which includes organic matter and the soil clay. Adsorption occurs when liquids, gases or solutes accumulate on the surface of a solid. The adsorption of herbicides on the soil colloids is caused by the attraction between the electrical charges on the herbicide (positive +) and the soil colloids (negative-) charge.

The electrical charges that hold the herbicide to the soil colloids are not very strong. This tie-up or bonding is easily broken allowing the herbicide to go back into the soil water. This weak bonding maintains an equilibrium between free herbicide and bound herbicide.

There is an equilibrium in the soil environment that is maintained when adsorption, degradation, or other processes occur. If herbicide molecules in the soil water break down because of degradation, they will be replaced by active herbicide molecules that are released from the soil colloids back into the soil water. Also as the herbicide molecules adsorbed on the soil colloids degrade they are replaced on the soil colloids by the free herbicide molecules in the soil water. These two processes occur because an "equilibrium" must take place with each herbicide in the soil environment. There is a certain amount adsorbed on soil particles and a certain amount in the soil solution.

Soil type, which refers to the amount of clay, loam or sand, has more to do with the adsorption of a herbicide then the types of herbicide applied. The herbicide label will in most cases give the rate of herbicide use based on the soil type. The higher the amount of clay in a soil, the more herbicide is recommended. This rule also applies to organic matter. Controlling weeds in high organic soils requires more herbicides. Soil herbicides are not recommended for use on soils with very high levels of organic matter like the peaty muck soils found in swamp like soils.

The Air Around The Growing Weed As A Barrier

When desiccating or defoliating crops in the moist humid areas of the country less desiccant and defoliant is required compared to dry arid regions of the country, like desert areas. Growing plants have a material in their surface that prevents the loss of water to the atmosphere around them. Where the surrounding air is high in moisture (high humidity) the loss of water by plants is less than in dry, low moisture areas like the desert.

This material located at the surface or epidermis of the growing plants that prevents water loss is comprised of a wax material. This epidermal wax becomes hard and impermeable in low humidity areas like the desert and soft and permeable in high humidity areas therefore more defoliants and desiccants are applied per acre in the desert.

Wind can move the herbicide from the target weed during application. Sunlight can break down herbicides. Rain can wash the herbicide from the weed. Fog can collect herbicide from the air during application and wind can move it to non target crops. Herbicide applications on foggy days should be avoided.

Seed Coat As A Barrier

One of the attributes of herbicides is their manufactured ability to enter the seed, root or shoot. The herbicide, Balan, can enter many germinating weed seed coats.

Seed coats are a mechanical protection for the embryo of the seed. The seed coat is made up of mature dead cells that are called sclerenchyma cells. Mature sclerenchyma cells do not contain living cytoplasm and cell membranes. Some weed seed coats like malva are extremely impervious to water and herbicides.

Moisture increases the respiration of the seed embryo inside the seed coat. Oxygen from the air around the seed enters the seed coat along with some other gases. This intake of gases and moisture increases the intake of herbicides in the gas form to the inside of the seed coat. Chemical herbicides like the fumigants can enter the seed coat. Soil fumigants kill weed seeds by reducing the respiration of weed seeds. Weed seeds die from suffocation when treated with soil fumigants.

The Weed Skin Or Epidermis Of The Weed’s Root System As A Barrier

The dormant seed contains an embryo with growth meristem cells that can actively divide and form the first roots and leaves. By the time the weed seedling has lost its seed coat the weed has developed a skin layer of cells that will cover the root, shoot, stem, leaf, flower, fruit and seed embryo of the weed. The skin layer of cells of the weed’s roots is referred to as the root epidermis. The uptake of water and some herbicides by the root is much easier than the uptake of water and herbicides in any other part of the weed. The roots’ epidermal cell walls do not have a waxy cuticle. This allows water, nutrients and some herbicides to enter the root system.

The root skin cell layer does not include the root cap. The root cap protects the developing root cells behind it as the root grows through the soil particles. Just above the cells of the root cap and inside the epidermal cells is where new root cells develop. The new root cells elongate pushing the root deeper into the soil. When the root elongation is rapid some weed roots can grow deeper and through the zone of any soil applied herbicides. Lettuce roots have the ability to rapidly grow deeper below soil applied herbicides. Lettuce is not affected by some soil applied herbicides while the competing weeds that do not have this ability are killed.

Above the cell elongation area of the root is the location of the plant cells that have root hairs. The root hair surface increases the absorbing area of the plants root system enormously. Water, nutrients and herbicides enter the weed through this vast absorbing root hair area of the weed. In the young weeds water and herbicides enter the epidermal root hairs and go directly into the xylem, the tissue that carries water up the plant. This is another reason to apply herbicides to very young weeds.

In some weeds especially in the arid desert the seedlings develop a cylinder of cortex cells just inside the skin or epidermis above the root hair area of the root called the hypodermis. The hypodermis cell walls are enriched with waxy suberin which prevents the loss of water and nutrients that have been absorbed by the root hairs. The hypodermis with resistant cortex cells is located just below the soil surface around the shoot. It is another barrier that prevents the absorption of shallow soil applied herbicides.

The Endodermis Of The Root As A Barrier

Located in the interior of the roots are the weed’s vascular tissues. The tissues that water moves up into the weed is called the xylem. The other main plant vessel that moves food processed in the leaves to the roots and moves sugars stored in the roots up into the plant when needed is the phloem tissue.

Water after entering the root epidermal cells must make its way to the weed's vascular system. In order to reach the leaves of the plant the water must enter the xylem. The xylem tissues are located on the inside of the living phloem tissues.

The endodermis inside the root is a cylinder containing a thick waxy material that surrounds the vascular system. The endodermis keeps the water in the weeds vascular system from escaping from the weed back into the soil. The endodermis blocks the entry of herbicides. Water and some herbicides can penetrate living cell membranes, but not through where the endodermis is located. There is a way through the endodermis.

A living weed cell membrane is similar to a rubber balloon containing fluid and situated in a building. The balloon skin can fill many rooms spreading from room to room through openings in the walls that divide the rooms. The particles and fluid in the balloon can travel from room to room through these openings in the wall by staying inside the membrane of the balloon. The cell membrane is shared by all the cells in the living plant. Each particular cell has its own cell components divided from other cell components buy barriers through which liquids can pass. All of these individual cells exist in one common cell membrane.

The membrane has a different make up for different cells depending on what is needed to protect the cell contents. Membrane for the root hairs is of a nature that will allow water to penetrate it. Water enters the root hair membrane by osmosis. Water flows from a high area of water molecules (the soil solution) to a low area of water molecules (the xylem of the plant).

This is how water, nutrients and some herbicides get through the waxy barrier of the endodermis. Water enters the cell membrane outside the endodermis and stays inside the cell membrane passing through the small openings or windows in the endodermis while inside the cell membrane. Water is now in the cells of the xylem where it travels up to the vital parts of the plant. If herbicides have been added to the soil water they can travel to the same vital parts of the plant in the water where they do their damage.

The Epidermis Or Skin Of The Weed Above The Roots As A Barrier

Some herbicides that are soil applied can enter the weed shoot before it emerges from the soil. The volatile herbicides like Treflan, Far-Go and Eptam can enter the shoot as a gas. Herbicides that can enter the shoots include: Dual, Prowl, Pursuit, and atrazine.

Once the shoot grows beyond the soil surface its epidermis cells become similar to all the above ground epidermal cells exuding a waxy cuticle coating on the cell membrane surface. Post emergence herbicides can enter the above ground shoots after penetrating this waxy cuticle. Adjuvants may be added to help herbicides penetrate the waxy cuticle.

Unlike the leaves, stems do not have veins. Stems like leaves and above ground shoots do have stomata. Stomata are small openings in the epidermis to allow gases to enter and water vapor and oxygen to leave the interior of the plant.

The outside of the cell membrane located above the soil surface protects the tissues of the entire weed with its wax cuticle and hair-like growths that protrude from epidermal cells. The cuticle layer of wax on the surface of the epidermis keeps water from being lost from the weed.

The cuticle on the outer surface of epidermal area of the cell membrane generally has three layers that over lap one another. The outer layer of the cuticle primarily contains wax to keep water inside the plant. Applied herbicides that can't penetrate this wax are kept out. The use of adjuvants can increase the herbicide penetration.

The mid layer of the cuticle contains wax with imbedded strands of a material called pectin. The strands of pectin in the cuticle are water loving and will allow water soluble herbicides to pass through them.

The 3rd inner layer of the epidermal cuticle contains less wax and pectin strand, but with more water soluble areas that will allow water soluble herbicides to enter the weed's interior cells where photosynthesis occurs.

The cell membrane of epidermal cells can sometimes contain hair-like protuberances. These hairs keep the herbicide away from the weed's surface. As the herbicide dries out on the leaf surface it is susceptible to being blown away by the wind. Also the hair like protuberances if not too numerous on the leaf or stem of the weed can hold the herbicide on the weed increasing weed control.

Internal Differences Of The Weed That Are Barriers to Herbicides

Herbicides are made to kill weeds by inhibiting functions of the weed that keep it alive. The areas where these life supporting activities exist in the weed are called sites. Herbicides must get to these sites and supposedly shut them down.

The vital life supporting sites in weeds include: amino acid production sites; chloroplasts where photosynthesis takes place; seedling shoot growth areas; and lipid or certain fat producing sites.

Like all other living things weeds are not all exactly alike. Even though they are of the same species. They can look alike but they have genetic differences. This genetic difference may be an alteration that changes the life supporting site. Genetic differences in life supporting sites may make a herbicide ineffective in shutting down these sites.

The herbicide Treflan inhibits the seedling root development protein called the tubulin protein. If a weed has a different tubulin protein due to its genetic make up, this particular weed could possibly survive a Treflan treatment.

The herbicide Passport has a mix of the chemical from Treflan and the chemical from Pursuit to overcome this resistance. Pursuit inhibits the development of an amino acid protein. This method of weed control works on two of the weeds life supporting sites instead of one. Rotation of the two herbicides can be used if the crops have label clearance.

Some weeds can break down the herbicide before the herbicide reaches the weed's life supporting site. Other weeds can compartmentalize weed killers in their cell walls. The cell walls of weeds are dead tissue therefore the herbicide becomes ineffective in shutting down life supporting sites. Crop and herbicide rotation plus cultural practices can be used to overcome these herbicide resistant weeds.

Roundup ready crops have been genetically engineered to overcome the fatal effects of the chemical (glyphosate) and can be treated with the chemical without perishing like the weeds that haven't been genetically engineered to withstand Pound Up.

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HERBICIDE APPLICATION By Tim Braun

Application equipment for applying herbicides can be either factory made or be part of a general implement used for other farming practices.

Liquid applicators usually have a tank to carry the mixed diluent, usually water, plus herbicide and any adjuvant that may be added. Liquid fertilizer can be used as the diluent instead of water if the label justifies it. The diluent is used to dilute the spray.

The materials may be mixed in a mix tank before being transferred to the tank mounted on the applicator implement. Either bypass agitation, where the spray liquid is pumped through the tank, is used to mix the spray ingredients or mechanical turning paddles are used to physically mix the materials.

The approved label for the herbicide has the requirements for each type of mixing. The label will have compatibility testing instructions when different materials are mixed together.

Some of the liquid herbicides can be injected from the original herbicide container into the line that carries the water to the boom. There are spray rigs that have a container near the line that holds the measured amount of chemical concentrate. This concentrate is injected into the line carrying the liquid diluent source. This type of apparatus allows mixing and application of a set amount of herbicide needed for that sprayed area.

When mixing pesticides only the amount needed for the particular field or site should be prepared in advance. In some cases the label will recommend that only enough mix for a period of four hours of spray time should be prepared at one time. Mixing only the amount needed avoids the problem of what to do with excess herbicide mixtures.

Herbicide applicator sprayers are normally low pressure sprayers. Medium to high pressure sprayers may be needed for pesticide and fungicide application. If a long boom is used the higher pressure sprayers should be used.

High pressure applicators include sprayers that create pressures up to 500 pounds per square inch (psi). A low pressure sprayer has a pressure up to 80 psi..

Low pressure sprayers are usually equipped with roller or centrifugal pumps. The high pressure pumps include; piston and diaphragm.

The use of by pass systems lowers the pressure of the higher pressure pumps when herbicides have to be applied. The cost of the higher pressured pumps are more expensive. The higher pressure pumps are usually equipped with a good agitator to handle wettable powders.

Some spray equipment only use liquid herbicides and can operate at a psi between 20 to 50. The lower pressure (below 50 psi) roller pumps can fill the need with a marginal agitator system.

The most effective type of agitation is mechanical. Paddles inside the spray tank and other mechanical equipment that thoroughly mixes the contents are expensive, but they provide the best agitation. In some cases the agitator source of power is separate from the pumping motor.

An agitator that uses the sprayers pressure system to push the liquid mix through pipes with jet outlets is less expensive. Jet agitators are effective when spraying properly designed suspension materials. Materials that are water soluble and in emulsions can be mixed with the by-pass type of agitator.

The wettable and flowable herbicides that are designed to stay in suspension can settle out giving uneven application. A few years back the suppliers of the clay used in the formulation of Balan had some very serious problems with application. In this instance the clay would not stay in suspension resulting in some claims of crop damage when applied with by-pass agitation. There were less complaints when using the mechanical agitators.

Quality and strength of application hoses are required to hold up under the pressures required when spraying. Hoses should be flexible, durable, resistant to sunlight, different chemicals, and the wear that is encountered during herbicide application.

Strainers keep any particles out of the spray that may clog up the nozzles. A strainer is placed over the intake to the mix tank. Finer strainers are located at the outlet of the mix tank. Some sprayers are equipped with extra locations of strainers throughout the system. 50 mesh strainers will allow wettable materials to pass through the nozzles without clogging them.

Pressure regulators are used to regulate the pressure by allowing material to escape back to the spray tank. Pressure regulators relieve the pressure when shut off valves are applied.

Pressure gauges are used to monitor the pressure build up needed for spray application. These gauges should be easy to read and if possible close enough so that the operator can see them. When high and low pressure application of chemical is used by the same rig, a system using two gauges should be installed: one system built for pressures up to 100 psi, and one system for pressures up to 500 psi.

Valves should be used to control the flow of materials throughout the spray system. Quick acting valves are installed between the pressure regulator and the boom to stop the entire flow of material to the boom. Cut off flow valves can be installed to control any section or sections of the spray booms. This allows areas around the plant or tree to be treated while protecting other areas from the spray. Remote electrically operated valves are used by some applicators to control booms and nozzles from the operator's position.

Spray booms consist of two types: wet booms and dry booms. The term "wet" refers to the fact that the boom or the pipe is the carrier that the liquid passes through to the nozzles. The nozzles may be screwed directly onto the liquid boom.

Dry booms are equipment fixtures like angle iron structures or rigid pipes that the hoses and tubes with nozzles are attached. Dry booms are a more flexible piece of spray equipment and can be more easily adjusted than the liquid spray booms.

The spray booms for orchards have features that increase the spray coverage of the soil without allowing the herbicide to contact the foliage of the tree crop. The booms have shields that protect the lower foliage of the tree.

The boom height is adjustable with the use of hydraulic cylinders. Booms used in orchards have a breakaway feature that avoids damage to the tree trunks and boom itself.

Some orchard spray booms spray the center of the rows. There are sprayers equipped with two booms. One spray boom is mounted on the rear of the rig and sprays one half of the center of the row. The other spray boom is mounted on the front of the sprayer and made to break away from the tree trunks. This type of orchard herbicide sprayer covers one half of the tree row with each pass.

Herbicides can be applied with applicator equipment that doesn't require a spray boom. These rigs are called boomless rigs. The boomless spray pattern is subject to drift. The spray nozzles made for this types of application use large nozzles or clusters of nozzles. Because the total amount of this type of large area spray pattern only supplies half of the material to the covered area, a double spray application should be used. On the second pass. The overlap covers half of the first pass.

Band spraying of herbicides is done with the nozzles mounted directly behind the planter. This type of herbicide application depends on cultivation to control weeds in the rest of the bed and furrow. The nozzle for band spraying is called an *even spray nozzle*. This type of nozzle puts out an even spray pattern across the entire spray width.

When applying herbicides to an emerged crop the use of applicators equipped with skids is used. The spray nozzles lines are attached to the skids. The nozzles are directed at the soil or emerged weeds under the foliage of the crop plants .

Nozzles can be placed on cultivation equipment to apply herbicides to the soil near the growing crop. The cultivators incorporate the herbicides into the seed area of the weeds between the growing crop plants. Lay-by herbicide application equipment use cone nozzles. Cone nozzles produce larger droplets thus reducing the drift.

