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**Item ID Number** 03976

**Not Scanned**

**Author** R.W. Bovey

**Corporate Author**

**Report/Article Title** Selected Bibliography of the Phenoxy Herbicides: VIII.  
Effects on Higher Plants

**Journal/Book Title**

**Year** 1978

**Month/Day** August

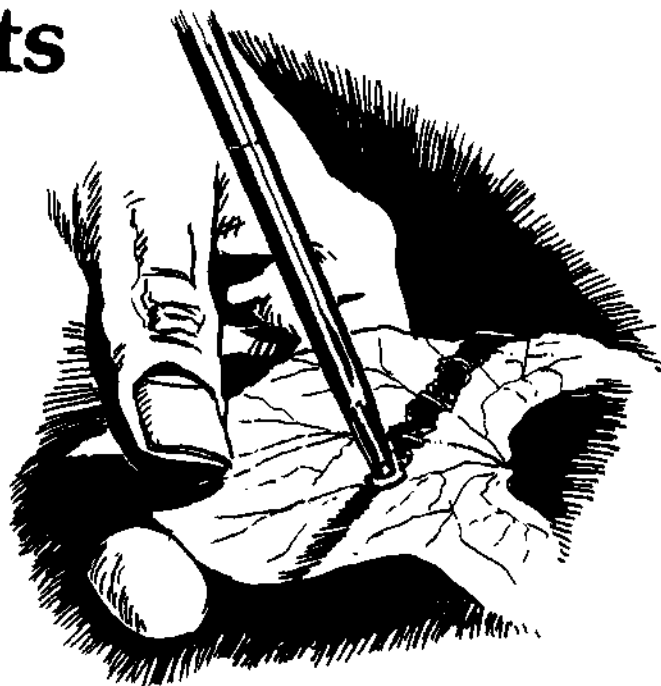
**Color**

**Number of Images** 63

**Description Notes**

# Selected Bibliography of the Phenoxy Herbicides

## VIII. Effects on Higher Plants



The Texas Agricultural Experiment Station, Neville P. Clarke, Director,  
The Texas A&M University System, College Station, Texas

In cooperation with Federal Research—Science  
and Education Administration, U.S. Department of Agriculture

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SELECTED BIBLIOGRAPHY OF THE  
PHENOXY HERBICIDES

VIII. Effects on Higher Plants

R. W. Bovey and J. D. Diaz-Colon\*

Introduction

This is the final publication in a series of bibliographies on the phenoxy herbicides. Previous publications regarding fate, dioxin, toxicology, ecology, microbiology, methods of extraction and analyses, and military uses were published during 1976, 1977, and 1978.

Physiological research of the phenoxy herbicides in higher plants is necessary to enlarge our understanding of the mode-of-action and plant responses manifested. Such information also helps explain the susceptibility or resistance of a given weed or crop species to a specific phenoxy herbicide and its practical use under field conditions. This publication provides a list of old and recent references on the effect of the phenoxy herbicides in higher plants.

References are listed in alphabetical order according to senior author's name. A subject numerical index is provided, consisting of two sections each identified by a Roman numeral. Section I comprises research papers dealing with plant responses to herbicides and herbicide activity in plants. Section II consists of reviews dealing with most of the aspects covered in Section I. A separate list of the common and chemical names of herbicides covered is also provided.

Each Arabic numeral on the subject indexes identifies a reference in its respective author's alphabetical lists. For references published in languages other than English, the abbreviated form of the particular language is enclosed in parentheses after the title. A list of the abbreviated and complete names of languages and a list of the abbreviated and complete names of periodicals, together with their countries and cities of origin, are also provided. If English abstracts for the references are available, the abstract sources are included after the listed reference.

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\*Respectively, research agronomist and agricultural research technician, Federal Research, Science and Education Administration, U.S. Department of Agriculture, and The Texas Agricultural Experiment Station (Department of Range Science).

