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HORMONE-TYPE HERBICIDES--SAFE USE AND PRECAUTIONS

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Hormone-type herbicides are highly effective and essential for broadleaf weed control in grain crops and grassland. Several broadleaf crops, such as cotton, are highly sensitive to these chemicals. With proper selection of chemical formulations, application conditions and sprayer operations, however, risk of damaging susceptible crops can be minimized. The spray operator has control over many factors and variables, which are discussed.

Hormone-type herbicides are some of the oldest organic weed killers in agriculture. Since the 1940's, 2,4-D and related chemicals have been used on broadleaf weeds on millions of acres. There are no known or documented reports of adverse effects either on humans, domestic animals, fish or wildlife when the herbicides are applied properly. However, some broadleaf crops, such as cotton, are highly sensitive and can be injured by low chemical rates.

Hormone-type chemicals include *three major* groups: (1) *phenoxy compounds* (2,4-D, 2,4,5-T, MCPA and silvex); (2) *benzoic acids* (dicamba (Banvel) and (3) *picolinic acids* (picloram (Tordon). Phenoxy compounds are sold under numerous trade names.[1]

Necessity of Hormone-Type Herbicides

Weed problems. Herbicides, 2,4-D or dicamba, are highly effective and provide economical control of many broadleaf weed species in grain sorghum and other grass crops. These chemicals are effective in controlling the deep-rooted perennials, Texas blueweed, field bindweed (possession vine) and silverleaf nightshade (whiteweed).

Hormone-type herbicides give excellent control of annual weeds, pigweed (carelessweed), volunteer castor, devil's claw, morning-glory, cocklebur and many other species.

Economics in crops. In many instances, use of 2,4-D or related phenoxy chemicals and dicamba offer the only economical means of controlling weeds. In grain sorghum yielding 4,000 pounds per acre, as few as 400 pigweeds per acre can cost \$5 to \$8 per acre. Denser stands of pigweed are more costly.

Preemergence herbicides, either cannot be used in furrow-planted sorghum or on sandy soil, or are not profitable to use because of lack of rainfall. Atrazine (AAtrex) postemergence will control annual weeds but it is residual in soil and can damage cotton, castors, guar, sugar beets or vegetable crops the following year. Usually, hormone-type herbicides are the only effective herbicides available for controlling broadleaf perennial weeds.

Brush and grassland. Approximately 80 million acres of pasture (range) are infested with mesquite and other brush species in Texas. Broadleaf weeds and brush in pasture use soil moisture and nutrients, thus reducing grass production and making cattle management difficult. Ranchers must use inexpensive, effective methods of brush control to maintain grazing capacity. Consequently, 2,4-D, 2,4,5-T, picloram and dicamba are commonly used for woody plant control and are an economic

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[1]Anonymous. 1971. Texas Herbicide Manual. TDA-Q-369A. Plant Quarantine Division. Texas Department of Agriculture. Austin. p. 69.

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necessity for the state's livestock and hunting industry.

Safe Use of Chemicals

Hormone-type herbicides may cause symptoms on susceptible plants in the following ways.

Formulation is a chemical preparation mixed to affect its solubility, volatility and other characteristics. Formulations of the same herbicide contain the same active ingredient, but either a salt or an ester of the active ingredient is formulated. In agriculture, commonly used formulations are esters, amines and inorganic salts. The amine salt formulations rarely volatilize and are the least hazardous to use near sensitive crops.

Ester formulations are effective on older susceptible weeds and brush and penetrate the leaf surface to give good weed control. Consequently, low volatile esters, such as 2,4,5-T ester (Esteron 2,4,5 OS, or Trinoxol)[2] are used for brush control.

The 2,4-D used mostly in grain sorghum is an amine salt, such as Formula 40, Dacamine 4-D or Weedar 64. Dicamba is formulated as a dimethyl amine salt, Banvel.

Drift is the physical movement of spray particles away from the spraying nozzle.[3] Even cinder blocks will drift if released in a high wind. Hazards of herbicide drift increase as wind speed increases, spray droplets get smaller and/or the height of the spray boom above the ground increases.