The mechanical soil incorporation of herbicides can be a separate operation or the booms, pumps, tanks and nozzles can be mounted on the incorporation equipment. Incorporation equipment includes: tandem disks, field cultivators and soil mulchers.

Because incorporation equipment is larger and heavier than normal cultivation equipment, tractors designed for the normal cultivators cannot pull the heavier incorporation equipment at speeds necessary for good incorporation. Use an incorporating tillage device smaller than you typically match with your tractor. This will make up for the needed horsepower to pull the tanks and spray material and still operate the sprayer equipment.

The C-shank cultivator is an implement used to incorporate herbicides. The mixing depth of the C-shank cultivator is 1/2 of its operating depth. Each shank is equipped with a sweep that is at least as wide as the effective shank spacing to till the soil evenly across the width of the implement. Too wide sweeps on C-shanks will stunt the crop by concentrating the chemical where they overlap. Sweeps too narrow will leave untreated streaks with weeds.

The implement has to be level otherwise the shanks will go too deep or too shallow resulting in streaks of weeds. Slow or fast speeds can result in weed streaks.

C-shank field cultivators work well in heavy crop residue and rough soils. Because the C-shank gives less complete mixing of the herbicide in the soil; a harrow used behind this implement will improve the C-shank performance even more.

The S- Shank field cultivator is a very good implement for surface mixing or for the second pass of a two-pass incorporation. The vibrating motion of the flexible S-tine field cultivator shatters the soil. The mixing depth of the S-Shank field cultivator is about 2/3 to 3/4 the operating depth. This is because of the shattering affect of the vibrating S-Shank which disks and C-shanks do not produce.

When there is restriction of the vibration action of the S-Shank field cultivator the incorporation of the herbicide is reduced. This is why the S-Shank field cultivator works more efficiently on tilled soil for second pass incorporation. If the tines of the S-shank cultivator are set too deep, it will dig up untreated soil. The maximum recommended operating depth of the S-shank cultivator is 3.5 to 4 inches.

Equipment specifications for the S-Shank field cultivator is for 2.5-inch sweeps on 4-inch shank spacing or 4-inch sweeps on 6 inch shank spacing. Because of the vibrating motion of the tines, S- Shank sweeps do not have to overlap. S-Shanks cannot accommodate larger sweeps.

Depth control is one of the strong points of S-Shank field cultivators, but because they don't go deep enough they are not recommended for single pass incorporation unless the label states the need for shallow mixing depths. When compared to the tandem disk or the C-Shank field cultivators the horizontal mixing of S-Shank field cultivators is one to one and a half times better.

In agriculture discs are used in many cultural practices. Discs can be used as an implement of incorporation. Because of the high demand for incorporation of herbicides, the manufacturers of tandem disks have altered their disks to be used in the incorporation of herbicides. To increase the mixing of herbicides in the soil, disc company manufactures make a lighter disk with smaller blades that are spaced closer together.

The manufacturer's efforts to adapt the tandem disk for herbicide incorporation have made the tandem disk an excellent tool for single and double pass incorporation. It will handle rough fields with large amounts of crop residue.

The volatility of some herbicides can make up for an inadequate job of incorporation. The heavier discs with large disc blades, over 22 inches or spaced 9 inches apart can be used with some of the volatile herbicides like Treflan. With non-volatile herbicides the mixing, especially horizontal, with the large offset discs is inadequate for incorporation.

Of the two types of disk blades available, the spherical (flat angled) blades cut, invert and mix the herbicides in the soil, while the conical (curve angled) disk blade cuts and inverts the herbicide with no mixing. The spherical should be used for herbicide incorporation. Tandem discs will mix the herbicide at half the operating depth.

The angle of the tandem disk gangs determines the distance soil is moved. When the front gang of disk blades throws out more soil than the rear gang of disk blades returns, adjustment of the angle of the disc gangs must be made. This is done so that the amount of soil thrown by both gangs are equal.

The front gang of disk blades will tend to go deeper and bury the herbicide. The disk must be leveled front to rear for even distribution of the herbicide.

During the second pass the disk will mix the herbicide deeper (3/4's of the operating depth) than the first pass. If the operating depth for the first pass was 6 inches the second pass should be set at 4 inches. This is because on the first pass the herbicide incorporation mixing depth with a tandem disk is half the operating depth .

When using the disk for a double pass incorporation of a herbicide, the second pass setting of the operating depth should be reduced by a 1/3. The first and second pass herbicide mixing will both be in the 0 to 3 inch depth of the soil.

The PTO powered harrow with the tines moving horizontally is one of the powered units used for herbicide incorporation. For increased mixing the spray for PTO powered harrows should be directed into the tines. This is instead of spraying the soil in front of the incorporation. PTO powered harrows should not be used at speeds over 5 miles per hour. The incorporation with this powered unit mixes the chemical in the top three inches.

Rotary tillers are powered units used for herbicide incorporation. Rotary tillers have a mixing depth of 2/3 of the operating depth. The L-shaped blades mix the herbicide better than the units with knife blades. Operating rotary tillers at speeds over 4 miles per hour will result in the loss of good mixing.

The PTO units mix the herbicide in the soil and seal the soil over volatile herbicides. This activity prevents losses and allows the gas of the volatile herbicide to spread throughout the air spaces of the soil.

Harrows are used to knock down the ridges and mix the herbicide in the top 1/2 to 2 inches of soil. Rolling baskets, coil-tine and flexible spike harrows are used for this purpose. The coil-tine and flexible spike harrows are the most common.

Coil tine harrows used behind disks, C-shank field cultivators and combination implements provide residue shedding and leveling of the soil. A three bar harrow is recommended with 3-inch spacing between the coil tines. To maintain uniform mixing the coil tine harrow should be attached by two arms per harrow 6-7 inches behind the last row of tillage gangs.

Down pressure and tine angle are the two adjustments for coil tine harrows. With a coil tine harrow the aggressive mixing increases, as the tines are perpendicular to the soil surface. This aggressive mixing decreases as the tines are angled toward the rear. In high residue situations the tines will plug up when in the perpendicular position. As residues decrease the tines should be set perpendicular with as much down pressure as possible without interfering with the tine lateral movement or increasing the vibration.

Flexible spike harrows are suspended from the rear of the implement penetrating the soil with their own weight. Flexible spike harrows have five bars with spike harrow teeth separated by 1.5 inches between spikes. This narrow spacing gives effective lateral soil movement for herbicide mixing. This harrow levels the soil and sheds residue.

Wiping and rolling method applicators can be used where weeds are taller than the growing crop. A commercially available "hockey-stick" applicator has been used effectively for applying Roundup.

There are several roller-type applicators now in use, including several tractor mounted models and small one-man portable machines for use in small fields. The herbicide is slowly delivered to a rotating drum, with an absorbent covering. This wipes the foliage of tall weeds and bushes, transferring the herbicide from roller to leaves. In order to avoid misses most rollers must be operated slowly.

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer’s label.

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Herbicides In The Soil By Tim Braun

Herbicides applied to the soil have chemical properties that allow them to exist in the soil long enough to control the weeds that they can enter and kill. The physical and chemical properties of the soil that affect the herbicide should be known before application of the herbicide. With the proper use of soil herbicides, cultivation and hoeing, crops can remain weed free throughout the growing season.

According to Bob Hartzler in his article published on March 1, 2002 *Absorption of Soil Applied Herbicides* "Generally, the differences in chemical characteristics among herbicides are relatively small, and therefore soil type and environment will have a greater impact on performance than does the specific herbicide applied." This hour discusses the weed seed, soil type, soil environments and herbicide's chemical characteristics.

Weed seeds stay in the soil where they are placed or covered. Weed seeds do not move through the soil by their own volition. When a seed falls to the soil from a plant it can pick up enough moisture to germinate if the temperature is appropriate. It can be covered by the wind blown soil or fall into soil cracks where the proper soil moisture, temperature and aeration are available for germination.

The weed seed could also be buried to such a depth with tillage where the conditions are not suitable for germination for a long period of time. Although a very high percentage of buried weed seeds do not survive there are varieties of weed seeds that can exist without conditions for germination for years and still remain viable. When the conditions for germination of the seed are available, the viable seed begins its growth.

The larger seeds including sunflower and sandburs that can exist at deeper depths in the soil and will germinate at these depths and grow to the surface.

Most weed seeds are located from 1/4 to a 1/2 inch from the soil surface. When tillage takes place the seeds are buried deeper in the soil until further tillage brings the weed seeds back to their germinating depth. Tilling fields encourages the germination of more weed seeds. Crops planted behind healthy growing non-tilled perennial crops like alfalfa will have fewer weeds then crops planted behind tilled crops like corn.

Records have shown that some weed seeds have germinated after being buried for forty years, but most weed seeds that are buried will perish if they are not brought to the surface area of the soil by tillage. Cultivation for control of growing weeds is most effective when the soil depth of the implement is set at a two-inch depth. This practice brings weed seeds up to where they germinate and are killed, but isn't deep enough to bring deeper weed seeds to the germinating area of the soil.

Soil herbicides when applied to the soil are manufactured to react positively to the soil environment that it encounters. The herbicide attributes that make the herbicide react positively to the soil environment include site of herbicide uptake by the weed, water solubility, and the herbicide's capacity for adsorption, persistence, leaching potential, volatility and photodecomposition. Many of the values for these are available from pages 4,5,6 of *Factors That Affect Soil-Applied Herbicides*; G92-1081-A Website: http://www.ianr.unl.edu/pubs/pesticides/g1081.htm

The herbicide used is selective for the crop and the weed species. Therefore the concentration of herbicide chemical must be enough to kill the weed seed and weak enough to allow the crop roots to grow into the deeper soil that is not treated.

If the herbicide is mixed to a greater depth of soil then recommended by the label the herbicide will be diluted by the soil. The toxicity of the herbicide will be reduced resulting in less weed control.

Soil Environmental Factors Effecting Herbicides

In the soil environment the following factors have a pronounced affect on the use of herbicides: the water table level, the cation exchange capacity, organic matter, soil type, pH, temperature and the soil moisture level.

Herbicide Attributes

The Site of Herbicide Uptake

Soil applied herbicides are incorporated at a depth of 0 to 3 inches to enter the weed seed, shoot or root. After being absorbed by the weed and/or its seed, herbicides kill the plant by interfering with photosynthesis, protein synthesis, enzyme systems, cell division, or in other ways.

Treflan and Prowl are absorbed somewhat by plant roots but most of this herbicide is absorbed through the shoot by the young seedlings' shoot organs.

Balan is absorbed into two sites: the germinating seed and the shoot. Often two herbicides that are absorbed in different sites by the weeds are mixed together for greater weed control.

Most of the weed species germinate near the soil surface, but certain deep germinating large-seeded weeds like sunflower, cocklebur and morning glory are controlled with deeper placement of herbicides. A root-absorbed herbicide like Atrazine mechanically incorporated 2 to 3 inches deep is recommended for control of these weeds.

Herbicide Solubility

This attribute of the herbicide applies to the amount of herbicide that will dissolve in water. This value is expressed as parts per million. Where rainfall is used to incorporate the herbicide this characteristic becomes very important. Relatively insoluble herbicides need more rainfall for activation. The minimum amount of rainfall needed for herbicide incorporation is around 0.5 inches to activate the herbicide. Rainfall or irrigation is needed within five to seven days of herbicide application for best results.

A herbicide will not be activated and kill the weeds unless it is dissolved. Some herbicides like Dual are effective with less rainfall then herbicides like Atrazine. Dual is more soluble then Atrazine.

Mechanically soil incorporated herbicides are less affected by weather than surface applied herbicides. Irrigated fields have a built-in moisture control. The amount of water applied is controlled to move and dissolve the herbicide.

The solubility of the herbicide doesn't affect the leaching as much as the adsorption on soil clay and organic matter. Highly water-soluble herbicides will move through the soil more readily and can become a contaminant of ground water.

In most cases when the herbicide is more soluble in water, adsorption to soil colloids by the herbicide decreases. The high solubility of a herbicide doesn't always mean that the herbicide will not adsorb to soil colloids. Paraquat (Gramoxone) and Round-Up (glyphosate) are highly soluble in soil water, but they are very tightly adsorbed to soil colloids. They are not considered to be a concern of leaching to the ground water table.

Absorption occurs when one substance enters another structure. The roots, shoots and seeds of weeds absorb soil water. This is a passive process. When herbicides are dissolved in the soil water they enter the weed seedling and seeds when absorbed with the soil water. The herbicide that stays in the soil environment is partially in the soil water and partially bound or adsorbed to the soil colloids which includes organic matter and the soil clay.

Adsorption occurs when liquids, gases or solutes accumulate on the surface of a solid. The adsorption of herbicides on the soil colloids is caused by the attraction between the electrical charges on the herbicide (positive +) and the soil colloids (negative-) charge. The electrical charges that hold the herbicide to the soil colloids are weak and the tie-up or bonding is broken allowing the herbicide to go back into the soil water to maintain equilibrium of free herbicide and bound herbicide.

The adsorption of the herbicide molecules on the soil colloids can be measured and the measurement value number is referred to as the sorption index. The ratio of the amount of herbicide adsorbed by the soil to the amount in soil solution is termed the sorption index (Koc). A low sorption index (Koc) means a greater amount of applied herbicide is found in soil solution and less is tied-up by the soil. Herbicides with a low sorption index (Kerb at a Koc of 200) are more available as a herbicide, but more likely to leach in a given soil than those with a larger value (Balan at a Koc of 9000).When Paraquat or Gromoxone is applied to the soil the Koc index level is 1,000,000 and leaching isn't a problem.

There is an equilibrium in the soil environment that is maintained as adsorption, degradation, or other processes occur. If herbicide molecules in the soil water break down because of degradation they will be replaced by herbicide molecules breaking loose from the soil colloids back into the soil water. Also as the herbicide molecules adsorbed on the soil colloids degrade they are replaced on the soil colloids by the free herbicide molecules in the soil water. These two processes occur because an equilibrium must take place with each herbicide in the soil environment that is: a certain amount of herbicide adsorbed and a certain amount of herbicide in the soil solution.

Acid soils have a low pH, which means that acid soil water has more positive hydrogen ions. Many herbicides can take these positive hydrogen ions into their molecules. This addition of hydrogen ions to the herbicide increases its total positive charge. The increase in positive charges increases the herbicide adsorption to the negative soil colloids thus reducing the amount of leaching and degradation. The analysis of the Koc index should always be run with the same type of soil. This gives a true Koc index value to the herbicide for each individual soil type.

Soil type, which refers to the amount of clay, loam or sand, has more to do with the adsorption of a herbicide then the types of herbicide applied. The herbicide label will in most cases give the rate of herbicide use based on the soil type. The usual rule is that the heavier the soil or the higher the amount of clay, the more herbicide is recommended.

The lab test that measures the amount of adsorption sites on the soil particles is called the cation exchange capacity. This soil factor which determines the number of adsorption sites will effect the amount of herbicide recommended. On sandy soils with low cation exchange capacity soil applied herbicides are limited in use because of the increased toxicity to the crop. Because of the lack of adsorption sites in sandy soils that tie-up herbicides, low or no of herbicides are recommended. Clay soils tie-up more herbicides than loam and sandy soils therefore more herbicides can be safely applied.

Herbicide Persistence (half life)

How long a herbicide remains active as a weed killer in the soil is expressed by a half-life value. The half-life is a period of time it takes for 50% of a herbicide to degrade. In the soil the half-life varies with soil microbial populations, soil moisture, soil temperature, pH, and farming practices.

Part of the degradation is the consumption of the herbicide molecule by the soil bacteria. High organic soils have greater populations of soil bacteria. Soil applied herbicides are ineffective in high organic soils. Plant applied herbicides are used instead.

The high persistence of a herbicide is its ability to stay active and free for a period of time in the soil environment. Herbicides that are adsorbed on the soil colloids are less subject to degradation with a longer half-life than when the herbicide is dissolved in the soil water.

Herbicides like atrazine can incorporate the positive hydrogen ions in acid soils onto its molecule. This gives a positive charge to the atrazine molecule. The atrazine is then bound to the negative charged soil colloids where the atrazine gains longer persistence because it is less subject to degradation when adsorbed.

Atrazine added to acid soils (low pH) with a high amount of hydrogen ions (H^+) will have a longer persistence then atrazine added to alkali soils (high pH). Persistence index numbers should always be analyzed in the same soil types.

Leaching Potential

Factors that affect the leaching potential include: solubility, amount and frequency of rainfall soil adsorption, persistence and soil texture and structure. Protecting ground water is a high priority when using herbicides.