List of Abbreviated Sources

- |  |   |
|--|---|
| Acta Agrobot.  | Acta Agrobotanica<br>(Naukowe, Warsaw, Poland)  |
| Acta Bot. Hung.  | Acta Botanica Hungarica<br>(Szeged, Hungary)  |
| Acta Soc. Bot. Pol.  | Acta Societatis Botanicorum Poloniae<br>(Warsaw, Poland)  |
| Advan. Carbohyd. Chem.   | Advances in Carbohydrate Chemistry<br>(New York, N.Y.)  |
| Agric. Biol. Chem.   | Agricultural and Biological Chemistry<br>(Tokyo, Japan)   |
| Agrokhimiya  | Agrokhimiya<br>(Moscow, USSR)   |
| Agron. J.  | Agronomy Journal<br>(Madison, Wis.)   |
| Allahabad Farmer   | Allahabad Farmer<br>(Allahabad, India)  |
| Am. Chem. Soc., Abstr. Pap.,<br>Nat. Meet., Pestic. Chem. Sec. | American Chemical Society, Abstracts<br>of Papers of the National Meetings,<br>Pesticides Chemistry Section<br>(Washington, D.C.) |
| Am. J. Bot.  | American Journal of Botany<br>(Lawrence, Kans.)   |
| Am. Potatoe J.   | American Potatoe Journal<br>(New Brunswick, N.J.)   |
| Ann. Appl. Biol.   | Annals of Applied Biology<br>(London, England)  |
| Ann. Bot. (London)   | Annals of Botany (London)<br>(London, England)  |
| Ann. Sci. Univ. Besancon                                       | Annales Scientifiques de l'Universite<br>de Besancon<br>(Besancon, France)  |
| Ann. Univ. Mariae Curie-Sklodowska,<br>Sect. E                 | Annales Universitatis Mariae Curie-<br>Sklodowska, Sectio E<br>(Lublin, Poland)   |
| Annu. Rev. Plant Physiol.                                      | Annual Review of Plant Physiology<br>(Palo Alto, Calif.)  |
| Arch. Biochem. Biophys.  | Archives of Biochemistry and Bio-<br>physics<br>(New York, N.Y.)  |
| Arch. Environ. Contam. Toxicol.                                | Archives of Environmental Contamina-<br>tion and Toxicology<br>(New York, N.Y.)   |
| Aust. J. Agric. Res.   | Australian Journal of Agricultural<br>Research<br>(Melbourne, Australia)  |
| Aust. J. Biol. Sci.  | Australian Journal of Biological<br>Science<br>(Melbourne, Australia)   |
| Aust. J. Exp. Agric. Anim. Husb.                               | Australian Journal of Experimental<br>Agriculture and Animal Husbandry<br>(Melbourne, Australia)                                  |

- |                                      |   |
|--------------------------------------|---|
| Ber. Dtsch. Bot. Ges.                | Berichte der Deutschen Botanischen<br>Gesellschaft<br>(Berlin, Germany)           |
| Biochem. J.                          | Biochemical Journal, The<br>(London, England)                                     |
| Biochim. Biophys. Acta               | Biochimica et Biophysica Acta<br>(Amsterdam, Netherlands)                         |
| Biol. Abstr.                         | Biological Abstracts<br>(Philadelphia, Pa.)                                       |
| Biol. Plant.                         | Biologia Plantarum<br>(Prague, Czechoslovakia)                                    |
| Biol. Zh. Arm.                       | Biologicheskii Zhurnal Armenii<br>(Yerevan, USSR)                                 |
| BioScience                           | BioScience<br>(Washington, D.C.)  |
| Bitki Koruma Bul.                    | Bitki Koruma Bulteni<br>(Ankara, Turkey)  |
| Bot. Gaz.                            | Botanical Gazette<br>(Chicago, Ill.)  |
| Bot. Mag.                            | Botanical Magazine<br>(Tokyo, Japan)  |
| Bot. Zh.                             | Botanicheskii Zhurnal<br>(Leningrad, USSR)  |
| Bull. Torrey Bot. Club               | Bulletin of the Torrey Botanical<br>Club<br>(New York, N.Y.)                      |
| Calif. Agric.                        | California Agriculture<br>(Berkeley, Calif.)                                      |
| Can. J. Agric. Sci.                  | Canadian Journal of Agricultural<br>Science<br>(Ottawa, Canada)                   |
| Can. J. Bot.                         | Canadian Journal of Botany<br>(Ottawa, Canada)                                    |
| Can. J. Genet. Cytol.                | Canadian Journal of Genetics and<br>Cytology<br>(Ottawa, Canada)                  |
| Can. J. Plant Sci.                   | Canadian Journal of Plant Science<br>(Ottawa, Canada)                             |
| Can. J. Res.                         | Canadian Journal of Research<br>(Ottawa, Canada)                                  |
| Can. Seed Grow. Assoc., Ann.<br>Rep. | Canadian Seed Growers Associations,<br>Annual Report<br>(Ottawa, Ontario, Canada) |
| Caryologia                           | Caryologia<br>(Florence, Italy)   |
| Chem.-Biol. Interact.                | Chemico-Biological Interactions<br>(Amsterdam, Netherlands)                       |
| Contrib. Boyce Thompson Inst.        | Contributions from Boyce Thompson<br>Institute<br>(Yonkers, New York, N.Y.)       |
| Crop Sci.                            | Crop Science<br>(Madison, Wis.)   |