Volatility is the loss and movement of a herbicide as fumes or vapor in the air. In temperatures greater than 90 degrees F and relative humidity less than 20 percent, ester formulations sprayed in

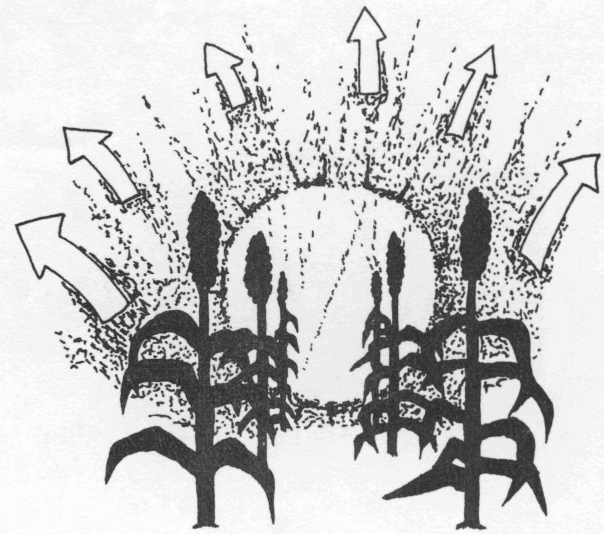


Fig. 2. Volatility.

either water or emulsion may volatilize. These herbicide vapors may cause symptoms on sensitive crops several miles from application site.

Minimizing spray drift. Since herbicide drift depends on wind speed, droplet size and boom height, wind speeds in excess of 10 miles per hour are too high for safe application of hormone-type herbicides when susceptible crops are in the area. In addition to hazards from spray drift, weed control is reduced since less spray reaches the weeds. Wind velocity can be determined by using an accurate wind gauge.

Non-volatile and low volatile hormone-type herbicides can be applied safely under conditions listed in Table 1 when (1) the concentration does not exceed 1½ lbs. acid equivalent per acre (3 pints of a 4 lbs./gal. formulation); (2) the chemical is applied either in water or oil-in-water emulsion; (3) aircraft flies no higher than 10 feet above the top of crop, weeds or brush; (4) the aircraft equipment pressure is either under 30 pounds per square inch, or pressure for ground equipment is less than 40 pounds per square inch (20 pounds pressure is safer).

[2]Product trade names are mentioned solely to aid readers in identifying and locating herbicides, and there is no endorsement intended.

[3]Hoffman, Garlyn O. and Robert H. Haas. 1969: L-848-Controlling Drift of Herbicidal Sprays, Texas Agricultural Extension Service, Texas A&M University.

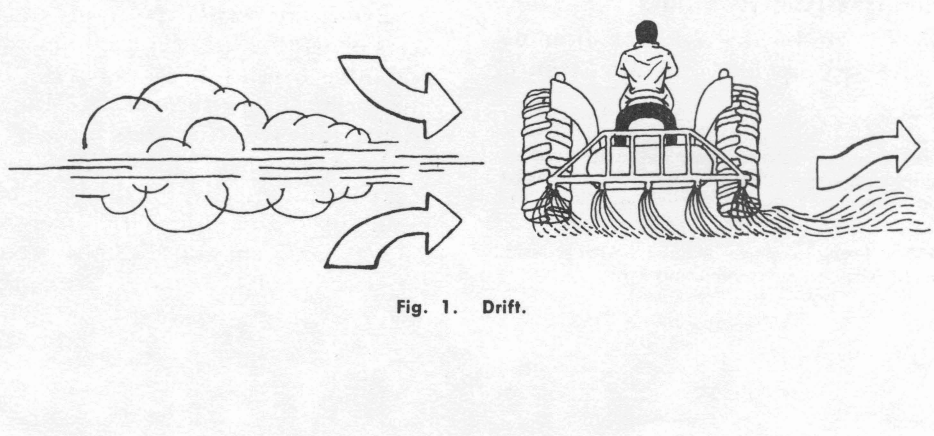


Fig. 1. Drift.