When a great amount of the herbicide is adsorbed on the soil colloids and a small amount is available for weed uptake the result is less herbicide being leached through the soil.

Atrazine, which has a low solubility (33 ppm), and a medium sorption index (100) should have a low leaching potential. However the half-life of Atrazine is relatively high (60 days) making it susceptible to leaching.

The atrazine label carries a groundwater advisory statement against using the product on well-drained sand and loamy sandy soils where groundwater is close to the soil surface.

High solubility of herbicides will also leach below the soil seed germination level. If the herbicide leaches below the 2-inch level, weed seeds that germinate in the top 1-inch will not absorb enough herbicide to kill them.

Dinitroanilines, Treflan and Prowl, because they are strongly adsorbed by the soil colloids, they have a low leaching potential. They are both fairly insoluble in water and this also prevents them from leaching to the groundwater.

Photodecomposition

Photodecomposition is the breakdown of a chemical by light. This may occur with some herbicides when they are applied to the surface of the soil and are allowed to lie there without incorporation. As the light causes the chemical breakdown the herbicide volatilizes. Photodecomposition can be avoided by incorporating the herbicide into the soil mechanically, by irrigation or by rainfall.

The dinitroaniline herbicides are susceptible to photodecomposition. Usually herbicides like Treflan will evaporate due to its high volatility. Once it is in the air it will degrade by photodegradation.

Volatility

The tendency for a liquid to undergo a phase change to a gas is called volatility. All chemicals are volatile to some extent, but they also differ in their amount of volatility. This is the reason for incorporation of soil applied herbicides.

Warm temperatures, high winds and soil surface moisture increase volatility. Incorporation when the soil is cool and dry enough for good soil mixing reduces the loss of herbicides from volatility. The dinitroaniline, Treflan, is very volatile and should be incorporated into the soil within hours after being applied to the soil surface. Pendimethalin, Prowl, is also a dinitroaniline but it is not as volatile and incorporation can wait a week.

Command herbicide carries instructions on various state labels restricting its use within 1500 feet of towns and subdivisions, commercial fruit or vegetable production, and commercial greenhouses for nurseries. This is because of the volatility of the herbicide that can be easily drifted to these areas.

The highly volatile herbicide Ro-Neet should be applied and incorporated at the same time when applied as a water mix. When Ro-Neet is mixed with liquid fertilizer, incorporation can be delayed for 4 hours. When Ro-Neet is mixed and impregnated on dry fertilizer the incorporation can be delayed for 8 hours.

Soil Organic Matter

Organic matter in the soil can affect soil-applied herbicides to a greater extent than the clay content of soils. Organic matter has more surface for the herbicides to adsorb on than clay. Soil tests for organic matter should be taken when herbicides that are affected by organic matter are being applied.

Organic matter in the soil affects herbicides in two ways. 1. The herbicide can be tied-up or adsorbed by the organic matter. 2. The microorganisms that exist in the organic matter can consume and break down the herbicides.

The label has rates of herbicide needed for different percentages of soil organic matter. In the desert soils the percentage of organic matter is low, but when planting in desert soils containing high amounts of crop residue some tie-up and degradation can occur.

Herbicides like Eptam, Ro-Neet and Atrazine require higher rates of herbicide to be effective in high organic soils. The Gowan Treflan 4 label states that Treflan 4 should not be used on soils containing 10% or more organic matter. In the delta area peaty muck soils foliar applied herbicides are the effective herbicides used.

Because microorganisms are selective and feed on certain herbicides compared to other herbicides. Repeated applications of the same herbicide on a soil over a period of time will build up a population of microorganisms that will consume and destroy that herbicide. This results is a soil where this herbicide will not be as effective as a weed control tool. This is one of the reasons for rotation of herbicide use on a field.

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

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Spinach Weed Control By Tim Braun

Weeds are one of the major pests of spinach. Weed competition will do the following to a spinach crop: Buyers will reject the crop because they cannot sell spinach with weeds in it.

Weeds in nearby fields, and on the edges of the field are a source of insect pests, diseases, vertebrates and nematodes.

Spinach is a poor competitor against weeds resulting in loss of nutrients, water, space and sunlight to the growing crop. Harvest of a weed infested spinach crop is too costly for the grower. The crop is often destroyed.

Because of the thickness of the fast growing spinach crop, cultivation is not possible and expensive hand weeding is required.

There are weeds that are considered to be spinach production problem weeds. These include: burning nettle; little mallow; chickweed, London rocket and shepherd's purse. There are several others, but these thrive under the same growing conditions that spinach grow in. Spinach is a broadleaf plant and so are most of these weed pests.

Economical cultural and chemical types of weed control have to be managed in a year round planned program to produce the desired weed free spinach crop. If the crop is organically grown, the chemical type of weed control is replaced by costly hand weeding.

The management program starts when the grower picks the field where the crop of spinach will be grown and continues even after the spinach crop is harvested. Mapping and recording of the weeds in a field includes the conditions that caused them to grow in that field. These conditions include weather, moisture (irrigation or rainfall), soil and air temperature, calendar dates when the weeds grow, cultural practices, soil type and so on. This also includes the name of the weeds.

There are several web sites that contain pictures of weeds for identification. This type of information gives you an idea of what the field's weed seed bank contains. This seed bank of the field contains weed seeds that have been there for several years.

Weed seeds will not germinate until they encounter specific environmental cues. This means the conditions (temperature, moisture, salt, acid, nutrition and other stimulants) will make these specific weeds germinate.. You may have seen flushes of different weeds growing in a field where you haven't seen them before. These weed flushes often appear in fields that have recently received an application of manure.

Research has shown that the nutrient stimulation from the manure causes seeds in the field's seed bank to finally grow. In many situations the weed seeds are already in the field and the manure application doesn't put them there. Manure nutrition can stimulate the fields old weed seeds to germinate.

A good pre-irrigation can give your field a wide variation of stimulation that weeds seeds might like. If there are several weeds after pre irrigation you may need to spray them with a herbicide before you disc them.

Spinach is sensitive to Balan, Glean, Gallery, Prowl, Treflan, Kerb, and Prefar. The labels on all of these products will give you the length of time needed for these herbicides to dissipate before planting your spinach crop. There are plant back label instructions that can reduce the plant back period by plowing. Check the labels.

Herbicides For Spinach

The fumigant, Clean Crop Metam Sodium, is used to control soil borne diseases, nematodes, symphylids (garden centipedes) and many weed species. (Refer to label). Metam Sodium is a water soluble liquid. After it is applied to the soil, the liquid becomes a fumigant (gas) that can control target pests. The fumigant dissipates in a period of time and a spinach crop can be planted in the treated soil.

Metam Sodium can be applied in irrigation water. The label has specific instructions on the application of Metam Sodium by sprinkler, drip and flood irrigation. The following information is taken from the Clean Crop Metam Sodium label. The entire label must be read and understood by the applicator before use of this product..

Metam Sodium can be applied mixed in liquid fertilizers. It can be injected, disk applied, with rotary tillers or power mulchers.

The label rate for metam sodium is from 40 to 100 gallons per acre. The rate is based on the texture of the soil. The heavier the soil the more Metam Sodium needed. Organic soils require the higher rate per acre. The concentration of the pest population will determine the need for high or low gallons per acre. The rate per acre should take into account the volume of soil treated. The application method used to mix the material in the soil will decide how much volume is being treated.

The condition of the soil should be tilled to break up any clods. The soil moisture content should be adequate to form a ball in the hand that breaks up easily. The soil should be from 40 degrees F. to 90 degrees F.. Temperatures above 90 degrees F. will result in product loss due to gas escape.

Vegetative residue in the soil should be reduced by allowing enough time for organic matter decomposition. Heavy organic soils will require higher rates. Application through a sprinkler over an existing cover crop is approved on the Metam Sodium label.

The sealing of Metam Sodium in the soil after application can be done with a light sprinkling of water. If the material is sprayed on top of the soil and worked into the soil rollers should be used to seal the soil. Tarping over the treated soil will help prevent gas escape of the applied Metam Sodium fumigant.

Shut off sprinkler applications when high winds occur. The water in the spray mist will contain enough Metam Sodium to injure surrounding emerged crops. If strong odors occur during or after application the application should be stopped until the source of the odor is found and corrected.

The personal protective equipment for handlers and applicators is explained in detail on the Clean Crop Metam Sodium label and other approved labels.

RO-NEET 6-E is a liquid formulation herbicide used to kill weeds in spinach. It can be applied pre plant to spinach crops in California. RO-NEET is not approved for use on spinach in the state of Arizona. RO-NEET is taken up by the seed and shoots of germinating weeds. It stops germination of the seed and shoot development. It will not control established or germinated weeds.

RO-NEET 6-E is a product of HELM AGRO US, INC. Use only according to the recommendations of the RO-NEET 6-E label. RO-NEET 6-E has a CAUTION word label.

In California RO-NEET 6-E should be applied broadcast on the soil at the rate of 2/3 of a gallon material per acre in 10 to 50 gallons of water with a boom sprayer set at 20 to 50 pounds pressure per square inch .

RO-NEET 6-E should be incorporated to a mixing depth of 3 inches in the soil in California. *Soil incorporation implements have different operating depths with their own individual mixing depths. Be sure to rely on the mixing depth not the operating depth of the implement for the soil incorporation of herbicides*.

RO-NEET 6-E can be combined with water, liquid fertilizer or impregnated on label specified dry fertilizer. When applied in water RO-NEET 6-E must be incorporated into the soil immediately.

When applied in liquid fertilizer, RO-NEET 6-E must be incorporated into the soil within 4 hours of application. When applied impregnated on dry fertilizer RO-NEET 6-E must be incorporated into the soil within the same day of application. If the soil is damp or wind conditions are over 15 MPH, incorporation of RO-NEET 6-E applied in liquid fertilizer or impregnated on dry fertilizer must be incorporated immediately.

RO-NEET 6-E can also be incorporated into the soil for spinach with irrigation sprinklers in California, Idaho, Nevada, Oregon, Utah and Washington only. According to the RO-NEET 6-E label, the soil surface should be dry and free from dew or incidental moisture to a depth of at least 1/2 inch before application. The RO-NEET 6-E can be applied before or immediately after planting. Start sprinkler irrigation immediately after application. Incorporation should be completed within 36 hours after application using enough water to penetrate to a depth in the soil of 3 to 4 inches.

Band application of RO-NEET 6-E can be used for spinach by reducing the rate from the amount needed for the band width compared to solid coverage. This can be done by reducing the number of injection shanks. An example would be: use 4 injector shanks per row for a band of 10 to 12 inches and 6 injector shanks for a band of 15 to 18 inches. Shanks should be set 2 1/2 to 3 inches apart and set to inject RO-NEET 6-E at a 1 1/2 to 2 inch depth. Shanks should be staggered to avoid trash build up. To protect the seed, place shanks 1 1/4 to 1 1/2 inches on either side of the drill row.

The RO-NEET 6-E label has directions on how to, how much and what kinds of fertilizer to mix or impregnate when applied to spinach.

POAST may be used for the control of grass weeds in spinach. Poast should be applied at a rate of 1.5 to 3.0 pints per acre, 15 days before harvest applied by air or ground. The label has thorough directions on how, when and where Poast is to be applied to spinach. The label recommends the use of some specific additives to be used with POAST.

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

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Small Grain Crop Weed Control By Tim Braun

Small grains, especially wheat crops, are a very vital and popular crop. Weed control research by universities and the business community has continued to increase for small grains. Weeds are tough competitors with small grains because high yielding small grains need ideal growing conditions. This is evident when these newer varieties are grown under harsh growing conditions like low fertility levels and dry conditions. The new varieties of small grains that have been developed and planted in California and Arizona require increased levels of nitrogen and phosphate for maximum yields along with good moisture and soil conditions.

Weeds with their genetic make up that allowed weeds to exist in many harsh conditions for ages have a distinct genetic advantage over the small grain crops. Under these ideal growing conditions used by commercial growers for growing small grains, the sturdy weeds multiply, invade and compete aggressively with the small grain crops.

Every advantage should be given to the small grain crop. Drilling the small grain at the ideal depth for germination is a proven planting practice. If broadcast methods of planting are used an increase in the application rate of seeding is recommended. As the season progresses from winter to spring planting, increased planting rates will give small grains an advantage over weeds. Because weeds are able to thrive in conditions that are less than ideal for growing small grains; nutrients, soil conditions and planting times have to be considered. Winter planted small grains that receive enough nitrogen and phosphate have been developed to compete aggressively with weeds.

Nitrate nitrogen soil quick tests can easily be taken to assure that enough nitrate nitrogen is available during very cold winter conditions. Phosphate soil tests will only indicate the amount of citrate soluble phosphate. The small grains seedlings need a source of water soluble phosphate to germinate. Applying a low rate of water soluble phosphate on the field prior to planting. This application will overcome any critical water soluble phosphate shortages in the soil for germination.

It should be mentioned that any delay in planting small grains can reduce the yield. If time allows, a plowing of the field before pre irrigation will dilute herbicides that were applied for the previous crop. This deep plowing will bury small weed seeds like the mustards depriving them of oxygen.

Wheat growers that also grow vegetables now use sprinklers when planting wheat after the vegetable harvest. This sprinkling will bring up the wheat more rapidly and evenly. The sprinkling provides an even amount of moisture over the field.

When time is not a problem the practice of pre irrigation to germinate weeds before planting is one method of small grain weed control. After the pre-irrigation a shallow cultivation will control the germinated weed seedlings and will not bring small weed seeds to the upper level of soil that germinate after planting the small grains. Weed seeds that can germinate below one inch soil levels like wild oats will not be controlled with shallow cultivation. Shallow tillage should take place before the weeds mature and produce seeds.

Herbicides like glyphosate (Round Up) can be used to control weeds that emerge after a pre irrigation. Round Up will also control the perennial weeds growing from crowns, stolons and rhizomes. Glyphosate will control above ground annual weed seedlings germinating from seeds. The faster acting Paraquat can be used on pre irrigated weeds. The systemic, Glyphosate, will take a period of 7 to 10 days for control whereas the contact, Paraquat, will give results in one. Always follow label directions.

Mulching the soil before planting small grains will control annual weeds. The mulched soil will dry out preventing weed seeds in the top soil from germinating. Small grain seed is drilled below the dry mulched soil into moist soil. The small grain seeds have enough moisture to germinate while the weed seeds in the dry area of the mulched soil do not germinate.

Planting small grains in fields that previously had herbicides applied to them is a form of weed control through crop rotation. These herbicides that are registered for use on the previous crop control weeds that small grain herbicides cannot control. The plant back restrictions should be adhered to and in some cases plowing or cultural practices may be needed before planting the small grain crop. An example of this practice is small grain crops following vegetable crops. Many of the registered vegetable herbicides are not registered for use on small grains.

Another crop rotation technique to control weeds in small grains is to plant small grains after growing a crop that shades out weeds. Some crops that small grains follow in a field can out grow and shade the weeds from the sunlight, thus reducing the use of herbicides for the small grain crop. Crops like cotton will shade out weeds that produce seeds that could infest small grains during the warm spring weather. Crops that are grown on a field for more than three years like alfalfa will control many weed varieties.

Reducing the weed seed banks of the field to be planted to small grain crops can be done with several methods. Knowing what seeds are present in a field and when they can become a problem helps reduce the weed seed bank. Weed seed banks are made up of weed seeds that are able to germinate under the certain conditions.

These weed seeds exist on or in the soil. The seeds can be old seeds that have been in the field for months and in many cases for several years. One to nine percent of the weeds seeds that are produced by adult weeds in a field germinate in that year. The rest of them can germinate in later years depending on how deep they are buried and how long they can survive in a dormant condition.

If the weed seeds stay on the surface of the soil they can be eaten by seed eating predators like birds. Other weed seed predators include rodents, insects, fungi and bacteria that attack weed seeds on and in the soil. Hard coated seeds last longer in the field. Seeds tend to stay dormant longer the deeper they are buried. Lighter soils like sand that are tilled have weed seeds at deeper depths than tilled clay or heavy soils. At the same time tillage will move more weed seeds to the shallow depths of the soil in sandy soils than tillage in heavy soils. Weeds seeds in the shallow depths are more likely to germinate because of the increase in available oxygen that is required for seed germination.

When pre irrigation causes the shallow weed seeds to germinate the use of a contact or systemic weed killer will not bring the deeper weed seeds to the oxygen rich shallow depths like deep disking. This deep disking may bring up weed seeds to germinate and become a problem after small grains germinate. When controlling pre plant weeds shallow disking instead of deep disking should be used to kill weed seedlings.