Crops Soils	Crops and Soils (Madison, Wis.)
CSIRO Div. Trop. Past., Rep.	CSIRO Division of Tropical Pastures, Report (Melbourne, Australia)
Curr. Sci.	Current Science (Bangalore, India)
Cytologia	Cytologia (Tokyo, Japan)
Diss. Abstr. Int.	Dissertation Abstracts International (Ann Arbor, Mich.)
Dokl. Akad. Nauk Az. SSR	Doklady Akademii Nauk Azerbaidzhanskoi SSR (Baku, USSR)
Dokl. Bot. Sci. - En. Transl.	Doklady Botanical Sciences - English Translation (New York, N.Y.)
Dokl. TSKhA	Doklady TSKhA (Moscow, USSR)
Econ. Bot.	Economic Botany (New York, N.Y.)
Experientia	Experientia (Basel, Switzerland)
Farm Home Res.	Farm and Home Research (Wooster, Ohio)
Farm Res.	Farm Research (Ithaca, N.Y.)
Fed. Proc., Fed. Am. Soc. Exp. Biol.	Federation Proceedings, Federation of American Societies for Experi- mental Biology (Washington, D.C.)
Fiziol. Rast.	Fiziologiya Rastenii (Moscow, USSR)
Food Technol.	Food Technology (Chicago, Ill.)
For. Res. Notes	Forestry Research Notes (Madison, Wis.)
For. Sci.	Forest Science (Washington, D.C.)
Fruit Var. Hort. Dig.	Fruit Varieties and Horticultural Digest (Wathena, Kans.)
Hawaii Farm Sci.	Hawaii Farm Science (Honolulu, Hawaii)
Health Aspects Pestic.	Health Aspects of Pesticides, Ab- stract Bulletin (Chamblee, Ga.)
Hilgardia	Hilgardia (Berkeley, Calif.)



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|--|--|
| HortScience                                    | HortScience<br>(St. Joseph, Mich.)   |
| Indian J. Biochem. Biophys.                    | Indian Journal of Biochemistry and<br>Biophysics<br>(New Delhi, India)                               |
| Indian J. Exp. Biol.                           | Indian Journal of Experimental Biology<br>(New Delhi, India)   |
| Indian J. Weed Sci.                            | Indian Journal Weed Science<br>(Hissar, India)   |
| Iowa State Coll. J. Sci.                       | Iowa State College Journal of Science<br>(Ames, Iowa)  |
| Izv. Akad. Nauk Turkm. SSR,<br>Ser. Biol. Nauk | Izvestiya Akademiyi Nauk Turkmenskoi<br>SSR, Seriya Biologicheskikh Nauk<br>(Ashkhabad, Turkmen SSR) |
| Izv. Timiryazevsk. Skh. Akad.                  | Izvestiya Timiryazevskoi Sel'skokhozy-<br>aistvennoi Akademii<br>(Moscow, USSR)                      |
| J. Agric. Food Chem.                           | Journal of Agriculture and Food<br>Chemistry<br>(Washington, D.C.)                                   |
| J. Agric. Sci.                                 | Journal of Agricultural Science<br>(Cambridge, England)  |
| J. Agric. Univ. P.R.                           | Journal of Agriculture of the Univer-<br>sity of Puerto Rico<br>(Rio Piedras, Puerto Rico)           |
| J. Am. Soc. Agron.                             | Journal of the American Society of<br>Agronomy<br>(Geneva, N.Y.)                                     |
| J. Am. Soc. Hortic. Sci.                       | Journal of the American Society for<br>Horticultural Science<br>(St. Joseph, Mich.)                  |
| J. Elisha Mitchell Sci. Soc.                   | Journal of the Elisha Mitchell Sci-<br>entific Society<br>(Chapel Hill, N.C.)                        |
| J. Environ. Qual.                              | Journal of Environmental Quality<br>(Madison, Wis.)  |
| J. Exp. Bot.                                   | Journal of Experimental Botany<br>(London, England)  |
| J. Food Sci.                                   | Journal of Food Science<br>(Chicago, Ill.)   |
| J. For.  | Journal of Forestry<br>(Washington, D.C.)  |
| J. Hortic. Sci.                                | Journal of Horticultural Science<br>(London, England)  |
| J. Org. Chem.                                  | Journal of Organic Chemistry<br>(Washington, D.C.)   |
| J. Range Manage.                               | Journal of Range Management<br>(Denver, Colo.)   |
| Khim. Sel'sk. Khoz.                            | Khimiya v Selskom Khoziastive<br>(Moscow, USSR)  |