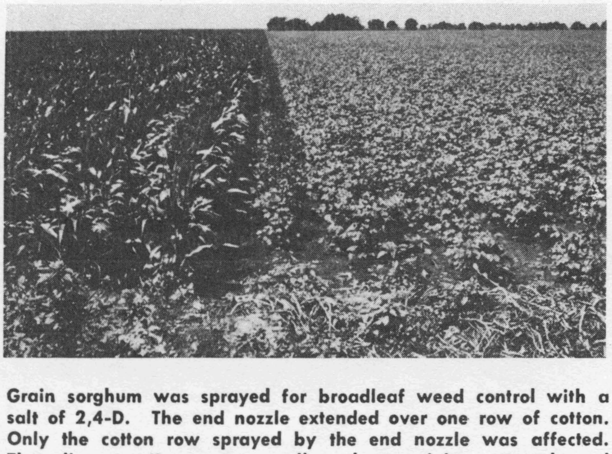
Table 1. Location of cotton or susceptible crop.[4]

Wind velocity (MPH)	Downwind (miles)	Upwind
0 - 3	1	½ mile
4 - 6	2	⅛ mile
7 - 10	4	250 feet

Large spray particles are produced when sprayers operate at low pressure, 30 to 20 psi or lower, and with high gallonage nozzle tips, 15 to 30 gals./A. High pressure, 40 psi or more, breaks the spray pattern into small particles and produces a mist that can drift.

Spray booms on ground equipment with flat-fan nozzles should be operated so that nozzle patterns overlap 17 to 20 inches above the top of the weeds. Boom height can be reduced to 6 or 8 inches above the target by using flooding nozzles. If weeds are shorter than the crop, hormone-type herbicides can be applied as a directed postemergence spray with drop nozzles which release the spray under the crop canopy and closer to soil surface. Use of foams, invert emulsions and particulated sprays are being investigated for reducing drift from ground and aerial sprayers.

Aerial application causes more herbicide drift than ground application. Aerial sprayers release spray droplets higher above the ground and create air turbulence. All equipment should have a cut off valve installed between the tank and the outlets (nozzles). Each outlet should have a positive cut off valve. Hose and hose connections must be installed and constructed to prevent leaks.



Grain sorghum was sprayed for broadleaf weed control with a salt of 2,4-D. The end nozzle extended over one row of cotton. Only the cotton row sprayed by the end nozzle was affected. The adjacent cotton rows as well as the remaining cotton showed no chemical effect. Wind velocity was low and blowing away from the cotton. *(Photo by Guth Chemical Company)*

[4] "1972-Texas Herbicide Regulations," Texas Department of Agriculture, Austin, p. 8.

When the preceding safety precautions are followed, chemical drift can be minimized greatly as demonstrated with ground equipment.

Cleaning Spray Equipment

Do not use the same sprayer for hormone-type herbicides as you use for other pesticides on sensitive crops. Maintain two sprayers, one for hormone-type herbicides and one for other chemicals.

If equipment is used for herbicides and other pesticides, ester formulations of hormone-type herbicides are far more difficult to remove from spray equipment than are amine and inorganic salt formulations.

Decontamination. Flush all equipment with water immediately after using hormone-type chemicals. Wash and drain sprayer or mixing tanks; flush all lines, screens and pumps. The 2-4-D amine or inorganic salt or dicamba that remains can be removed from smooth surfaces by one of the following methods:

Ammonia solution—Completely fill all lines, valves, pump and tanks with water by eliminating all trapped air. Be sure the tank's top, both inside and out, is washed. Then add at least 1 quart of concentrated household ammonia for each 50 gallons of water. Ammonia also can be added from an anhydrous ammonia fertilizer tank by placing the filler hose from the fertilizer tank under water in the spray tank. Open the anhydrous valve carefully and bubble the gas through the water to make a strong ammonia solution. Agitate and circulate the ammonia solution through the sprayer or tank system for at least 10 minutes and let stand for at least 24 hours. Then drain, flush and rinse thoroughly twice. Tractor and implement tires also should be washed. All nozzles, screens and filters should be washed and brushed to remove foreign particles.

Activated charcoal plus laundry detergent—Add at least 1 pound of activated charcoal and 1 pint of laundry detergent for each 25 gallons of water. Agitate and circulate the suspension through the system repeatedly and empty.