Keeping records of the yields, crops, irrigation, fertility and soil type of individual fields is a sound practice. Field records on the weed types and when they occur is an inexpensive, necessary management tool for growing weed free small grains. Weeds should be identified when they are in the seedling stage if possible. I highly recommend that the purchase of weed identification publications is a good start. U.C. at Davis (My alma mater) has a web site of weed photos: www.ipm.ucdavis.edu/PMG/r730700999.

The winter wild mustard and black mustard along with fiddle neck, shepherd's purse and spiny sow thistle compete with the small grains early in the season of fall planted wheat. Control should be made before booting occurs to avoid loss of yield.

London Rocket is one of the first annual broadleaf weeds to appear in small grains during the winter months. When high temperatures increase London rocket disappears in the desert areas. In the cooler areas of Arizona and California London rocket may hang on through the summer and into the fall months. It has a firm tap root. London rocket is an annual weed growing from seed. It grows to 1 and 1/2 feet tall. The lobed leaves are alternate on stems with a large terminal lobe. The flowers of London Rocker are yellow in dense inflorescence spikes. These spikes form elongated seed pods.

Shepherd's purse is a winter annual broadleaf weed . The seed pods of this weed gives the weed its name because these seeds pods have the appearance of a purse. The seedling basal leaves form a rosette on the ground. The adult flowers have small white petals. Each seed pod puts out about 20 seeds. Each shepherd's purse weed plant puts out up to 38,500 seeds per plant.

The summer annual weeds in small grains include; Russian thistle (tumble weed), common sunflower, kochia, redroot pigweed and common lambs quarter. These are annuals and grow from seeds.

Control of **lamb's quarters** with post emergence herbicides is critical because it can grow beyond the height of the small grains. Good field monitoring will aid in control during this critical period. Lamb's quarters is very hard to control under dry conditions. The lamb's quarter seedling's leaves are egg shaped with a petiole. The lambs quarter's leaf color is light green on the top and purple on the underside. Each lamb's quarter's plant produces 30,000 to 176,000 seeds with an average of 72,000. Lamb's quarter's seeds are some of the most persistent seeds in the soil of small grain crops. Lamb's quarters seeds on a single plant can have dormancy requirements that are varied. The seeds from the same lamb's quarter's plant can come out of dormancy and germinate under a large number of conditions including: fertility, moisture and temperature. Dormant studies have found that after 12 years 50% of the lamb's quarter's seeds were still able to germinate. As the lamb's quarter's seeds are buried deeper in the soil their length of dormancy increases.

Field bindweed in the morning glory family of weeds is a perennial. It is considered to be a prohibited noxious weed in the state of Arizona. Field bindweed can be controlled with 2,4-D in a small grain crop. Usually field bindweed is treated with glyphosate when no crop is on the field . Field bindweed is a prostate growing vine with white or pink funnel shaped flowers. It has rhizomes that are full of meristem cells that can produce new plants. Field bindweed has a very deep tap root and has the advantage of being drought resistant making it very hard to control in dry conditions.

Grass weeds in small grains are winter annuals for the most part. These grasses include: wild oats, wild barley, little seed canary grass, rabbit foot polypogon, hood canary grass, Italian ryegrass, foxtail, goat grass, Johnson grass and rip gut brome.

Wild oat seed bodies are formed to avoid laying on the soil surface and falling pray to seed predators. The wild oat seeds have awns protruding parallel from the sides of their bodies. The awns are like small rods with a bend in them. As the awns absorb water from the atmosphere they begin twisting in a manner that turns the seed bodies on the soil surface. A small change in the surrounding humidity starts the twisting. This twisting causes the wild oat weed seed to move across the soil until it tips into a soil crack and burrows into the soil. The wild oat seed ends up below the soil surface where it can germinate.

The wild oat roots that are formed are well adapted for obtaining moisture even in drought conditions. Winter seeded wheat is competitive with wild oats. Spring seeded wheat is weaker than wild oats. Wild oats are allelotropic. This means that the residue of wild oats emit chemicals in the soil that inhibit the growth of other plants.

Little seed canary grass is a serious weed in small grains in the desert areas of California and Arizona. It became a major weed during and 1990s because of the lack of a herbicide that would control it. Since then herbicides that will control little seed canary grass have been approved. The small little seed canary grass seedlings can be identified by breaking the stems off. Blood-red droplets of plant fluids are produced. by little seed canary grass seedling stems when broken off.

The adult seed stock of little seed canary grass is similar to cattails, only much smaller They are about the size of a wheat seed stock. Each littleseed seed stock produces around 100 seeds.

Because viable little seed and canary grass seeds are small they are usually found in the surface inch of the soil. During the 1980s some growers in the desert planted their wheat on beds. This method of planting reduced the little seed canary grass infestations, but salt forming on the bed tops and harvesting were a problem. California and Arizona now have three herbicides that are effective against little seed and canary grass: Puma, Osprey and Achieve

Puma (fenoxaprop) controls littleseed canary grass, wild oats and foxtail and it suppresses mustards. Puma cannot be mixed with the 24-D and MCPA because the mix reduces the grass kill. Achieve is the third herbicide to be released for control of little seed canary grass. Achieve is a AC Case inhibitor like Puma, but the chemical structure is different. Both of these AC Case inhibitors interfere with the making the fat of lipid needed by growing cells.

Osprey (mesosulfuron) systemic grass herbicide controls the problem grasses in small grains and many of the broadleaf weeds. When Osprey is applied the wheat will turn light green. Applications of nitrogen can correct this. Osprey can be mixed with 24-D. Osprey is a sulfonyurea. Osprey uses a different action than Puma and Achieve. Osprey interferes with a key enzyme, acetolactate that is vital for cell growth of the weeds.

Most of the post emergence herbicides are systemic. Systemic herbicides should be applied when the weeds are healthy. Buctril is a contact herbicide and doesn’t require that the weeds that it is applied to be healthy. Buctril is not a systemic and good coverage is needed.

Shark is another contact broadleaf herbicide for small grain weed control. 24-D and MCPA are systemic broadleaf weed control herbicides used in small grains. Another similar herbicide is Banvel (Dicamba) which controls fiddleneck and chickweed. 24-D and MCPA do not control fiddleneck and chickweed. In California Glean can be used for broadleaf weeds in small grains, but it leaves a residue in the soil for 18 months.

Two more grass herbicides for small grains include: Achieve and Pinoxaden. By alternating these herbicides in weed control programs for small grains the normal resistance that weeds develop will be reduced to some extent.

When applying herbicides post emergence for the control of weeds in small grain crops, there are two very important conditions that affect the results. (1) The germination of as many healthy non stressed weeds as possible should have occurred. In some cases two applications may be needed if the first application was made early. (2) The herbicide should be applied before crop damage may occur. Many herbicides can be applied up to the boot stage of the small grain’s growth.

Banvel is applied up to the 5th leaf stage before crop damage occurs. Counting the leaf stage of both the small grain and the grass weeds includes all leafs even the damaged leafs. Careful observation of the stem will show scars where leafs had been. Count the leaf scars in the total leaf count. Do not count the tillers that emerged between the leaves. Small grains that have been planted during the fall will have more tillers. Tillers of small grains are extra stems that produce seed heads. The labels of post emergent herbicides have crop growth stage timing for application to avoid crop damage

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Melon Weed Control By Tim Braun

Melons when produced out of season are in such a demand that in order to compete for the best prices melon growers use out of season melon growing techniques. Growing out of season melons requires more intensive weed control methods.

Melons are cucurbits and if you go to the vegetable counter of most large grocery stores you will see a large variety of cucurbits at almost any time of the year. Herbicide labels for melons list most melons by either a common name or the species name.

Reading the label of a herbicide can give an applicator or PCA information about the type of cucurbit that can be treated with that particular herbicide. William M. Stall in a University of Florida publication HS190 revised November 2007 states that EPA defines what crops may be included under certain general commodity names on the approved labels. The term melon on a label includes: muskmelons, which includes hybrids and or varieties of Cucumis melo: true cantaloupe, cantaloupe, casaba, Santa Claus melon, Crenshaw melon, honeydew melon, honey balls, Persian melon, golden Persian melon, mango melon, pineapple melon, snake melon, and watermelons.

The term on the label for Summer squash includes fruits in this category that are consumed when immature; are 100% edible either cooked or raw; cannot be stored once picked; have a soft rind which is easily penetrated; and have seeds which, if they were harvested, would not germinate; e.g. Cucurbita pepo (le. crookneck squash, straight neck squash, scallop squash, and vegetable marrow). Laginaria spp. (le. spaghetti squash, hyotan, cucuzza): Luffa spp. (le. bitter melon, balsam pear, balsam apple, Chinese cucumber): and other varieties and/or hybrids of these.

The increase in melon types is generated by customer demand. Melons are grown in the warmest areas of Arizona and California. In order to have a longer growing period melon growers are using techniques that overcome the cooler weather during planting.

Melons have vigorous growth when grown in warm conditions that allow melons to overcome weed problems. During ideal weather melon crops can outgrow the weeds. Weed control using only cultivation without the use of herbicides can produce a good crop of melons when grown during melon growing weather. When grown during weather that reduces the vigor of the melon, many weeds will flourish and can reduce melon yields. Several weeds can survive in cool weather and further reduce the growth of melons. This reduction in melon yield is increased when melons are planted early when temperatures inhibit melon growth, but are conducive to weed growth.

Weeds can be a serious problem in melon crops planted during December through March. London rocket is a winter annual that is a problem weed in melons during late winter months. Other winter weeds that cause problems in melons include: black mustard, wild radish, shepherd's purse, cheese weed (Malva), sow thistle, prickly lettuce, and annual sweet clover.

Grasses that germinate in early planted melons include: wild oats, canarygrass, annual bluegrass and wild barley.An early spring weed that infests melons is common lambsquarter. Other early spring weeds include: nettleleaf goosefoot, Russian thistle and knotweed.

During late spring and early summer a troublesome weed in melons is the common purselane. Other weeds infesting melons during this season include the broad leafed pigweeds and Wright's ground cherry. Water grass and cup grass are some of the late spring and early summer weeds causing problems for melons.

Summer planted melons are up against morning glory and purple nutsedge. Fall planted melons have to contend with previous crop seeds like wheat and barley. These emerging small grain plants become weeds when found in melon fields.

Growing a high producing weed free crop of melons involves the use of productive management of farming techniques. All the cultural growing methods are used. Fertility, irrigation, pest control, planting methods, picking the right variety and soil, planting at the right time and other good cultural methods will produce a fast growing crop that will compete with all of the above mentioned weeds. These production methods plus the use of herbicides when needed go hand in hand for good melon production.

This is especially true when the crop of melons has to be in the commonly called early markets when prices are at a premium. Early season methods of weed control is needed to get the good growing conditions needed to meet this market demand. Research has shown that weeds allowed to compete with melons in the first five weeks during the melon's growth will result in a 20 percent loss in yield. Some research work has shown that after being weed free in the first five weeks any amount of weed infestations will not affect the melon yield.

Growers have several melon growing techniques that allow melons to overcome weed competition that occurs when melons are planted before melon growing temperatures have arrived. Hot caps that cover single plants and can be used over melons planted by seed or as transplants. The use of large soft drink cups have been used successfully by some seedless watermelon growers in the Yuma Arizona area.

Plastic covered tunnels are used as hot houses that protect the melons from inclement weather. High tunnels are plastic-covered, solar greenhouses. These are fairly permanent and some of them can be seen when driving through the Coachella Valley in

California during the winter months. Low tunnels using wire hoops covered with plastic are torn down after the melons reach a safe stage of growth. Plastic mulch can be laid down on rows to prevent weeds from emerging and trap heat for growth. Holes to plant seeds can be made in the plastic or melon seedlings can be planted in these holes. Clear plastic mulches and low clear plastic tunnels will encourage the growth of weeds along with the melons. To prevent the growth of these weeds under clear plastic mulch, tinted plastic can used to reduce sunlight that causes weed seed germination.

Bed preparations such as the Yuma slanted beds give the melons a better start. The seed is planted on the south side of the slanted bed to gain more sunlight thus warming the seed row for faster germination. Black oil sprays over the planted seed row will absorb the suns heat and warm the soil.

Using a shallow seed row cultivation after an irrigation to form a dry layer of soil where weed seeds won't germinate will control weeds. This method of planting melon seeds under shallow cultivated and dried soil is referred to as dry soil mulching. When using the dry soil mulching method irrigation after planting is delayed until the three to fourth leaf stage of the melons. The emerging melon plants get a head start on any weeds that germinate after this irrigation.

Even with these growing techniques integrated growing practices may be required. The use of herbicides in conjunction with cultivation, hoeing, tents and mulches may be required. The number of herbicides that are cleared and available for melons are limited. The use of cultural practices combined with the use of herbicides will make up for the lack of available registered herbicides.

Pre plant Melon Herbicides Fumigants are used as a pre plant herbicide when clear soil mulches, tunnels, and mid-bed trenches are used. The soil is heated by the trapped heat that penetrates the plastic mulches. This technique increases early seed germination. The warmed soil conditions allow the fumigants to penetrate the soil controlling weed seeds, nematodes and diseases. Weed seeds absorb water when soil temperatures are above 55 F. The air temperature may be below this temperature, but the soil temperature below the plastic mulch may be above the 55 F. level. This is especially true during sunny weather. Taking soil temperatures below the mulch at a 3 inch depth will allow you to make a determination for fumigation.

Fumigants inhibit the respiration of seeds and seedling. Weeds suffocate when fumigated. Weed seeds will absorb fumigants when their seed coats swell when moistened with water. Some weed seeds will not swell readily and are difficult to control with fumigants. Little mallow and bur clover have tough seed coats that resist swelling when moistened. Little mallow and bur clover weed seeds can survive fumigant weed control.

Two major fumigants will control weeds in melons. If a fumigant is used for melon weed control the use of metam sodium has some advantages over the methyl bromide. Metam sodium is less expensive than methyl bromide and metam sodium is less restrictive in use. There are certain methods of applying metam sodium to prevent failures. Methyl bromide moves in the air spaces in the soil. Whereas metam sodium moves in the soil water. Having enough moisture in the soil when applying metam sodium is very critical in obtaining weed control. Metam sodium is applied through drip systems no more than 6 inches off center and 2 to 3 inches deep. Research and advances in the use of metam sodium have improved the herbicide results. The label has to be followed in order to obtain weed killing results. Drip irrigation, narrower bed widths, multiple drip tubes per bed and placing the plants closer to the drip tubes are some of the activities required when using metam sodium.

Proper soil tillage is required for fumigation. Soil clods in the field will not be penetrated by metam sodium. The weed seeds inside these dirt clods will germinate. Metam sodium can be injected with spray blades set at 2 to 3 inches below the surface of the soil. Form a soil cap over the spray blade using disc hillers. Remove the caps one to two weeks after application. Metam sodium can be injected into drip systems under plastic mulch. A 14 day waiting period after Metam sodium application before planting is required. Both metam sodium and methy bromide will control weeds along with soil borne diseases and nematodes. Fumigation is a last resort when other weed killing methods are ineffective.

Non selective herbicides can be used to kill the weeds that germinate after a pre irrigation. Round Up is a nonselective herbicide that kills germinated weeds after a pre irrigation or rain and before planting melons. Round Up (glyphosate) is a weak acid that is applied to the leaf and stem surfaces of weeds. After entering the weed's vascular system (phloem), glyphosate travels with the sugars to the growing areas of the weed. Glyphosate bonds with and immobilizes an enzyme that is vital to the plant growth system. Glyphosate will control the perennials, Bermuda grass and Johnson grass. The time taken to kill weeds needed by glyphosate takes a few days in good growing weather and 10 days in cool weather.

Other herbicides like Paraquat kill the weeds in a much faster period. Paraquat kills cells in the surface of leaves and stems on contact. Thorough coverage of Paraquat is required. Another contact herbicide that can be used is pelargonic acid (Scythe).

Both the systemic glyphosate and the contact herbicides do not have plant back restrictions. Contacts and the systemic glyphosate can be applied after planting, before emergence. Care should be taken to prevent any spray contact with germinated melons when applying glyphosate, Paraquat or Scythe.

After planting and the pre emergent herbicide, Bensulide, with trade names of Prefar and Betasan is the most commonly used herbicide in the desert regions of California and Arizona. Prefar is an organophosphate herbicide. Most of the organophosphates are insecticides. Prefar is not an excellent herbicide considering the number of weeds that it doesn't control but melons have a high tolerance for the chemical. Prefar is used to control some grasses and the broadleaved purselane and pigweed. Prefar will not control emerged weeds. Prefar is a persistent herbicides that can be applied preplant by mechanical incorporated. Prefar can be applied pre emergence (after planting but before seed germination) with chemigation. The persistence of Prefar in soil is a positive asset for weed control in melons because melons have a high tolerance for the chemical. Prefar resists leaching to a certain extent. Crops that are susceptible to residual Prefar include: Sudangrass, corn and sorghum.