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- Proceedings of the International  
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- Proceedings of the North Central  
Weed Control Conference  
(Omaha, Nebr.)
- Proceedings of the Northeastern Weed  
Control Conference  
(Farmingdale, N.Y.)

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(Stillwater, Okla.)
- Proc. South. Weed Conf. Same as: Proc. South. Weed Sci. Soc. - which see
- Proc. South. Weed Sci. Soc. Proceedings of the Southern Weed Science Society  
(St. Louis, Mo.)
- Proc. Swed. Weed Conf. Proceedings of the Swedish Weed Conference  
(Uppsala, Sweden)
- Proc. West. Weed Control Conf. Proceedings of the Western Weed Control Conference  
(Salt Lake City, Utah)
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(College Station, Tex.)
- Tex. Agric. Exp. Stn., Misc. Publ. Texas Agricultural Experiment Station, Miscellaneous Publication  
(College Station, Tex.)
- Tex. Agric. Exp. Stn., Prog. Rep. Texas Agricultural Experiment Station, Progress Report  
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- Tex. J. Sci. Texas Journal of Science  
(Austin, Tex.)
- Torreyia Torreyia  
(Lancaster, Pa.)
- Trop. Grassl. Tropical Grasslands  
(Brisbane, Queensland, Australia)

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- U.S. Dep. Agric., Tech. Bull.
- U.S. Dep. Agric., Yearb. Agric.
- U.S. For. Serv., Pac. Northwest For. Range Exp. Stn., Res. Paper
- Vestn. Skh. Nauki Kaz.
- Vestsı Akad. Navuk B. SSR, Ser. Biyal. Navuk
- Weed Abstr.
- Weed Res.
- Weeds
- Weed Sci.
- Weed Sci. Soc. Am., Abstr., Meet.
- West. Soc. Weed Sci., Res. Prog. Rep.
- Wyo. Agric. Exp. Stn., Res. J.
- Z. Pflanzenkr. Pflanzenschutz
- Z. Pflanzenphysiol.
- U.S. Department of Agriculture, Agricultural Research Service, ARS (Washington, D.C.)
- U.S. Department of Agriculture, Technical Bulletin (Washington, D.C.)
- U.S. Department of Agriculture, Yearbook of Agriculture (Washington, D.C.)
- U.S. Forest Service, Pacific Northwest Forage and Range Experiment Station, Research Paper (Berkeley, Calif.)
- Vestnik Sel'skokhozyaistvennoi Nauki Kazakhstana (Alma Ata, USSR)
- Vestsı Akademii Navuk Belaruskai SSR, Seryya Biyalagichnykh Navuk (Minsk, USSR)
- Weed Abstracts (Oxford, England)
- Weed Research (Oxford, England)
- Weeds (Champaign, Ill.)
- Weed Science (Champaign, Ill.)
- Weed Science Society of America, Abstracts, Meetings (Champaign, Ill.)
- Western Society of Weed Science, Research Progress Report (Logan, Utah)
- Wyoming Agricultural Experiment Station, Research Journal (Laramie, Wyo.)
- Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz (Stuttgart, Germany)
- Zeitschrift fuer Pflanzenphysiologie (Stuttgart, Germany)

