7-1-1999

Field Evaluation of Herbicides on Small Fruit, Vegetable, and Ornamental Crops, 1998

Ron E. Talbert
University of Arkansas, Fayetteville

Lance A. Schmidt
University of Arkansas, Fayetteville

Jennifer A. Wells
University of Arkansas, Fayetteville

FIELD EVALUATION of HERBICIDES on SMALL FRUIT, VEGETABLE, and ORNAMENTAL CROPS, 1998

Ron E. Talbert,
Lance A. Schmidt, and Jennifer A. Wells

ARKANSAS AGRICULTURAL EXPERIMENT STATION
Division of Agriculture | University of Arkansas
July 1999 | Research Series 467

Technical editing and cover design by Karen Eskew

Arkansas Agricultural Experiment Station, University of Arkansas Division of Agriculture, Fayetteville. Milo J. Shult, Vice President for Agriculture and Director; Charles J. Scifres, Associate Vice President for Agriculture. PS1.2799PM65.The Arkansas Agricultural Experiment Station follows a nondiscriminatory policy in programs and employment.

ISSN:0099-5010 CODEN:AKAMA6

FIELD EVALUATION OF HERBICIDES ON SMALL FRUIT, VEGETABLE, AND ORNAMENTAL CROPS, 1998

Ron E. Talbert
University Professor

Lance A. Schmidt
Research Specialist

Jennifer A. Wells
Graduate Assistant

Authors are all in the Department of Crop, Soil, and Environmental Sciences

Arkansas Agricultural Experiment Station
Fayetteville, Arkansas 72701

SUMMARY

Growers generally use herbicides to efficiently produce high-quality fruit and vegetables for processing or fresh market sales. Due to the smaller acreage of these crops compared to major field crops, fewer herbicides are registered for use in fruit and vegetable crops than for field crops. Each year, new herbicides are evaluated under Arkansas growing conditions with the objective of improving the herbicide technology for the grower, processor, and ultimately the consumer. This report includes studies on the control of many of the more serious weed problems in important crops of this region, including snapbeans, spinach, southernpeas, watermelon, cantaloupe, summer squash, and grapes. In addition, the report includes information on the tolerance of selected bedding plants to some effective herbicides.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

This research was made possible in part by financial support through the Interregional Research Project #4 (IR-4) program in the Southern region. The following companies supplied herbicides used in these experiments: AgrEvo, American Cyanamid, BASF, Bayer, Dow AgroSciences, DuPont, FMC, Gowen, Monsanto, Novartis, Platte Chemical, Valent, and Zeneca. Seeds were supplied by Dr. Ted Morelock, Plants Plus, and Alma Farm Supply. The financial and technical support received from these companies is appreciated. Appreciation for assistance in these studies is extended to Dennis Motes, Resident Director, Steve Eaton and Larry Martin, Research Assistants, and the technicians of the Vegetable Substation, Kibler; and Steve Brown and William Russell of Allen Canning Company.

FIELD EVALUATION OF HERBICIDES ON SMALL FRUIT, VEGETABLE, AND ORNAMENTAL CROPS, 1998

R.E. Talbert, L.A. Schmidt, and J.A. Wells

INTRODUCTION

Field evaluations of herbicides provide the chemical industry, governmental agencies and programs such as the Interregional Research Project #4 (IR-4), and the Arkansas Agricultural Research and Extension Center with an evaluation of herbicide performance on small fruit, vegetable, and ornamental crops grown under Arkansas conditions. This report also provides a means for disseminating information to interested private and public service weed scientists.

Experiments at the Arkansas Agricultural Experiment Station in Fayetteville were conducted on grape, summer squash, watermelons, cantaloupe, southernpeas, and ornamentals. At the Vegetable Substation near Kibler, experiments were conducted on over-wintered spinach and southernpeas. A snapbean trial was conducted on a private farm near Lowell.

The chemical names and formulations of the herbicides used in these experiments are listed in Appendix Table 1. A table for converting metric units to English units can be found on page 33.

At Fayetteville, trials were conducted on a Captina silt loam with 1 to 2% organic matter and pH of 5.9. Soil at Lowell was a Perridge silt loam with 1.5% organic matter and pH of 5.3. At Kibler, trials were conducted on a Roxana silt loam with 1% organic matter and pH of 6.9. Unless stated otherwise, the experimental design for all experiments was a randomized complete block with four replications. Preplant incorporated, preemergence, delayed preemergence, postemergence, and postemergence-directed treatments were applied in 187 L/ha of water. Liquid herbicides were applied with a hand-held, carbon-dioxide pressurized sprayer.