There are restrictions on the use of Curbit as a herbicide in melons. Curbit is gives good control of many grasses and some of the small seeded broadleves like purslane and pigweed. Curbit can be applied after planting and before emergence in a spray band over the planted seed line. Incorporate Curbit with water which will activate it. Mechanical incorporation of Curbit for melon weed control will cause crop injury. Do not use Curbit on transplants. Do not use Curbit under plastic mulches. Cold weather reduces Curbit's effectiveness as a herbicide and will cause injury to melons. Label plant back restrictions apple when using Curbit.

Post Emergence Melon Herbicides

When melons have emerged and grasses are located in the field the herbicide Poast (sethoxydim) is registered for control. The perennial grasses including Bermuda grass can be controlled by Poast. Two applications of Poast may be necessary for good control. Annual grasses should be treated in their earliest stages for good control. The control of annual bluegrass will vary and in some cases control will not be adequate. If the grasses are stressed by lack of moisture applications of Poast will be ineffective for control. The label instructions on the use of adjuvants should be followed.

Lay by Herbicides for Melon Crops

When the type of melon being grown has a long growing period, weeds may become a problem before the melon plants has covered the soil surface. The same situation can happen when cool weather delays the growth of the melon vine. In these situations the use of layby herbicides may be needed to prevent infestation of the field by weeds.

Lay by herbicides are used to prevent weed problems caused by the field’s weed seed bank. Under the right conditions weed seeds that lay dormant in the field will germinate. This weed problem occurs before the melon plants are large enough to shade them out. Layby herbicide applications is a part of the planning that goes into good melon weed control.

To control weeds that emerge after the melon crop has been thinned the use of layby herbicides may be required. These lay by herbicides do not control emerged weeds growing in melons. The decision to apply lay by herbicides is considered to be a preventative pest control measure. The use of registered herbicides that affect the weed seed, shoot or root are used in this situation. Trifluralin (treflan), DCPA (Dacthal) and ethalfuralin (Curbit) are registered for use during the layby period of the melon growing season.

The melon plants have been thinned and this should be done during the last cultivation of the soil around the plant. For lay by herbicide applications in melons the plants should have four or five leaves. The herbicide is applied with directed spray to the soil around the melon plants taking precautions to protect the plants from any spray droplets.

Trifluaralin should be incorporated into the soil mechanically. The rolling type cultivators can be used for incorporation. Dacthal doesn’t require mechanical incorporation. The irrigation that follows application will incorporate the Dacthal. The plant back restrictions on the labels should be followed for the safety of the following crop. The practice of using a lay by herbicide program is to prevent weeds from emerging before the melons have covered the growing area with their leaves.

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LETTUCE WEED CONTROL By Tim Braun

Lettuce requires less nitrogen then several other crops, but lettuce has a critical need for phosphate. This is especially evident in the seedling stage of growth. There are pweeds that have the ability to seek out phosphate in the soil with their long roots and or a multitude of root hairs. There are other weeds that have the ability to excrete organic acid materials like citric acid that can dissolve unavailable forms of phosphate contained in the soil. These weeds can survive in low phosphate soils.

Lettuce and some of the other crops and weeds are genetically deficient in these phosphate mining attributes and thus require applications of available water soluble phosphate. Lettuce seedlings require an available source of water soluble phosphate to reach its maximum growth and size. When lettuce is planted as seed, applications of water soluble phosphate are required. Streaks in an emerging lettuce crop is usually caused by application problems with water soluble pre plant phosphate.

Common purslane, the weed, has the same problems in obtaining phosphate as lettuce. Common purslane grows to its maximum size in soils well fertilized with water soluble phosphate. Shepherds of sheep have told me that sheep feed first on areas in an alfalfa field where the common purslane weeds are the most abundant. The sheep find that these areas have more phosphate available. The available phosphate allows the alfalfa, purslane and other weeds to become a nutritious feed source in these areas of the field. The need for phosphate and the high amounts applied by vegetable growers encourages the growth of common purslane.

Phosphate applications to lettuce increases the field's need for weed control requirements. Lettuce fields with broadcast phosphate require higher thinning expenses. Studies have found that broadcast phosphate fertilized fields compared to fields with phosphate applications that are drilled under the planted lettuce seeds required higher thinning expenses. The purslane seeds were not getting enough phosphate outside the seed line when phosphate was only applied under the lettuce seed line.

Common purslane is found in moist, warm areas and cool coastal areas of California and Arizona. In some areas it is an edible crop and is used as a salad or a cooked vegetable. In the desert areas of Arizona and California purslane is a problem starting in the months of February and March and is still around in October. Common purslane, an annual plant, is a succulent plant that grows into a dense mat. When this mat is turned over thousands of seeds are visible on the soil surface.

The common purslane plant has no stalk. The stems grow out from the weed's center with leaves that are located either opposite or alternate from one another . Purslane stems extend to 12 inches in length from their centers. The leaves are oval, succulent, shiny, smooth and 1/2 inch to 2 inches in length. In the axils of the leaf stems five petalled flowers emerge. The common purslane flowers are yellow in color and only open in sunshine. Common purslane seeds are formed in small pods with lids. The seeds are brown to black.

The seeds germinate very near the soil surface and many germinate on top of the soil if surface moisture is sufficient. Any type of soil moisture either irrigation or a rainstorm will fill the field with germinating purslane seedlings. Most of these seedlings die from overcrowding but the survivors start flowering within a few weeks.

Disking the common purslane after the weeds have matured will cut up the stems. These purslane cut stems are full of mertistem cells that produce roots and shoots. The cultivated cut stems of purslane stay viable in the soil moisture for several days often until the next irrigation. I can remember when many growers complained that the herbicide Balan didn’t work on common purslane seedlings. Balan kills the seedlings from the seeds but it doesn’t stop the stem cuttings from producing roots and new weeds. Paraquat or other contact and systemic weed killers applied before disking will reduce this problem.

Another weed that is stimulated by preplant phosphate applications is lambsquarters. Lambsquarters is a summer annual weed that is a problem in the lettuce growing areas of Arizona and California. One lambsquarters plant growing in a five foot row of lettuce that has received preplant phosphate can reduce the lettuce yield by as much as 65% during a 10 week growing period. One lambsquarters weed can produce 30,000 to 176,000 seeds with an average of 72,500 seeds. The seeds can lie dormant for long periods of time and will germinate when a variety of weather and good nutrient conditions are present.

In some cases researchers have had lambsquarters seed germinate after 12 years of dormancy. The depth of burial in the soil will affect the length of time for dormancy. Plowing will bring these lambsquarters seeds to the soil surface where germination can occur. The plowing is followed with irrigation. Herbicide applications or cultivations will control the weeds that emerge.

Lamsquarters are problem weeds during the period when the fall months turn from warm temperatures to cool temperatures. This is a period when desert lettuce is being planted. The seedling leaves of lambsquarters are shaped like an egg. The lambsquarter seed leaf and first seedling true leaves are dull green on the top and often purple on the bottom.

Other weeds that occur in lettuce fields during the fall when hot to cool temperatures exist include nettleleaf, knotweed and cheese weeds.

The winter annual grass weeds that cause problems in lettuce include: canarygrass, wild oats, bluegrass (Poa annua), wild barleys and volunteer small grains. Broadleaf cool weather weeds in lettuce include London rocket and black mustard.

Weeds that are a problem in lettuce production because they are not killed by lettuce herbicides include: annual sowthistle, prickly lettuce, shepherd’s purse, burning nettle and nutsedge. Control of these weeds can take place by using approved herbicides like Devrinal on crops grown before the lettuce. Cole crops are examples of weed control rotation crops. After harvesting the cole crops treated with Devrinal or Treflan be sure and follow the Devrinal label’s residual periods before planting lettuce. Pronamide, Kerb, is effective on shepherd’s purse in lettuce most of the time.

Lettuce planted when soil temperatures are very warm require several sprinkler irrigations to cool the soil for germination. When several hours of sprinkler irrigations are used for cooling, leaching of the Kerb occurs below the weed seed germination level. Weeds can emerge and the effects of the Kerb are lost. Exceptions to the label in some areas allow the Kerb to be applied through sprinkler chemigation after the field has received four or five days of cooling sprinkler irrigations and before lettuce seed germination.

Mild weather that occurs in the summers of the coastal areas, the San Juaquin Valley areas and in desert areas will encourage the growth of pigweeds, amaranthus spp., and the groundcherry weeds. Pigweeds produce a high amount of seeds that can be missed by the herbicide applications. Research tests have observed a reduction of 20 to 40% in lettuce yields where pigweed wasn't controlled during the 3 to four weeks after crop emergence. They found that one spiney amaranth plant (pig weed) will reduce the yield and quality of the four lettuce plants around it.

This period of growth, three to four weeks after emergence, requires hand weeding or hoeing as the only method of weed control. Most of the preplant herbicides used on lettuce with the exception of Prefar will control pigweeds. Because of the high seed population of pigweeds, seeds and seedlings can easily escape application.

Amaranth (pigweed) is listed as a crop on some pesticide labels. Amaranth is listed as a leafy green along with head and leaf lettuce, endive and spinach. When cultivators are set too deep or herbicide misses occur, pigweed (Amaranth) seeds can be brought to the soil surface and germinate. Hand hoeing crews are a common sight right before Christmas in many lettuce fields controlling the pigweed. plants that are seen growing among maturing lettuce.

If a field has a history of pigweed infestations, shallow cultivations and the use of combinations of preplant herbicides will reduce the infestations in fall planted lettuce. Seed specialists say the pigweed seeds in the soil can still germinate after 25-30 yrs. A pigweed plant can produce 117,400 seeds.

Balan

Balan is one of the oldest herbicides used on lettuce and it is still used today. Balan is a member of the dinitroaniline herbicides. This class of herbicide includes: Surflan, Prowl and Treflan. Balan is taken up by the shoots and the roots, but it is not translocated throughout the plant. Dinitroanilines interfere with the movement in the plant chromosomes which occurs during one of the processes taking place as the cells divide. This part of the division of cells is called mitosis. Due to the breakdown in the cell forming process in the roots the weed seedling dehydrates and dies.

The injury caused by Balan happens where the herbicide enters the roots and shoots. Balan is not a systemic. It does not travel up into the plant. The roots swell without growing. Balan injured roots have a thick, short, stubby appearance. The stem below the seed leaf will swell in most cases. The brittleness of this stem at the soil surface is apparent. Balan leaf injury causes more of a distortion type of damage to the cotelydon leaf and the first true leaves above the surface of the soil when compared to the damage of other lettuce herbicides: Prefar and Kerb.

The weeds controlled by preplant applications of Balan include grasses and broadleaved weeds. These include: annual bluegrass, barnyardgrass, crabgrases, crowfootgrass, fall panicum, foxtails, goosegrass seedling Johnsongrass, junlerice, ryegrass, sandbur, Texas panicum, carpetweed, chickweed, knotweed, lambsquarters, pigweed, purslane, redmaids, and Florida pusley.

Weeds not controlled by Balan include established weeds. Other weeds not controlled by Balan pre plant applications include: nightshade, mallows, nutgrass, cocklebur, groundsel and ragweed.

Kerb

Kerb is another herbicide applied pre plant to lettuce. Kerb is a substitued amide and like Balan it inhibits root growth. Kerb is taken up by weeds through their roots and shoots. After entering the weed Kerb is translocated up into the entire plant. The small weed seedling roots receive the greatest damage. This injury prevents the weed from taking up enough water to survive.

Lateral roots are not clubbed or pruned as with Balan damage. The leaves of the young weed seedlings thicken, look puffy and are stunted from Kerb toxicity. Sometimes the leaves become chlorotic at their margins.

When applied to lettuce being grown in sandy soils the higher rate of Kerb should be avoided because of injury to the lettuce. As mentioned earlier in this course, Kerb can be leached by sprinkler irrigation used to cool warm desert soils. This leaching removes the Kerb leaving the weed seeds to germinate and infest the lettuce beds.

Prefar

Prefar is a pre emergent or pre plant herbicide used in lettuce. Prefar wasn't used as much as Kerb or Balan until growers and applicators learned how to use it properly. When most of the lettuce and other vegetable crops were irrigated up with row irrigation Prefar was not effective as the Balan incorporated herbicide or the sprinkler incorporated Kerb.. Once the use of sprinklers for lettuce seed emergence was developed Prefar became a effective major lettuce herbicide.

Prefar can be applied through the sprinklers. Prefar is an organophosphate chemical. Prefar kills the weeds by preventing the synthesis of the young weed seedling's long chain fats or lipids.

Prefar is taken into the weeds roots and shoots where it prevents the roots from growing. This causes a shortage of water for the seedling and the germinating weed dies.

Prefar is not translocated beyond the root system. Because Prefar is held very tightly by the soil particles less Prefar is in the soil water. If heavy sprinkling is required for the lettuce seed to germinate, unlike Kerb, Prefar will not leach below the soil's 1/2 inch surface where the largest amount of weed seeds are germinating.

Prefar is effective on grasses and some broadleaves. Prefar is effective in the warm temperatures that occur during the late summer lettuce planting season in the desert areas.

Other Lettuce Herbicides

Prefar, Balan and Select Max are not effective on the ground cherries and in some areas Malva (cheeseweed). Goal applied 3 to 4 months before planting is effective on these weeds. Herbicides on ground that is allowed to lie fallow before planting lettuce include Goal Tender as a pre emergent and post emergent herbicide. Paraquat, Scythe, Roundup and Shark can give control of emerged weeds on fallow beds before planting lettuce. Depending on the herbicide label a waiting period may be required before planting. Roundup will control some of the perennials, including Bermuda grass, that have emerged in the fallow beds.

Applications of the fumigant, Metam sodium, will give some preemergent weed control when applied to fallow lettuce beds.

Poast and Select Max can be applied to emerged lettuce crops. Poast will not control annual bluegrass. Select Max will control annual bluegrass. The herbicides, Poast and Select Max should be applied when the seedling weed grasses are very young. When grasses are under stress Poast and Select Max will have difficulty in controlling these grasses.

Lettuce Herbicide Application

Balan incorporation into the soil for weed control requires certain precautions. Reduction of volatility and photodecomposition are two of the main reasons for mechanical incorporation. Because Balan adsorbs onto soil colloids, it is mechanically incorporated into the soil more accurately than by using irrigation or rainfall. For ideal soil incorporation of Balan, the soil should be cool, dry, free of crop residue and if the soil is cloddy, the clods should break up easily with the incorporation.

Application of the herbicide, Prefar, is effective when applied in the sprinkler irrigations. Prefar is held very tightly by the soil particles and doesn't leach below the weed germinating area of the soil when repeated sprinkler irrigations are used for lettuce germination. Combinations of Kerb and Prefar give a wider range of control for weeds that infest lettuce.

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Corn Weed Control By Tim Braun

Weeds can take up nitrogen three times faster than corn which has been bred to require high amounts of nitrogen to produce a paying crop. Tests in 1999 and 2000 run by Purdue Extension Service on weed competition with corn for nitrogen uptake gave the following results. When weeds emerged with the corn, the weeds contained 3 times as much nitrogen as the corn. When the corn emerged 10 days before the weeds, the weeds contained only half as much nitrogen as the corn. This nitrogen loss to weeds when emerging with corn is one of the main reasons for weed control. Round Up was sprayed to control the weeds because this field in the test was planted with Round Up ready corn seed. Nitrogen was applied to offset the nitrogen loss, but this didn't offset the yield loss caused by the stress on the corn plants due to loss of moisture taken up by the weeds.

Another severe stress placed on corn plants is slow germinating corn seeds that germinates after the rest of the crop has germinated. Later germinating corn plants are unwanted plants even though they were meant to be part of the crop. They become weeds that can’t be controlled. Having all the corn seed germinating at the same time keeps all the plants at the same stage of growth. Later germinating plants are smaller and their smaller size reduces the amount of water and nutrients that their smaller roots can get from the soil. The taller plants shade the vital sunlight away from the smaller later germinating plants.

The smaller corn plants with their increased stress levels may become barren without any harvestable ears or produce a smaller ear. These smaller corn plants keep growing however and compete for costly nutrients, water and sunlight. These late germinating corn plants still thrive and consume costly inputs that the total crop receives. Because the early germinating plants are aware of this competition the early germinating corn plants are stressed also. This stress interferes with their normal growth causing yield losses.