Language Abbreviation

Bg - Bulgarian

De - German

Es - Spanish

Fr - French

Hu - Hungarian

It - Italian

Ja - Japanese

Pl - Polish

Ru - Russian

Tr - Turkish

List of Herbicides Mentioned

<u>Common Name</u>	<u>Chemical Name</u>
2,4-D	(2,4-dichlorophenoxy)acetic acid
2,4-DB	4-(2,4-dichlorophenoxy)butyric acid
2,4-DP (dichlorprop)	2-(2,4-dichlorophenoxy)propionic acid
MCPA	[(4-chloro- <i>o</i> -tolyl)oxy]acetic acid, (2-methyl-4-chlorophenoxyacetic acid)
MCPB	4-[(4-chloro- <i>o</i> -tolyl)oxy]butyric acid, (4-(2-methyl-4-chlorophenoxy)butyric acid)
MCPP (mecoprop)	2-[(4-chloro- <i>o</i> -tolyl)oxy]propionic acid, (2-(2-methyl-4-chlorophenoxy) propionic acid)
2,4,5-T	(2,4,5-trichlorophenoxy)acetic acid
2,4,5-TB	[4-(2,4,5-trichlorophenoxy)butyric acid]
Silvex (2,4,5-TP)	[2-(2,4,5-trichlorophenoxy)propionic acid]
Phenoxyacetic acid	Phenoxyacetic acid
2-CPA	(2-chlorophenoxy)acetic acid
4-CPA	(4-chlorophenoxy)acetic acid

Subject Index

## I. Research Papers

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 302, 307, 321, 330, 383, 384, 406, 496, 500, 506, 507

7. 2,4,5-TB ..... 299

## D. Cytological and Genetical Effects

1. 2,4-D ..... 17, 18, 19, 27, 37, 41, 52, 63, 69, 80, 110, 111,  
 118, 140, 175, 176, 196, 223, 243, 246, 247, 250, 263, 264,  
 298, 324, 325, 341, 351, 352, 366, 392, 402, 403, 405, 409,  
 415, 426, 427, 429, 430, 443, 454, 455, 456, 457, 463, 464,  
 483, 484, 494, 501, 503, 515

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2. 2,4-DB ..... 78, 298
3. MCPA ..... 103, 127, 247, 298, 422
4. MCPB ..... 298
5. 2,4,5-T ..... 63, 66, 68, 110, 140, 148, 220, 247, 288, 298, 308,  
366, 403, 428, 443, 463, 514, 515
6. 2,4,5-TB ..... 298
7. Silvex ..... 371
8. 2-CPA ..... 196
9. 4-CPA ..... 196

## E. Anatomical, Histological and Morphological Effects

1. 2,4-D ..... 17, 27, 43, 69, 77, 80, 98, 124, 130, 131, 132, 134,  
180, 184, 186, 215, 222, 223, 224, 246, 247, 250, 268, 296,  
325, 341, 351, 402, 408, 426, 427, 430, 431, 435, 437, 442,  
477, 478, 486, 494, 501, 513, 515
2. 2,4-DB ..... 442
3. 2,4-DP ..... 296
4. MCPA ..... 247, 296
5. MCPP ..... 296
6. 2,4,5-T ..... 43, 66, 67, 68, 188, 220, 247, 288, 296, 308, 332,  
385, 428, 446, 514, 515, 526
7. 4-CPA ..... 43, 526

## F. Absorption, Penetration, Uptake, Accumulation and Distribution in the Plant, Organ, Tissue, and Cell

1. 2,4-D ..... 29, 30, 36, 46, 51, 56, 72, 79, 108, 109, 114, 208,  
230, 240, 241, 250, 274, 316, 320, 323, 334, 353, 359, 360,  
378, 395, 396, 397, 399, 400, 404, 418, 421, 483, 492, 493
2. 2,4-DB ..... 72, 475
3. 2,4-DP ..... 72
4. MCPA ..... 72, 337
5. MCPP ..... 452

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6. 2,4,5-T ..... 40, 70, 71, 121, 148, 241, 281, 301, 323, 384, 399, 400, 401, 418, 452, 506
7. Phenoxyacetic acid ..... 72, 242
8. 2-CPA ..... 323, 399
9. 4-CPA ..... 72, 323, 399, 400

## G. Structure of Herbicide as Related to Its Activity in Plants

1. 2,4-D ..... 1, 2, 3, 4, 23, 56, 125, 136, 270, 305, 333, 399, 416, 420, 453, 509, 523, 524
2. 2,4-DB ..... 524
3. 2,4-DP ..... 524
4. MCPA ..... 3, 125, 416
5. 2,4,5-T ..... 125, 270, 399, 420, 453, 524, 526
6. 2,4,5-TB ..... 524
7. Silvex ..... 524
8. Phenoxyacetic acid ..... 242
9. 2-CPA ..... 399
10. 4-CPA ..... 399, 526

