MN 2500 AGFO-1366

AG-FO-1366
North Central Regional
Extension Publication 162–1981
Crop Pest Management Series

UNIVERSITY OF MINNESOTA
DOCUMENTS
APR 15 1986
ST. PAUL CAMPUS LIBRARIES

Herbicide Drift Symptoms in Sunflowers

Jeff Coultas, area agent, crop pest management; Alan Dexter, extension specialist; and Galen Schroeder, research associate, University of Minnesota.

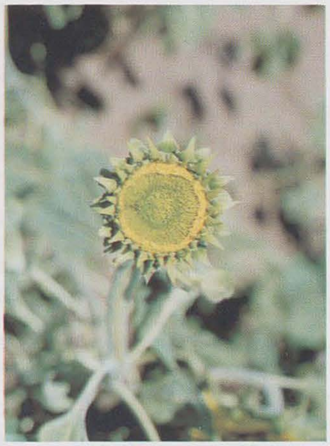
Sponsored by the Extension Services of Illinois, Indiana, Michigan, Minnesota, North Dakota, Ohio, and South Dakota. In cooperation with SEA-Extension, USDA.

1. Normal sunflower leaves

2. Dicamba—leaf crinkled with distorted tip

3. Dicamba—leaf cupping and crinkling

4. Dicamba—fused ray petals, small head



5. Dicamba—center of head sterile

6. Bromoxynil—yellowing and death of leaves

7. Paraquat—dead spots and desiccation of treated leaves

8. 2,4-D—stem twisting

9. 2,4-D—stem breakage, result of a callus

10. 2,4-D—stem splitting and brittleness

11. 2,4-D—excessive branching of stem

12. 2,4-D—gall-like growths on roots, stunting

13. 2,4-D—reduction in root growth

slides continued on page 4

UNDERSTANDING HERBICIDE DRIFT AND ITS EFFECTS

Because sunflowers are becoming an important component of many crop rotation plans throughout the Midwest, growers should be aware of the factors that can reduce the sunflower's yield and quality. Familiarity with the causes and symptoms of herbicide drift will aid in distinguishing between a drift problem and some other weather, soil, or pest problem.

Herbicide drift is the movement of herbicide from target (sprayed) areas to nontarget areas. Spray drift and vapor drift are two kinds of herbicide drift. Spray drift occurs at the time of application when small spray droplets are carried by the wind. It is the most common type of herbicide drift and the one most likely to occur in concentrations that are hazardous to sensitive crops. Vapor drift is the movement of the herbicide in the gaseous state and can occur hours or days after application. The most important factors affecting herbicide drift are droplet size, weather conditions, growth stage of the sensitive crop, and chemical formulation of the herbicide. Table 1 lists factors that influence herbicide drift.

Table 1. Summary of various factors influencing spray drift.*

Factor	More drift	Less drift
Spray particle size	smaller	larger
Release height (aircraft)	higher	lower
Wind speed	higher	lower
Spray pressure	higher	lower
Nozzle size	smaller	larger
Nozzle orientation (aircraft)	forward	backward
Nozzle location (aircraft)	beyond ¾ wing span	¾ or less wing span
Air temperature	higher	lower
Relative humidity	lower	higher
Nozzle type	smaller droplets	larger droplets
Air stability	inversion	lapse
Herbicide volatility	volatile	nonvolatile
Boom height (ground sprayer)	higher	lower

*Dexter[3]

REDUCING HERBICIDE DRIFT

Drift can be reduced by increasing droplet size (table 2). Large spray droplets can be produced by using lower sprayer pressure, proper nozzle orientation on aircraft, nozzles with a larger orifice, and additives that increase viscosity (thickness) of the spray solution. Special drift reducing nozzles such as "Raindrop" or "LP" (low pressure nozzles) are available. A properly adjusted ground sprayer usually will allow less drift than a properly adjusted aircraft sprayer primarily because of its lower boom height.

Air temperature, wind speed, relative humidity, and air stability can influence spray drift. Drift increases under conditions of low relative humidity and/or high air temperature because spray droplets evaporate quickly, producing smaller droplets that are carried by the wind. Weather conditions at sunrise or sunset are often closest to the optimum conditions for spraying to avoid drift. The temperature and wind velocity are lower and the humidity is higher than at other times of the day. Though these conditions reduce the risk of drift, with some herbicides this may not be the best application time for effective weed control.

Spraying should be avoided during temperature "inversions," which may occur around sunrise. An inversion exists when a warm layer of air covers cooler air near the ground. Spray particles or vapors remain suspended in this cool air, and even light winds can move these particles or vapors long distances. A "lapse" is the opposite of an inversion. A lapse exists when warm air near the ground rises quickly and dilutes the concentration of spray particles or vapors. Damage from drift is not likely to occur under such conditions.