Reducing the late germination of corn plants will reduce this costly corn crop stress. Most of the seed purchased for planting has passed germination requirements and is treated with chemicals to prevent soil borne diseases that slows germination. Working the soil to produce a seedbed that encourages uniform germination is vital. Making sure that all the working parts of the corn seed planter are in order is vital. The speed that the planter travels decides accuracy of the seed placement in the soil. Calibration of the planter before and during field planting reduces mistakes that can’t be corrected after the corn plants emerge.

It takes about 125 days for corn to mature. The corn plant produces 20 to 21 leaves with collars. The silk stage of corn when pollination and new seed is formed occurs around 65 days after emergence. All of the corn’s growth periods vary. Hybrids grow faster or slower depending on the hybrid. Different hybrids will have different lengths of time between life stages.

Rather than use the number of calendar days corn growers use the number of Growing Degree Days (GDD). Degree days for corn starts the day after planting. Each day varies in the amount of energy available for corn growth. The use of degree day counting gives a guide to when the growing stages occur. (GDD) are obtained by taking the days high temperature plus the days low temperature divided by 2 minus 50. This gives the Growing Degree Days (GDD) or heat units using Fahrenheit (F.).

Calendar days contain a varied amount of heat units depending on the weather. Seed companies provide heat unit guides for their different hybrids. Applications of post-emergence herbicide label instructions refer to growth stages in their instructions for when to apply herbicides.

There are a few methods used to identify growth stage but the collar method is used most of the time: Vegetative (V) and Reproductive (R). The reproductive (R) stages indicate the seed development from silk formation (R1) to physiological maturity of the seeds on the cob (R6).

Where the corn leaves join the stem a collar forms around the stem as the corn plant grows. This collar becomes the base of the formed leaf. Not all leafs have this collar. Leafs with the collar are counted and the number of collars are used to indicate the corn plant’s stage of vegetative growth:

The first V is Emergence from the seed: VE, then collars: V1,V2..... to VT(tasseling)

Corn plants may have several leafs but only the leafs with collars are counted when deciding the maturity of the corn plant. Sometimes the leaf collar is barely visible, but it should still be counted.

The first vegetative stage is the VE or emergence stage. The planted seed germinates when it has 30% moisture. The root radical extends down anchoring the plant while the shoot with the seed leaf starts heading for the soil surface. The growing point is the meristematic area containing the plant's growth cells joining the roots and the shoot.

The growing point will stay below the soil surface until the V5 to V6 stages which takes about 3 to 4 weeks. Keeping the growing point below the soil surface protects the vital growing point from frost, wind, hail, many insects, tire traffic and other above soil dangers. The corn's genetic make up require that the growing point stay below the soil surface during this early phase of growth.

The V1 and V2 stages are when the first and second collared leaf forms above the soil surface. The root system starts to grow taking up nutrients and water. Corn roots grow in whorls sticking out and around the base of the corn plant's growing point which is still below the surface of the soil. The first whorl of permanent nodal roots emerges from nodes on the growing point which is now 1/2 to 1inch below the surface of the soil.

The small seed roots are replaced with the permanent nodal roots. The growing point is still protected at this time. About 2 weeks after germination the V3, V4 and V5 stages of growth occur. During the appearance of the V5 collar the nodes on the corn stalk begin growing farther apart as the stems lengthen.

The formation of V5 is when the ear shoot number, which is the highest yielder, is determined by the plant. Counting down from the top of the plant an ear formed at the 6th or 7th node will produce the highest yields. Stress during the critical period, V5, when the growing point is below ground will delay the plant and produce its grain yield ear at the 8th or 9th node resulting in a lower yield.

Stress from weeds at this time will affect the yield. This (V5) is also when the plant decides how many rows of kernels per ear it will produce. This is a very critical time to have weed free corn. Stress causing weeds should be controlled before the V5 period of growth because the growing point below ground contains the microscopic tassel. The protected growing point is still below the soil surface and the corn plant is about 8 inches tall at V5.

By V6 the growing point has reached the soil surface and the length of the corn ear is already determined. The root system is visible and can be damaged by cultivation.. Post emergence herbicides can still be applied, but drop nozzles should be used to prevent damage. Late applications of post emergence herbicides will reduce ear size through stress to the growing plant. Some labels recommend drop nozzles be used at these later stages to avoid this stress.

The growth stages beyond V6 allow the corn to shade out weeds that germinate. Most of the grain corn only produces one ear of corn per plant so everything is done to obtain a stress free plant. Some hybrids produce more than one grain producing ear, but the yield is usually close to the same or even less than the corn that produces one ear of harvested corn.

Corn was originally grown similar to small grain crops. The need for weed control became the reason for corn planted in rows. The need for space between rows for horses pulling a cultivator determined the width of these row spaces. When tractors replaced horses and mules the tire widths of tractor powered cultivators dictated the distance between planted rows of corn. At the present time row spacing has been developed to gain the highest yield and quality but tire width is still a factor.

The use of herbicides to control weeds in corn has replaced the need for several cultivations. In many treated fields the number of cultivations has dropped to one. On non till fields herbicides have replaced cultivations.

Round Up ready corn has contributed to the low number of cultivations. The increase of Round Up resistant weeds in corn does require some cultivation so cultivation continues to be one of the corn farmers sure techniques of weed control. Reductions of cultivation is forced on growers because of the ever increasing petroleum expense. Some small acreage farmers, especially sweet corn growers, still use horses and mules to pull their cultivators.

Crop rotation reduces the weed infestations in many fields. When corn is grown as a second crop behind vegetables the weed control from the applied vegetable herbicides is very beneficial. The plant back restrictions on previous vegetable herbicides can be a problem in many cases.

Plowing the field before planting is a practice used to reduce the time required before planting corn. Plowing mixes the herbicide residues with more soil thereby diluting the toxicity levels in the soil. Label instructions should always be followed to avoid injury to the corn crop.

Nutrition, moisture, soil temperatures and seed bed preparations all ad to the strong growth of the young corn seedlings. The young corn seedlings do not require large amounts of nutrients. If starter fertilizers contain ammonium types of nitrogen they should not be placed directly below the seed to avoid root damage.

Starter fertilizers usually contain all three nutrients: nitrogen, phosphate and potassium. Irrigated soils in California and Arizona generally have adequate levels of potassium; but if the previous crop on the field had a large yield that diminished the level of potassium an addition of potassium in the starter fertilizer may be needed. Soil held potassium is constantly being released to the soil solution but an unusually large crop yield will lower soil potassium solution levels. It requires a period of time for the soil to release more available potassium for the following crop. A potassium application is faster.

Phosphate fertilizer is the most commonly needed nutrient in a starter fertilizers for corn. Soils that test high for phosphate may still require a phosphate starter fertilizer. Soil tests only indicate the availability of citrate soluble phosphate. Growing crops have established root systems that put out organic acids that can dissolve the citrate soluble phosphate. The dissolved citrate soluble phosphate becomes water soluble phosphate that plants need. Newly emerging plants do not put out these acids. Starter water soluble phosphate is used for young seedling roots to get the corn plant established. Then the maturing corn plant roots will produce enough of these acids to dissolve the citrate soluble phosphate.

Many of the hybrids were produced to have high yields with high nitrogen inputs. Even with the application of nitrogen some of the weed control practices increase the need for more nitrogen. As weeds die the bacteria and fungus that decompose the dying and dead weeds tie up enough nitrogen from the soil to reduce soil nitrogen levels. After using a post emergence herbicide or a cultivation, applications of nitrogen should be applied to offset the loss of nitrogen to the soil microorganisms that are consuming the dead weeds.

Testing for nitrogen needs with quick in field soil tests will let us know how much soil nitrate nitrogen is in the soil. The soil nitrate quick test in the field is fast. Leaf and petiole tests will tell how much nitrate nitrogen is in the plant but not the soil. If the plant is stressed, nitrate levels in the plant leaves and petioles increase. Plants do not use their stored nitrate nitrogen when they are stressed. A windy day will stress a plant. Therefore leaf and petiole nitrate test show a high level in the plant tissues while your soil nitrogen levels can be too low. If the irrigation or a nitrogen application period passes and no needed nitrogen is applied yields suffer.

The weeds that infest corn are both winter and summer types because corn is grown in the field for more than one season. The critical period for corn weeds is during the early stages of the corn crop. Depending on the location of the field in the two states, California and Arizona, the early season for corn may be during various months and seasons of the year. Soil temperatures above 50 degree F. are usually needed when planting corn.

The weeds that are a problem in corn include the broadleaves: lambsquarters, common sunflower, horse purslane, common purslane, annual morningglory, cocklebur, hairy nightshade, black nightshade, field bindweed, velvetleaf, redroot pigweed, and green amaranth pigweed.

Barnyardgrass is one of the commonest grass weeds in corn grown in Arizona and California. Other grasses include: volunteer small grains, perennials like nutsedge, Johnsongrass and bermuda grass.

Pre irrigation followed with disking the emerged weeds is effective in controlling weeds that will germinate during that season. When time or rainfall prevents the pre irrigation followed with disking the use of preplant herbicides may be required.

Preplant herbicides that require incorporation before planting include: Dual Magnum, Eradicane, Lasso and Prowl. These are especially effective on annual grasses and perennial weed seeds. Eradicane which has a fuming action should be incorporated to a depth of 4 to 6 inches. The other preplant herbicides should be incorporated at the 2 to 3 inch depth. Post emergence systemic herbicides for control of broadleaf weeds include 2,4-D and Banvel or Clarity. Buctril, Sencor. and Shark are contact herbicides used to control broadleaf weeds.

Herbicides that have differing chemical structures can be tank mixed to reduce chances of resistance. Accent is used no more than 2 years consecutively to prevent the buildup of resistant weeds.

Timing of the application of post emergence herbicides should be before the V5 or the 5th leaf with a collar. The growing center of the corn plant is still below the surface of the soil. Weeds are smaller and easier to control.

Banvel and 2,4-D should be applied before the V3 stage of growth to avoid injury to the plant. Even thought the corn plant is 14 to 21 inches high and has 4 to 5 collared leaves (V4 to V5) and the number of kernel rows and what shoot will produce the ear have all been decided, the vital corn plants growing point is still protected below the soil’s surface. The growing point has stalk and leaves above it and roots below it. The stalk between the internodes begins to lengthen after V5 forms.

The lengthening of the stalk and the growth of the roots elevates the growing point through and above the soil surface. Roots grow from the growing point node. These are large roots that form in whorls around the base of the corn plant as anchor roots for the tall stalk of corn.

At V6 the growing point is above the soil surface and exposed to damage from the elements, cultivation and herbicide sprays. In non tilled soils liquid fertilizers are sprayed to the surface of the soil. Irrigation or rainfall moves the fertilizer into the root zone. The possible herbicide applications, cultivations and fertilizer applications other than water runs should be completed for the corn crop. If the corn is without weeds at theV6 stage of growth, germinating weeds will be shaded out by the corn plant.

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer’s label.

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Cotton weed control

Cotton is a slow growing plant and weeds will take vital nutrients, sunlight and water from the cotton crop. There are however several herbicides that can be used in cotton for weed control. Early cotton takes forever to start vigorous growth in cool soils and there are many cool weather weeds that compete with the slow growing cotton plants. Cotton is a major crop worldwide. The research time and money made available for cotton weed control is large when compared to the number of herbicides needed by other crops.

The use of two applications spaced ten days apart of Roundup on cotton before the four leaf stage has resulted in good cotton weed control. This practice has eliminated the need for preplant herbicide applications for weed control on a great deal of acreage. Many growers have been able to stop the practice of lay-by applications for cotton weed control when using the Roundup Ready method of weed control. Precautions for applications of Roundup over the top of Roundup Ready cotton include early timing. The application of Roundup from the time of emergence until the fourth true leaf stage of the cotton plant prevents damage to the cotton crop.

Round Up applications after the four- leaf stage results in the abortion of the bloom. The reason for a cut-off time for applying Roundup over the top of cotton is due to the damage that occurs to the cotton flowers. Research with the use of Roundup that was applied to young cotton plant and was transported to the new squares which are formed after the four leaf stage discovered that because of the need for sugars to aid in the development of the squares these growing tip areas became sinks for the sugars and the Roundup.

The Roundup translocated to these squares caused the developing flowers to stop shedding pollen. Without the pollen the boles become deformed and are shed by the plant. The deformed boles have their tip growth tipped to one side. These boles are referred to as *parrot beaked*. The deformed boles drop from the plant and have to be replaced by the plant. The replacement of new boles delays the cotton production and reduces the yield of the crop.

If for some reason the growers see that they cannot apply two Roundup applications before the four leaf stage of cotton growth, a preplant herbicide application should be planned in their cotton weed control program. Two of the preplant herbicides used in cotton include the dinitroanilines: Treflan and Prowl. Treflan and Prowl are used on regular cotton and Roundup ready cotton. They are effective against most of the annual weeds including grasses and broadleafs. When dinitroanalines, Treflan and Prowl, are combined with Caparal they will control the nightshades.

Dinitroaniline resistant weeds include weeds in the potatoe family. These weeds include: the wright groundcherry, an annual broadleaf weed; silverleaf nightshade, a perennial broadleaf which grows from seed and creeping, deep penetrating rhizomes; also desert thorn apple that is an annual broadleaf produced from seed with trumpet shaped flowers. Common sunflower in the thistle family is an annual broadleaf that is resistant to the dinitroanilines.

Dinitroanilines do not control perennials like annual morning glory, Bermuda grass, Johnson grass and nut grasses that reproduce from the growing parts of these weeds. The perennial rhizomes, tap roots, crowns, nuts, bulbs and stolons contain meristem cells that can grow to become above ground weeds. Treflan and Prowl will control the weeds emerging from seeds of the perennial grasses like Bermuda grass and Johnson grass. If a preplant herbicide is applied along with one application of roundup after cotton emergence before the four leaf stage. This control method will usually control the annual and the perennial weeds when sprayed over Round Up Ready cotton.

On other varieties of cotton directed sprays of Roundup can be used to control weeds throughout the growing season. Weeds that have come up in skips within the cotton field can be controlled with directed sprays when drift conditions are not aproblem.

After the bolls begin to crack Roundup can be sprayed over the top of Roundup Ready cotton. Roundup can also be used mixed with defoliants in cotton to aid in the control of cotton regrowth that interferes with harvest.

The use of Ignite which is a glufosinate can be used in “over the top of cotton” sprays with the *Liberty Link System*. Ignite has a different type of action than glyphosate (Roundup). Ignite will control a wide spectrum of weeds. As far as cotton plant growth stages are concerned, there are no restrictions for the Liberty Link system of weed control and there are no crop rotational restrictions with Ignite. Ignite can also be applied as a directed spray or as hooded system sprays on cotton that is not in the Liberty Link growth system.

Ignite unlike Roundup is a contact herbicide with limited translocation in the weed. Thorough coverage of Ignite is required. Application to the weeds should be made when the weeds are very small for best control. Ignite works on broad leaf weeds as well as some grasses. Ignite sprays should be terminated 70 days before harvest.

Liberty Link cotton varieties have an enzyme that changes the applied Ignite to a nontoxic chemical. Ignite cannot be sprayed over the top of Roundup Ready cotton and Roundup cannot be spayed over the top of Liberty Link cotton. Damage will occur unless these two herbicides are used properly.

Staple is a herbicide that can be sprayed over the top of cotton for the control of broadleaf weeds even though cotton is a broadleaved plant. Staple does not control grasses. Staple controls some of the weeds that are hard to control in cotton. The black and hairy nightshades, cocklebur, velvetleaf and pigweed are some of the broadleaf weeds controlled by Staple. Annual morningglory and ground cherry are only partially controlled by Staple.Grasses and nutsedge are not controlled by Staple.

A slight yellowing of the cotton will appear, but the cotton out grows these symptoms in a few weeks. There is a residual condition with Staple. Staple is taken up by the roots and foliage. This residual in the soil after applying Staple is a problem in fields that are not cultivated or disked before planting another crop. Disking allows the soil to dilute the toxicity of the Staple residues. The label has restrictions on crops that are susceptible to residues of Staple.

Staple is an (ALS) inhibitor an enzyme of plants not animals. Staple will stop the growth of susceptible weeds which die within 14 to 21 days. For best results Staple should be applied between emergence and the fourth leaf stage of the weeds. A directed spray of Staple over the top of the cotton plant should be applied. Broadcast applications should be avoided to prevent drift.