## H. Interactions Between Herbicides and Other Chemicals

1. 2,4-D ..... 1, 37, 48, 49, 50, 62, 90, 118, 122, 123, 164, 187, 204, 206, 208, 217, 218, 219, 232, 312, 321, 381, 405, 411, 436, 441, 497, 512
2. 2,4-DB ..... 88
3. MCPP ..... 452
4. 2,4,5-T ..... 40, 62, 64, 307, 321, 332, 386, 405, 450, 451, 452

## I. Effects of Environmental Factors on Herbicidal Activity in Plants

1. 2,4-D ..... 28, 29, 36, 55, 61, 75, 97, 104, 112, 183, 204, 233, 292, 306, 316, 334, 353, 356, 359, 360, 364, 483
2. MCPA ..... 300
3. 2,4,5-T ..... 22, 70, 71, 183, 281, 307, 309, 375, 384, 506

## J. Effects on Germination

1. 2,4-D ..... 9, 53, 106, 113, 202, 207, 259, 294, 317, 319, 325, 362, 380, 387, 398, 412, 414, 442, 459, 495
2. 2,4-DB ..... 442
3. MCPA ..... 228
4. 2,4,5-T ..... 9, 113, 414
5. 4-CPA ..... 9

## II. Reviews

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1. 2,4-D ..... 133, 166, 211, 318, 365, 417, 525
2. 2,4-DB ..... 211, 365, 525
3. 2,4-DP ..... 211, 365, 525
4. MCPA ..... 211, 365
5. MCPB ..... 211, 365
6. MCPP ..... 365
7. 2,4,5-T ..... 166, 211, 365, 525
8. 2,4,5-TB ..... 525
9. Silvex ..... 166, 211, 365, 525
10. 4-CPA ..... 365, 525

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1. 2,4-D ..... 14, 15, 107, 210, 331, 365, 417, 460, 490
2. 2,4-DB ..... 331, 365
3. 2,4-DP ..... 365
4. MCPA ..... 107, 331, 365
5. MCPB ..... 365
6. MCPP ..... 331, 365
7. 2,4,5-T ..... 107, 365

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8. Silvex ..... 210, 365

9. 4-CPA ..... 365

## C. Degradation, Metabolism, Translocation, and Hydroxylation of Herbicides in Plants

1. 2,4-D ..... 85, 165, 166, 253, 365, 433, 490

2. 2,4-DB ..... 85, 165, 365

3. 2,4-DP ..... 365

4. MCPA ..... 165, 365, 433

5. MCPB ..... 365

6. MCPP ..... 365

7. 2,4,5-T ..... 85, 165, 166, 365, 433

8. Silvex ..... 166, 365

9. 2-CPA ..... 165

10. 4-CPA ..... 165, 365

## D. Cytological and Genetical Effects

1. 2,4-D ..... 14, 417, 460

## E. Anatomical, Histological and Morphological Effects (plant, organ, tissue, cell and cell components)

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2. 2,4-DB ..... 525

3. 2,4-DP ..... 525

4. 2,4,5-T ..... 525

5. 2,4,5-TB ..... 525

6. Silvex ..... 525

7. 4-CPA ..... 525

## F. Absorption, Penetration, Uptake, Accumulation, and Distribution in the Plant

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2. 2,4,5-T ..... 166
3. Silvex ..... 166

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1. 2,4-D ..... 365, 461, 490
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3. 2,4-DP ..... 365
4. MCPA ..... 365, 461
5. MCPB ..... 365
6. MCPP ..... 365
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8. Silvex ..... 365, 461
9. 4-CPA ..... 365

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1. 2,4-D ..... 205

## I. Effects of Environmental Factors on Herbicidal Activity in Plants

1. 2,4-D ..... 166
2. 2,4,5-T ..... 166
3. Silvex ..... 166

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**KEYWORDS:** plant physiology/biochemistry/herbicide metabolism/anatomy/morphology/absorption/translocation/germination/histological/cytological/plant growth regulators/auxin/2,4-D/2,4,5-T/2,4-DB/MCPA/silvex/mecoprop/dichlorprop.