If a sprayer used for hormone-type herbicides is cleaned well, it is safe for spraying soil-applied herbicides such as trifluralin (Treflan) or prometryne (Caparol) and others. Materials and equipment of metal, fiberglass and most plastics clean well. These materials have smooth, slick surfaces, are relatively nonporous and retain little or no chemical when cleaned promptly. Rusty tank fittings and connections cannot be decontaminated. Hoses and flexible tubing are most difficult to clean because these materials usually are porous, develop small cracks and openings, absorb and retain chemicals and breakdown with age. Make two complete sets of hoses, one for hormone-type herbicides and another for other chemicals. Mixing equipment must be decontaminated in addition to the sprayer.

Hormone-Type Herbicide Symptoms

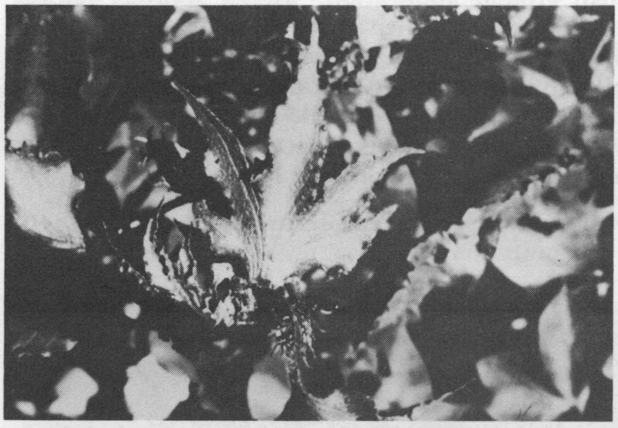
Susceptible crops. The level of yield reduction is related to the herbicide used, amount of drift and stage of crop growth when spraying. Susceptible crops may show foliar symptoms from .01 pound per acre or more of hormone-type herbicides. In cotton, 2,4-D causes no more symptoms than do comparable amounts of 2,4,5-T, MCPA, silvex or dicamba. Legume crops (soybean, edible beans, alfalfa, clover, peanuts and guar) are moderately tolerant of phenoxy herbicides, and yields are seldom reduced due to drift. However, legumes are highly sensitive to dicamba and picloram.

Plant appearance and symptoms on cotton. Drift of 2,4-D during the early square stage in cotton results in the most severe yield reduction followed by less yield loss after bloom and during early boll stages of growth. Dicamba causes leaves to cup downward, but leaves do not get very elongated or string-like Roots of 2,4-D affected plants may have enlarged tissues or swollen tap roots with vertical cracks. Terminal buds of cotton are usually not killed from drift rates. Under low drift rates, cotton fiber properties and seed development are usually not affected severely.

Evaluating damage. Effect of hormone-type herbicides on lint yield is often difficult to establish during the early stages when symptoms are first observed. Soil fertility, rainfall, irrigation, temperature, hail damage and freeze date after symptoms appear affect final yields. Yield losses can vary from 15 to 30 percent from chemical drift.[5] A yield loss of 30 percent or more can occur when a contaminated sprayer is used in cotton. Higher yield loss can be expected in cotton with a low yield potential due to adverse weather or late planting.

A reliable method for determining actual losses is to compare yields from portions of the field with and without plant symptoms. Immediately after symptoms are observed, the same number of rows should be marked permanently and staked in both the affected and unaffected portions of the field. The number of rows marked for harvesting depends on land slope and field uniformity. Rows may then be hand-harvested and yield per acre determined. The average yield difference between the affected and nonaffected areas should provide a fair estimate for making any necessary monetary adjustment.

When fields are uniformly affected and no valid comparison is possible, past yield records in the affected field must be compared with yields the same year on surrounding farms. Preferably the same planting date and varieties are compared.



Phenoxy herbicide symptoms in cotton are crinkled, cupped, curled and twisted foliage. Drift of 2,4-D during flowering or early boll formation frequently causes malformed flowers with fused petals or small, malformed, irregularly shaped bolls. Leaves may become very stringy, narrow and elongated and pucker or curl.

[5]Smith, D. T. and Wiese, A. F. 1972. B-1120, Cotton Response to Low Rates of 2,4-D and Other Herbicides. Texas Agricultural Experiment Station. Texas A&M University.

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