Mixing Staple with Roundup will give increased morningglory control. When morningglory has grown beyond the 2 true leaf stage Roundup needs this type of help from Staple to control it.

Back in the mid nineteen sixties the two arsenical herbicides, MSMA and DSMA were used to control nut sedges, Johnson grass and morning glory in cotton crops. There was some damage that occurred with the use of these two products, but the weeds in this case caused more damage then the herbicides. I’ve used DSMA on fields of cotton that were covered with Johnson grass in Buttonwillow Ca. and Yuma, AZ... The DSMA was applied by air. Ground applications didn’t do as well unless flood nozzles were used to increase leaf coverage. The use of adjutants increased the toxicity of DSMA and MSMA. The DSMA killed the Johnson grass and allowed the growers that I serviced to get a good crop of cotton.

When MSMA or DSMA is added with Staple to increase control it should be applied before first bloom or before the cotton is three inches high to reduce damage to the cotton. Combination sprays of MSMA and Caparol can be applied post emergent for hard to control nightshade. In some cases this combination may be needed preplant, postplant and layby in fields of cotton where nightshade has been a severe problem.

Caution should be used when applying MSMA and DSMA when citrus crops with fruit are within drift range. The drifting droplets of these two products will show up on the citrus fruit rinds after the fruit is gassed for color. The drops of MSMA and DSMA on the citrus will remain green and not color up with the usual yelllow lemon and orange orange. Green spots that stay on yellow and orange gassed citrus is downgraded.

Poast, Fusilade, and Prism are grass killers which can be sprayed over the top of growing cotton. Poast, Fusilade, and Prism controls most grasses. The perennials, Johnson grass and Bermuda grass are controlled by Poast, Fusilade, and Prism. The grass killing effect of Poast, Fusilade, and Prism occurs by preventing the synthesis of lipids (fats) in the meristem cells of the roots and shoots of grasses. Poast, Fusilade, and Prism does not prevent the synthesis of meristem cells in the roots and shoots of broad leafed weeds and will not control them. Cotton is a broad leaf perennial.

The use of an oil adjuvant or non-ionic surfactant is recommended to aid Poast, Fusilade, and Prism absorption into the weeds. Once inside the weed these herbicides are translocated to the sinks (young growing cells in the roots and shoots of the weed).To get the best possible weed control Poast, Fusilade, and Prism should be applied before the weeds are 6 inches tall. The weeds should be actively growing with out signs of stress. If Staple is applied before or with Poast and Prism grass control may be delayed. If Fusilade is tank mixed or applied within 7 days of an application of Staple reduced grass control may occur.

The fumigant, Vapam, or Metam, is applied preplant. Vapam is good for nightshade control and it will work on nutsedge under the right coditons. The control of nutsedge with Vapam is erratic on sandy soil and poor on clay loam soils. Vapam will sometimes reduce cotton seedling vigor when high rates are required.

Cotton growers who have treated their fields with prowl and treflan while bedding up during fall and winter months will have some weeds like mustards and other broadleaf weeds which aren’t controlled with these herbicides. There are several herbicides that will control these broadleaf weeds that emerge before planting. Shark is a fast acting, contact herbicides, whose mode of action is to cause a breakdown in the weed’s cell membranes. Shark can be used preplant and at lay-by. Shark applied to the growing weeds or soil where it will control emerging weeds. Shark is non-volatile and isn’t degraded by sunlight. Shark has slight activity in the soil.

When applied to growing weeds good coverage is essential because Shark is not translocated in the weeds. Drift should be avoided because Shark is not a selective weed killer. Residues of Shark in the soil lasts for a short period of time. Shark causes a water soaked appearance then turns leaves yellow and finally black with leaf and stem desiccation and then the weed dies. Shark has good activity on henbit, malva, and B. nettle.

Chateau another contact herbicide also attacks the cell membrane causing them to rupture. The damage is like Shark’s damage. A water soaked appearance followed by yellowing, black spots on leaves resulting in the death of the weed. Chateau is fast acting, non valatile and has some activity in the soil. Chateau will not lift off from the soil with evaporating water molecules. Chateau is very effective on clovers and malva when applied pre emergence. Chateau is non-selective and drift should be avoided.

Chateau is degraded by sunlight and is broken down by soil microorganisms and water. Chateau gives good control of chickweed, clover, henbit, fleabane, malva, B. nettle, sheperds purse and sowthistle. Chateau is used before planting and at lay-by. When used at lay-by the label for Chateau should be followed to prevent damage to the growing crop.

Goal is a contact herbicide that attacks the weed’s cell membranes. This causes the cell to lose its fluids resulting in the death of the weed. Goal requires good coverage because it is not systemic in the plant. Goal is moderately volatile. When in moist soil or leaf moisture Goal will lift off with the water molecules to the surrounding air.

When entering the soil water Goal will kill weed seedlings. Goal will form a soil barrier that can be broken with cultivation before planting cotton. Soil residues of Goal will last for a long time therefore plant back restrictions should be adhered to. Water and microorganisms will eventually break down Goal in the soil. The symptoms of goal toxicity include: the plant appears water soaked, then the stems and leaves turn yellow, then black and the weed dies. Weeds killed by Goal include: henbit, malva and B. nettle. Goal, Shark and Chateau herbicides are similar in the mode of toxicity to weeds, but they are not similar in their makeup.

Another herbicide, Paraquat, produces the same type of damage to the weed cell membranes, but this herbicide doesn't cause the direct damage itself. Paraquat reacts to the energy produced by the plant's photosynthesis. This reaction of Paraquat to photosynthesis inside the plant produces disruptive chemical compounds that cause rupture of the cell membrane.

This reaction is fast. Physical evidence shows that Paraquat damage can occur within 15 minutes. This is on a clear day with plenty of sunshine because of the need for the photosynthesis activity of the weed. Paraquat is a contact herbicide and requires good coverage because it is not systemic.

Drift is a problem with Paraquat and should be avoided. The symptoms of Paraquat damage includes a water soaked appearance that becomes necrotic with the yellowing, then the burnt look followed by the death of stems and leaves. Paraquat is non volatile, has no soil activity and is broken down by water and microorganisms.

Paraquat is very tightly held by clay particles in the soil therefore leaching is not a problem. The use of clean water that does not contain clay is recommended when using paraquat. Soil residues of Paraquat that are in the soil water are non existent and there are no label restrictions for Paraquat soil residues. The use of a surfactant is critical to the weed control when using Paraquat.

Weeds controlled by Paraquat include: Henbit, chickweed and mustard. Because Paraquat isn't affective in the soil as a herbicide the addition of karmex will increase the weed killing effect of the application.

All the above herbicides give their best control of weeds when the weeds are in their early seedling growth stages, but the use of cultural practices will aid in the control of weeds in cotton. Crop rotations will allow weed killers that cannot be used on cotton, but that can be applied to crops planted before the cotton crop.

Crops like Sudan grass that give good shade to the soil during their growth will reduce the nut grasses. Sudan planted between vegetable crops in the desert areas has reduced nut sedge when cotton is planted in the following season. The practice of checking a field after the application of a particular herbicide will give a grower the knowledge of what herbicides are useful in each particular field.

There are some resistant weeds to most of the established herbicides used in cotton. With the large choice of herbicides available, changing herbicides to prevent resistant weeds from flourishing is a sound practice. Problem weeds can occur in almost any field. Blackberry nightshade emerges with the cotton seed and can out grow slow growing cotton plants. The berries will stain cotton lint. Chopped-off blackberry nightshade plants do grow new shoots from their meristem cells located in their taproot.

Perennial Nutgrass isn't controlled by several of the registered cotton herbicides. Johnson grass and Bermuda grass are a problem in some cotton growing areas. Perennial morning glory is also a problem weed in cotton.

The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

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Cole Crop Weed Control By Tim Braun

When a crop has enough foliage that allows it to keep sunlight away from any emerging weeds, the crop should be able to protect itself from weed infestations. A Cole crop like cauliflower has some of the densest foliage that a crop would need for its own weed control. But this is only true for mature Cole crops. When the crop is just emerging the area of unprotected bare ground around each plant is huge. Cauliflower when planted by seed has only one seed line; therefore the weed exposure is even greater than the two seeded rows for broccoli.

Because Cole crops like broccoli, cabbage and cauliflower require cool temperatures their growth is slow. The Cole crop slow growth period can last for 8 to 10 weeks depending on the crop and field temperatures. To avoid this exposure to weeds and to reduce the length of time that a field is used for a crop transplants have replaced much of the seed plantings.

Members of the Cole crop family include cabbage, broccoli, Chinese cabbage, cauliflower, radish, rutabaga, turnip, and brussel sprouts. Weeds that are a problem in Cole crops can be part of the same family as Cole crops. Wild mustard, wild radish weeds, London rocket and lambsquarters are members of the Cole crop family.

According to Wikipedia as of 11-June 2008. The largest producer of cauliflower and broccoli on earth is China with 8.5 million tons. India is second with 5 million tons. The United states produces 1.2 million tons with California and Arizona producing most of it. The total world production of cauliflower and broccoli was put at 19 million tons.

Medical nutritionists state that Cole crops have become a major crop in the United states for improved health reasons. Recently the Mayo Clinic, which I visit now in my older years, has their nutritionists pushing the use of broccoli to reduce heart problems in diabetics. Broccoli and the other Cole crops produce a chemical, sulforaphane, that reduces the build up of substances that damage enzymes in our systems that control our sugar levels. They feel that broccoli and other Cole crops can improve the health of diabetics.

Cauliflower is very sensitive to any kind of stress that may interfere with its growth. Any condition that interferes with the cauliflower plant’s development will cause the plant to produce premature heads of cauliflower. These small cauliflower heads are referred to as buttons of baby cauliflower heads. These small size cauliflower heads are not marketable resulting in crop losses. Unfavorable conditions for cauliflower growth include drought, frost, pest damage, weed competition, misuse of herbicides and disturbances of the root system caused by cultivation or hand hoeing.

When cultivation is required shallow (less than 2 inches) disturbance of the soil is recommended. Cultivators that have knives set parallel to the soil are used. Brush cultivation is another method for shallow cultivations. This method is used when the weed seedlings are very small. When hoeing is required, hoeing beneath the leaves should be avoided to reduce damage to the cauliflower roots. These precautions will also avoid disturbing the preplant plant herbicides that may have been applied. Weed seeds that germinate after the crop has emerged and are in undisturbed soil will be controlled by the preplant plant herbicides.

Most of the cauliflower grown commercially in California and Arizona is transplanted. The desert plantings are made during September, October and December. Cauliflower grows best in cooler temperatures. Temperature of 60-65 F are ideal for cauliflower production. Fall plantings in the desert use the cooling temperatures for production. In the coastal areas of California cauliflower is planted and harvested in spring summer and fall.

Broccoli is similar to cauliflower in that it is a cool weather crop. Unlike cauliflower much of the broccoli is planted by seed. Planting with seed requires more weed control measures because seedlings spend a longer period of time where the plant is vulnerable to competition from emerging weed seedlings. The length of time before the Cole crop's canopy closes and prevents weed germination, is close to five weeks longer for seeded crops compared to transplanted crops. Weeds that emerge with Cole crop seeds have the same root growth as the Cole crops. The weed and the crop root systems intermingle making cultivation difficult and damaging to the Cole crop. Of the two planting operations (seeded or transplanted) there is a larger number of approved herbicides for transplanted Cole crops.

In the Desert areas of Arizona and California broccoli is planted during September through December. Desert crops of broccoli are harvested from mid November to March. In the San Joaquin Valley of California planting starts as early as July and goes on into January. The San Joaquin Valley harvest of broccoli starts in October. Harvest of broccoli in both areas can continue into April depending on the weather. On the coastal area of California broccoli is grown and harvested on a year around basis with some curtailment of both planting and harvesting during December.

It is important to know what weeds are germinating when the field of Cole crops will be germinating. The use of particular herbicides that control these weeds should coincide with the known germination period of the weeds that need to be controlled.

Unlike the cauliflower and broccoli crops cabbage is more susceptible to weed infestations. Cabbage other than Chinese cabbage is the slowest growing member of the Cole crops. Chinese cabbage is an upright growing crop that is susceptible to weed infestations, but it matures in a shorter period of time. This fast growth of Chinese cabbage reduces the number of cultivations and hand weeding necessary for the other cabbage crops.

The other cabbage cultivars with their slow growth are easily taken over by emerging weeds. Two cultivations or more may be required to keep weeds at a manageable level of control. Again very shallow cultivations are required to reduce root damage to the cabbage crop. The shallow cultivations will prevent carriage of the weed seeds like pig weeds to the surface soil where they may germinate. In herbicide treated fields the shallow cultivation prevents dilution of any herbicides with deeper untreated soil that can be brought up with deeper cultivations.

The need for high rates of nitrogen by Cole crops like cabbage, cauliflower and broccoli can increase weed growth. These Cole crops require about 8 1/2 pounds of nitrogen per ton of yield when compared to around 4 pounds of nitrogen per ton of yield for lettuce.

Any cultural needs for Cole crops will increase weed growth along with the Cole crop growth. Weeds that infest Cole crops in the desert growing areas of California and Arizona include weeds that have their best growth during the same time that growers are nurturing their Cole crops.

From August to November when soil temperatures are above the 55 degree F. range the grass weeds that are a problem include: barnyard grass (often called water grass), spangletop, junglerice and cupgrass. The cooler weather grasses include: canary grass, wild oat, annual bluegrass, wild barley and any small grain seed left over from previous grain crops.

Broad leaved weeds that are a problem in the desert areas of California and Arizona during September through November plantings include: common purslane, pigweeds (amaranthus) and Wright:s groundcherry. Later the broadleaved weeds include: common lambsquarters, nettleleaf goosefoot and knotweed. During the winter months the broadleaved weeds include: London rocket, black mustard, wild radish and shepherdspurse.

Hard to control Malva (cheeseweed), sowthistle, prickly lettuce and annual yellow sweet clover are a problem in cole crops. Two of the mustards, London rocket and shepherd’s purse, are in the same family as the Cole crops. Herbicides that are used to control weeds in Cole crops have a difficult job in controlling these two weeds. When high populations of these two mustards are known to inhabit these fields a rotation to crops that can be treated with herbicides (Roundup and Metam) that control them should be considered.

Nutsedges are not controlled by the herbicides used in Cole crop weed control. Because nutsedge doesn’t do well in the cold soils of winter, Cole crops should be grown during these months to prevent nutsedge infestations. Crops that use fumigation will kill out the nutsedges. Summer crops that have heavy foliage like the sudan grass grown in the desert areas will shade out the nutsedges thereby reducing the nut production.

Common groundsel is a winter annual weed that will infest Cole crops under the right conditions. Groundsel will grow in cool soils especially in the coastal areas of California. Groundsel is seldom found in the desert area crops. The herbicides approved for Cole crops are <u>in</u>effective for controlling common groundsel. When rotating with crops that can be treated with effective common groundsel herbicides, control can take place. Cultural practices like deep plowing before planting Cole crops will reduce the infestations of common groundsel. Pre irrigation to germinate common groundsel weed seeds followed with cultivation will reduce these groundsel infestations.

Burning nettle that produces a massive amount of seeds infests Cole crops in all regions of California and Arizona. The harmful effect on the fieldworkers’ skin when coming in contact with this weed reduces their efficiency when thinning and weeding. Treflan and Goal will control this weed when applied preplant.

Chickweed that can be very competitive with Cole crop seedlings can be controlled with preplant incorporated Devrinol. Cole crops require cooler temperatures to produce a saleable crop. Weeds that require warm temperatures usually are not a problem in Cole crops. Warm weather perennial weeds include Bermuda grass and Johnson grass. The use of pre irrigation to germinate weeds that can be killed with either cultivations, deep plowing or applications of contact herbicides should be considered.

Because Cole crops need cool mild weather for production for a fair amount of time, planting time will be when several weed types are also growing . In the desert areas summer weeds like purslane may be present when Cole crops seedlings are expected to germinate. As the crop grows into cool periods cool weather weeds like London rocket will be germinating. Late winter and spring planted Cole crops will be attacked by cool weather weeds at seedling stage and some warm weather weeds in slow growing Cole crops like cabbages.

Monitoring for weed control Cole crops has advanced to the same techniques used in insect, nematode, pathology and soil fertility inspections. A history of the field's weeds with dates of germination and type of weeds is made during the past year and years before that. If possible ground positioning should be used to mark the weed locations. When acquiring a new field the use of soil samples for weed seed germination tests may be beneficial. The same techniques where fields are divided into grids for fertilizer applications can be used. After the emergence of the crop, any weeds that emerged during the crop season are recorded and the infestation is rated numerically from 1 to 10. A history of herbicide use with control data and any misses or failures is recorded.