The risk of drift injury increases as the volatility of herbicide formulations increases. MCPA and 2,4-D are sold as either ester or amine formulations, the esters being volatile and the amines essentially nonvolatile. The risk of drift injury is thus greater with an ester of 2,4-D or MCPA than with an amine. Drift from esters of 2,4-D or MCPA occurs as both spray droplets and vapor. High volatile esters readily vaporize at temperatures of 60°-70° F, and vaporization increases as the temperature increases. Regardless of temperature, vapor formation from a high volatile herbicide formulation is significantly greater than from a low volatile formulation. Vapor drift is still a potential hazard, though, from low volatile esters.

Most amine formulations do not vaporize at common temperature ranges, although spray drift does occur. Dicamba (Banvel) amine, however, may be degraded to the acid form of dicamba on plant foliage. The acid form of dicamba volatizes at common field temperatures and may result in vapor drift for several days after application[2]. Due to the volatility of dicamba and the extreme sensitivity of sunflower, dicamba applications should not be made on crops near sunflower fields on windy days or when the temperature exceeds 85° F. The yield response of sunflower to dicamba and 2,4-D applied at various stages of growth is given in figure 1. Sunflower is more susceptible to yield loss from drift of 2,4-D and dicamba prior to the bud stage.

Drift problems can be reduced by correct equipment calibration and pressure regulation, by cleaning spray equipment to remove pesticide residues, by adding a drift control agent to the spray solution, by early applications of postemergence herbicides in target crops, and by spraying when wind, temperature, and humidity do not promote drift to sunflower.

Table 2. Influence of droplet size on potential distance of drift.*

Droplet diameter (microns)	Type of droplet	Time required to fall 10 feet	Lateral distance droplets travel while falling 10 feet in a 3 mph wind
5	fog	66 minutes	3 miles
20	very fine spray	4 minutes	1,100 feet
100	fine spray	10 seconds	44 feet
240	medium spray	6 seconds	28 feet
400	coarse spray	2 seconds	8 feet
1,000	fine rain	1 second	5 feet

*Klingman[4], Potts[5], and Akesson and Yates[1]

REFERENCES

1. Akesson, N. B., and Yates, W. E. "Problems Relating to Application of Agricultural Chemicals and Resulting Drift Residue." *Annual Review of Entomology* 9:285-318.
2. Behrens, R., and Lueschen, W. E. "Dicamba Volatility." *Weed Science* 27:486-493.
3. Dexter, A. G. *Herbicide Spray Drift.* Extension Folder #548. St. Paul, Minnesota: Agricultural Extension Service, University of Minnesota, 1980.
4. Klingman, G. *Weed Control as a Science.* New York: John Wiley and Sons, 1961.
5. Potts, S. F. "Particle Size of Insecticides and Its Relationship to Application, Distribution, and Deposits." *Journal of Economic Entomology* 39:6.

RECOGNIZING HERBICIDE DRIFT SYMPTOMS

Injury symptoms pictured in this publication occurred in production fields or were induced to simulate the effects of drift. The symptoms are representative of a herbicide or group of herbicides that could cause injury to sunflowers. Although many of the commonly occurring symptoms are presented, symptoms may vary depending on the stage of sunflower development and growing conditions when the injury occurred.

Banvel (dicamba) is in the benzoic group of herbicides. Dicamba is absorbed by leaves, stems, and roots and is translocated within the plant. Dicamba drift generally affects leaf or floral development. Leaves are cupped and crinkled, with the tip of the leaf distorted (2,3)* If the bud is injured, the sunflower develops branches, fused floral parts, and multiple or sterile heads (4,5). Dicamba can reduce root growth but may not cause the malformation of secondary roots that occurs on plants exposed to phenoxy herbicides. Symptoms appear 7 to 14 days following exposure. Callus formation and brittle stems characteristic of phenoxy herbicide injury are not observed on plants exposed to dicamba. In areas where sunflower is grown near small grain, dicamba often is applied with MCPA, making it difficult to associate a single herbicide with the symptoms.

Buctril or Brominal (bromoxynil) is in the benzonitrile group of herbicides. Bromoxynil is absorbed by sunflower foliage with only slight translocation in the plant. Symptoms are confined to treated leaves and appear as yellowing or bleaching and death of the leaves (6). Effects are visible 1 to 7 days after exposure.

Paraquat CL (paraquat) is in the bipyridilium group of herbicides. Paraquat is a contact herbicide that is absorbed by sunflower leaves but is not translocated. Paraquat has no soil activity. Depending on the amount of paraquat drifting to the sunflower, injury symptoms range from dead areas on leaves to complete desiccation of the plant (7). Symptoms develop within 24 hours after drift occurs.

MCPA and 2,4-D are phenoxy herbicides. Phenoxy herbicides are absorbed by leaves and translocated to growing points in roots and leaves. Stems become twisted, brittle, branched, and/or develop calluses (8,9,10,11). Root growth is inhibited or gall-like growths develop on roots (12,13). Leaves develop parallel veins and become malformed from unequal rates of growth and elongation (14,15). The terminal bud may be killed or distorted, producing abnormal or multiple heads (16). Phenoxy symptoms appear within hours after exposure.

MCPA and dicamba affect plants similarly, so determining if a single herbicide (17,18) or both herbicides (19,20,21) caused the observed symptoms is very difficult. Plant symptoms alone cannot be used to differentiate between drift from a MCPA-dicamba mixture or one of the herbicides applied alone.

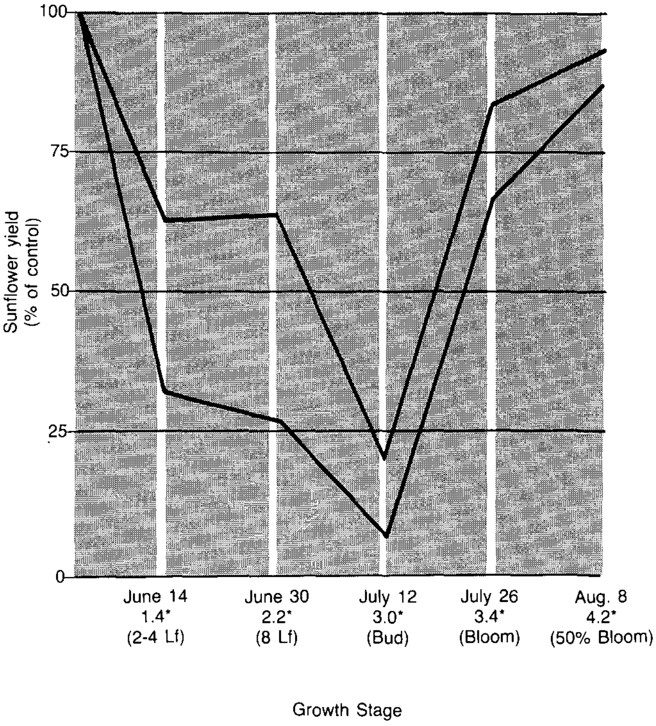
Other pests, problems, or chemicals can cause symptoms similar to those created by phenoxy herbicides. Stunting, yellowing, or leaf malformation are common symptoms of either phenoxy herbicides or downy mildew (22). Callous tissue can develop on sunflower stems from pre-emergence applications of pendimethalin, hail damage, or phenoxy herbicides (23,24). Malformed, sterile heads are symptomatic of midge damage or phenoxy herbicides (25).

Roundup (glyphosate) is a substituted amino acid herbicide. Glyphosate, a nonselective herbicide, is absorbed by leaves and translocated throughout the plant. Glyphosate has no soil activity. Yellowing of new leaves is a common symptom, appearing 3 to 7 days following exposure (26). As the yellowing progresses, plants wilt and die. Sublethal doses of glyphosate cause parallel veins and proliferation of vegetative buds similar to phenoxy herbicide symptoms.

*numbers refer to photos on pages 1 and 4

Tordon (picloram) is absorbed by roots and leaves and translocated to all parts of the plant. New leaves become distorted and yellow in color (27). Leaf cupping and crinkling (28,29) are similar to dicamba symptoms. After severe exposure, leaf growth is greatly reduced. Picloram may persist in the soil and cause injury to sunflowers several years after application (30).

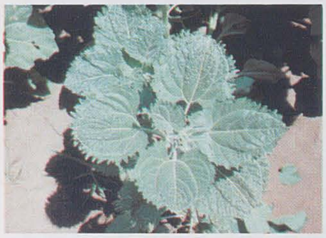
Figure 1. Pattern of yield loss from .0156 lb/A 2,4-D or dicamba at various stages of growth of sunflower planted May 25, 1979, at Casselton, ND.



**Growth stages according to Siddiqui, Brown, and Allen. See* Field Development of the Sunflower, *Extension Folder 541, for a more detailed description of this system.*

14. 2,4-D—chlorotic, narrow leaf with parallel growth of veins

15. 2,4-D—unequal growth of leaf margins, parallel veins



16. 2,4-D—malformed, sterile head

17. MCPA/dicamba—fused leaves with parallel veins

18. MCPA/dicamba—callus, stem branching

19. MCPA/dicamba—distorted regrowth after early injury

20. MCPA/dicamba—multiple heads

21. MCPA/dicamba—leaf and head fusion

22. Downy mildew similar to 2,4-D injury symptoms

23. Pendimethalin—callus at base of stem

24. Callus caused by hail damage, stem breakage from wind

25. Malformed, sterile head from midge injury

26. Glyphosate—yellowing of new leaves

27. Picloram—leaf twisting and yellowing

28. Picloram—leaf cupping, parallel veins, distorted tip

29. Picloram—leaf puckering, death of terminal leaves

30. Picloram—parallel venation caused by soil residue

31. Normal sunflower head

The information given in this publication is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Extension Service is implied.

Programs and activities of the Cooperative Extension Service are available to all potential clientele without regard to race, creed, color, sex, national origin, or handicap.

In cooperation with NCR Educational Materials Project

Issued in furtherance of Cooperative Extension work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and Cooperative Extension Services of Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Norman A. Brown, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108.