Preplant plant weed control entails the use of a pre irrigation to bring up weeds. The weeds that emerge after a pre irrigation can be controlled with contact and systemic weed killers. These include Paraquat and Roundup.

When applications of sulfuric acid soil treatments are used for soil alkali problems the acid will act as a contact control of weeds. Be sure and apply the sulfuric acid when the weed leaves are bone dry. Any water including morning dew that is present will stop any weed kill that could occur. Applications of sulfuric acid made late in the morning after the dew has dried will give good weed kill.

Cole crop preplant plant treatments of Prefar, Treflan, Devrinol and Dacthal can be applied and incorporated with ground equipment or irrigations. In areas with sufficient rainfall the need for irrigation is waived. None of these herbicides will control emerged weeds.

Dacthal is a material that can be used at planting. The residual carryover of Dacthal is less harmfull to following crops like wheat and Sudan grass than the other preplant herbicides. Dacthal is effective on grasses and some broadleaved weeds but it is not very effective on the mustard family weeds.

The residual qualities of Prefar allows heavy sprinkler applications to germinate the cool weather cole crop seeds. In the desert areas where soil temperatures last into the planting season this residual quality of Prefar prevents leaching of the herbicide below the soil level where weed seeds germinate. Prefar is ineffective on volunteer grains and many broadleaved weeds.

Devrinal is another herbicide that has a long residual period after application. Crops like lettuce, sugar beets and cereals can be injured when planted after Devrinal use on cole crops. Other crops that have plant back restrictions on Devrinal are stated on the label. Devrinol is effective in controlling annual grasses which includes volunteer small grain crops and many broad leaved weeds.

The residual effects of the use of Treflan has a list of sensitive crops that are stated on the label. Treflan is incorporated preplant 2 to 3 inches in the soil. In some of the arid desert areas and in very cold conditions cole crops may be sensitive to Treflan. Applications of the pre emergent herbicides Treflan, Devrinal, liquid ammonium nitrate and Goal Xl or Goal Tender can be applied before transplanting cauliflower and broccoli. Immediately after transplanting sprinkler irrigation should take place.

When weed seedlings are a problem after post emergence of seeded broccoli or cauliflower or transplanted broccoli or cauliflower Goal Tender may be applied. Goal Tender controls many broadleaf annual weeds. Goal Tender is not as effective in controlling large lamb's quarters and grassy weeds. After crop emergence Select Max applications on small weed seedlings will control annual grasses, some perennial grasses and also blue grass. Select Max will not control broadleaved weeds. Before the crop of broccoli and cauliflower passes the three leaf stage Goal Tender can be applied. Goal Tender controls emerged broadleaved weeds including cheese weed and nettle leaf goosefoot.

Liquid ammonium nitrate (20-0-0) can be sprayed on the small emerged weeds post plant. Shields are used to protect the new leaf growth of the cole crop. The weed leaves should be dry and very young in order to take in the liquid nitrate that will kill them. After the third leaf stage cole crops have a strong waxy cuticle that protects them from liquid ammonium nitrate 20-0-0. This method supplies the cole crops nitrogen needs and doesn't damage the crop's root system because no shanks are digging up roots.

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ALFALFA WEED PESTS BY TIM BRAUN

Sunlight is the key ingredient to plant life. Healthy active growing alfalfa prevents emerging weeds from getting their needed share of sunlight. Growers do many things to prevent weeds from growing in their alfalfa fields. A good stand of alfalfa with 55 or more stems per square foot will help the grower get good weed control. Unlike some crops, alfalfa is very competitive with weeds.

Because growing conditions are so variable if the right weed control methods aren't used by the grower, weeds in alfalfa can become very expensive. Alfalfa hay buyers want alfalfa hay without weeds. When alfalfa hay is plentiful buyers are influenced by an assortment of things besides the presence of weeds: The quality of the leaves and stems is a factor. Mold can reduce the price. The reputation of the grower as an alfalfa hay producer is also a factor.

Weeds when harvested with alfalfa are more than just another source of hay. Weeds can contain burs and thorns which can harm the feeding animal. Some weeds are toxic to animals. There are weeds that when mixed with alfalfa can make the hay unpalatable to the feeding livestock. Aromatic weeds can give an odor to milk. Some weeds take longer to dry than alfalfa and can cause wet spots in the hay stacks. These damp spots can attract molds and fungi that reduce the quality of the hay in the bale. Some vine like weeds make harvesting more difficult.

Weed Competition With Alfalfa

Healthy growing alfalfa can compete successfully with weeds. Alfalfa is a simple perennial. Alfalfa can go dormant or die back and put out new shoots from its crown. Alfalfa has deep growing roots that can pull water to the surface when the soil dries out. The alfalfa has bacteria that can obtain nitrogen from the atmosphere. Unlike the legume alfalfa most of the weeds are dependent on the soil or applied nutrients for their nitrogen needs.

Because of conditions that can weaken the alfalfa plant’s health, the large number of types of weeds can often gain the upper hand. If weather conditions delay the emergence of young alfalfa seedlings, fast emerging weeds can outgrow the alfalfa seedlings. These weed seedlings can take light, water and nutrients away from the late emerging alfalfa seedlings. Pests that specifically feed on alfalfa will weaken alfalfa allowing weeds to dominate a field for the available sunshine, nutrients and water.

Areas in the field where water doesn’t drain can scald the alfalfa in the summer. Phytophthora disease will attack alfalfa in standing water during cool weather. The areas in the field where this occurs allows weeds to multiply. Wheel traffic from harvest equipment can destroy alfalfa and these tracks become areas where weeds take over. Cutting alfalfa in a short cycle of days will reduce the vigor of the plants. This increased cutting of alfalfa will allow weeds to dominate instead of being shaded out by the healthy alfalfa plants. Some herbicides can harm the alfalfa to the extent that resistant weeds can live through the application and multiply.

Types of Alfalfa Weeds

Because of the various types of weeds, they can compete with alfalfa on a year round basis. The weeds are either broadleaves, narrow leaf grasses or sedges. Alfalfa is a broadleave plant. Weeds that are classified as broad leaves have a tap root with smaller roots growing from it. Shallow applied soil herbicides are not as effective on weeds with tap roots. A tap root can grow deep through the herbicide treated area of the soil. In this way broadleaved weeds can survive herbicides placed near the surface of the soil.

The broadleaf weeds have two seed leaves. This is where the name dicotyledon (dicots) originates. The cotyledon leaves refer to the leaves located in the seed at planting. These two leaves usually stay with the young dicot seedling after it emerges. These cotyledon leaves are not considered to be true leaves. Cotyledon leaves are located just above the soil level on opposite sides of the stem of young seedling broad leave plants.

If you've ever had a salad with alfalfa sprouts you found that there are just two leaves on the end of the sprouts These two alfalfa sprout leaves are the dicotyledon leaves of alfalfa before the stem takes on the true leaves. Alfalfa is a dicotyledon plant.

The term broadleaf refers to the structure of the leaf. The leaf has a wide surface with netlike veins. The structure of the leaf either broadleaf with netlike veins or narrow-grass leaves with parallel veins has a great deal to do with the type of herbicide applied to either leaf surface. The herbicide, Buctril, is used on broad leaved weeds like London rocket. The herbicide, Poast, is used on narrow leaved grasses like yellow foxtail.

The narrow leaved grasses have one seed leaf. The name monocotyledon is given the plants with one seed leaf. This one seed of the monocotyledon (monocots) stays below or just at the surface of the soil when monocots emerge as seedlings.Instead of a tap root like the dicots the monocots have a mass of small roots that spread out from the stem at the soil surface. Monocot roots take up water and nutrients at or near the surface of the soil. Shallow soil applied herbicides are more effective on the monocot weeds because their roots absorb chemical molecules in this shallow area where the soil herbicides are applied.

Sedges and grasses are monocots because they have only one seed leaf. Sedge stems are solid. Grass stems are hollow. Sedge stems are triangular. Grass stems are cylindrical or round. Sedges include yellow and purple nutgrass.

Weeds are also monitored for control by the length of time they grow and the seasons that they grow in. Different methods are used for weed control depending on these growth habits. Plants and weeds are annuals, biennials and perennials.

Annual weeds only grow for one year. They germinate and bare flowers, fruit, seeds and die in one year. The objective when controlling annual weeds is to prevent them from seeding. The first mowing will control many annual weeds in alfalfa.

There are two kinds of annual weeds in alfalfa. They include: summer and winter annuals that germinate when temperatures warm up in the spring of the year. Summer annuals grow through the summer then flower, seed and die when temperatures cool down in late fall. Spring planted alfalfa competes with the summer annuals for sunlight, water and soil nutrients. Some of the summer annuals include: pigweed, a broadleaf weed and yellow foxtail, a grass or narrow leaf weed.

Winter annuals germinate in the fall as the temperatures start to cool down. Winter annuals stay in the vegetative state through the cold winter months. As the days get longer in the spring winter annual weeds flower, produce seed and die as the temperatures warm up. Fall planted alfalfa competes with winter annuals for light, water and nutrients. A winter annual is the London rocket, a broadleaf weed.

Both summer and winter annuals can be controlled with contact and systemic herbicides. Sheep grazing in the spring months will control winter annuals that haven't flowered and the summer annual emerging seedlings.

The biennial weeds grow for two years. The first year's growth for biennial weeds is in the vegetative state. This is referred to as a rosette state. In the second summer the biennial weeds flower, produce seeds and die. Very often in the mild climates of California and Arizona winter annuals are mistaken for biennials. Biennials only produce from seeds.

There are only a few biennial weeds in both Arizona and California. Biennials are not often found in alfalfa. The purple star and burdock are biennial weeds. They are controlled by contact or systemic herbicides. Biennials can be controlled like the annuals. Biennials should be prevented from producing seed.

Biennials do not reproduce from their vegetative parts like the perennial weeds. Control should be made to biennials in the first year when they are in the vegetative stage of growth.

The Pennsylvania University Extension Service states that the burdock and musk thistle biennials should be controlled before planting alfalfa otherwise they will persist throughout the life of the crop.

Perennial weeds can lose their top growth from frost, mowing, sheep grazing or contact herbicides. Once perennials seed they can die back and when conditions are right they can grow again. Perennials grow again from their meristem cells in their vegetative structures. Perennial weeds can survive for more that two years.

Unlike the annuals and the biennials that must reproduce from seeds, perennials can reproduce from seeds and their vegetative structures. The vegetative structure of the perennial weeds consist of rhizomes, stolons, crowns, roots with adventitious buds and tubers or bulbs. The perennial weeds are grouped according to their different vegetative structures from which they reproduce: simple perennials, creeping perennials and bulbous perennials.

Simple perennials have crowns at the base of the plant. The crown can form around a tap root This simple perennial crown is where new shoots emerge from meristem cells and produce new roots, stems, leaves and flowers. When crown stems are cut during hay operations the meristem cells in the crown grow into new shoots. If perennial crowns are broken up by cultivation each piece can produce a new plant. Some simple perennials have tap roots with a crown. Dandelion tap roots have a crown at the top and contain meristem cells along the root that can grow shoots when needed. Alfalfa is a simple perennial type with crowns. Simple perennial weeds include: common mallow, dandelion, and plantain.

The vegetable structures of the creeping perennials consist of roots, under ground stems and above ground stems that spread horizontally and vertically. Roots of the creeping perennial, morning glory, have been found over 20 feet deep in the soil. Creeping stems are called stolons (above ground) and rhizomes (below ground). They are segmented. Each segment joint has stem cells that can put out new shoots and roots to form new plants that can produce shoots, stems, leaves and seeds. Bermuda grass, a narrow leaf weed with rhizomes, is a creeping perennial weed.

The bulbous perennials have bulbs and nutlets as their vegetating reproductive structures. In alfalfa the nutgrasses or sedges are one of the serious bulbous perennial weeds. When patches of grass like Burmuda are controlled with herbicides in alfalfa the nutgrasses will often fill in. This is especially true in light sandy soils.

Nutgrass or nutsedge reproduces from seed and root nutlets. The nutlets on nutgrass are similar to the bulbs on other weeds. The nutgrass is much harder to control than the grasses with their vegetative reproductive systems. Once the nuts mature in the soil the nuts no longer need sugars from the source where photosynthesis occurs. Systemic herbicides will not enter and control mature nutgrass nuts. Control of seedlings and young sedges with immature nuts that need sugar can occur with some of the systemic herbicides. Nutsedge needs sunlight and healthy vigorous alfalfa can shade nutsedge out.

Buds and shoots get their growing energy from the sugars that were stored as starch in the crowns, stolons, rhizomes, tap roots and bulbs. Sugars produced in mature leaves by photosynthesis are translocated to the root system. The applied herbicide travels with the sugar to the crowns and roots of perennial weeds where it kills the perennial weeds. Systemic herbicides that are approved for alfalfa weed control should be applied to the leaves of mature weeds. Mature leaves are where sugar is made. Crowns, stolons, rhizomes, tubers, bulbs and root nutlets are where sugar is stored. The sugar is used to grow new shoots and roots. Let the herbicide ride with the sugar to the stem cells in the perennial vegetative parts of the weeds.

Some Of The Weeds That Infest Alfalfa

There are several winter annual broadleaves that are a problem in alfalfa production. These include: Common chickweed, Fiddleneck, Fillarees, Henbit, Mallow cheeseweed, Minors lettuce, Mustard, Burning nettle, London Rocket, Sheperdspurse, Sow Thisle, Petty Spurge and Red Maid a succulent.

The winter annual grasses in alfalfa include: Hare Barley, Annual Bluegrass poa annua, Canary Grass, Wild Oat, Italian Rye Grass and Volunteer Wheat.

The summer annual broadleaved weeds in alfalfa include: California Bur Clover, Cockle Bur, Groundsel, Jimson Weed, Knotweed, Lambsquarters, Milk Thistle, Night Shade, Pigweed, Pineapple weed, Yellow Starthistle and Yellow Sun Flower.

The summer annual grass weeds in alfalfa include: Barnyard Grass and Yellow Foxtail.

There is a biennial weed, Ox Tongue, that invades alfalfa in California and Arizona.

Prickley Lettuce is referred to as a winter annual broadleaf. When prickly lettuce lasts through the summer and comes back the second winter to flower and seed in the following summer it is referred to as a biennial weed.

Dock and Dandelion are simple perennial broadleaved weeds that infest alfalfa. Common Mallow Is sometimes called a broadleaved summer annual, a broadleaved biennial or a broadleaved simple perennial. This all depends where you find them. California, Arizona, Ohio or New Mexico.

Creeping perennial broadleaved weeds that infest alfalfa include: Field Bindweed or Perennial Morning Glory, Silverleaf Nightshade and Whorled Milkweed. The grass or narrow leaved creeping perennial weeds that infest alfalfa include: Johnson Grass and Bermuda Grass.

The perennial bulbous or weeds with nut-like vegetative reproductive structures include: Yellow Nutsedge and Purple Nutsedge.

Dodder is a parasitic weed. After germination from seed in the soil the dodder plant attaches itself to the alfalfa. It is yellow to orange and grows on the alfalfa stems. Applying Treflan granules before dodder germinates in the late winter will control the emerging seedlings. Treating the dodder on the alfalfa with Paraquat will kill the dodder and alfalfa stems but not the alfalfa crown. If the spray doesn’t kill the crown the alfalfa will put out new shoots. Cutting the alfalfa below the point on the stem where dodder is attached is another control practice. Also spot flaming is another cultural control method for dodder.

Some of the weeds that inhabit alfalfa that are considered to be poisonous to livestock include: Fiddleneck, Yellow Starthistle and Common Groundsel.

Herbicides Used For Weed Control In Alfalfa

Pre-plant and pre-emergent herbicides include: Balan, Eptam 20 Granules, Eptam liquid water run, Treflan 10 granules, Liquid Treflan can be impregnated on dry phosphate fertilizer and applied preplant; Zorial Pre-emergence: Kerb pre- emergent and post-ermergent; Sencor pre-emergent and early post emergent,.

Post-emergent weed control herbicides in alfalfa include; Pursuit, Raptor, 24-DB, Gramoxone, Poast, Buctril, Select, Prism, Buctril and Prism combo.

Round Up ready alfalfa can be treated with Round Up for weed control especially grass control.

Control of grasses and nut grass in alfalfa is possible with Eptam applied in the irrigation water. Water run Eptam at 3 pounds active lasts 30 to 45 days. Later applications of Eptam at 2 pounds active are needed after the third and fourth cuttings.

. The use of trade names in this course is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer’s label.

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