Treatments involving timing and incorporation were (1) preplant incorporated (PPI), applied to the soil and incorporated prior to planting; (2) preemergence (PRE), applied to the soil surface soon after planting; (3) cracking (CRAC), applied 5 to 7 days after planting just before crop emergence; (4) over-the-top of transplants preemergence to weeds (POST-TP); (5) postemergence (POST), applied over-the-top to emerged crops and weeds at various stages–determined either by days after planting or by crop and weed growth stage; and (6) postemergence-directed (POST-DIR), applied to basal portion of the crop. The following environmental conditions were recorded for each application: air temperature (C); soil temperature (C) at 8 cm deep; soil surface moisture as wet, moist or dry; and percent relative humidity (RH).

Percentage of weed control by species was visually estimated: 0 represents no effect, and 100 represents complete control. Ranges for weed control are as follows: 70 to 79%, fair; 80 to 89%, good; and 90 to 100%, excellent. Weed control less than 70% is considered poor. Crop injury was assessed by visual estimation of percent injury: 0 represents no effect, and 100 represents complete plant kill. Crop injury ratings of less than 30% indicate crop tolerance. Crop yields are reported in metric tons per hectare unless stated otherwise. Least Significant Difference (LSD) values at the 0.05 level of significance were calculated for each set of treatment means.

For 1998, climatological data for Fayetteville are presented in Appendix Table 2, and for Kibler in Appendix 3. Standardized Plant (Bayer) Codes, as recognized by the Weed Science Society of America for weeds, appearing in this report are presented in Appendix Table 4.

METHODS AND RESULTS

Pertinent experimental details and a brief discussion of the results of these studies follow, and tabulated results are shown in Tables 1 to 12. Additional abbreviations used in the tables are: cm, centimeter; COC, crop oil concentrate; cv, cultivar; DAT, days after treatment; fb, followed by; kg/ha, kilograms active ingredient per hectare; NS, not significant; pl, plants; TM, tank mix; V2, first trifoliolate stage of legume; var, variety; v/v, volume per volume; WA, wetting agent; WAE, weeks after emergence; WAP, weeks after planting; WAT, weeks after treatment; and wk, week(s).

Evaluation of Herbicides for Snapbeans (*Phaseolus vulgaris*), Lowell (Table 1).

Snapbeans (cv. Envy) were planted 13 May in plots, 3 by 5.5 m, with four rows spaced 76 cm apart. PPI and PRE treatments were applied the same day (air 31°C; soil 27°C, moist; RH 88%). PPI treatments were incorporated in two directions with a tractor-drawn disk. POST treatments were applied 10 June (air 26°C; soil 22°C, moist; RH 70%). Weed control and crop injury evaluations were made 4 and 6 WAP. Plots were harvested 10 July.

By six wk, most treatments provided excellent control of tumble pigweed and smooth pigweed. At six wk, the greatest control of horsenettle (>80%) was provided by 1.12 kg/ha metolachlor PRE followed by 0.42 kg/ha fomesafen + 0.25% AG-98 POST; 0.56 kg/ha clomazone PRE + 0.14 kg/ha lactofen PRE, or followed by 0.42 kg/ha fomesafen POST; 1.12 kg/ha metolachlor PRE followed by 0.07 kg/ha halosulfuron POST; 0.56 kg/ha trifluralin PPI followed by either a tank-mixture of 0.07 kg/ha imazethapyr + 0.84 kg/ha bentazon + 0.25% v/v AG-98 applied POST or 0.14 kg/ha lactofen applied POST; or a total POST tank-mixture of 0.07 kg/ha imazethapyr + 0.84 kg/ha bentazon + 28% nitrogen + 0.25% v/v AG-98. All treatments provided excellent control of common lambsquarters except 1.12 kg/ha metolachlor + 0.14 or 0.28 kg/ha fomesafen PRE or 0.33 sethoxydim + 0.42 kg/ha fomesafen + 0.84 kg/ha bentazon POST.

Injury to snapbeans was tolerable with all treatments. Because of inadequate moisture, due to no irrigation and excessive heat, yields from treated plots were not significantly different from the untreated check.

Evaluation of Herbicides for Over-wintered Spinach (*Spinachia oleracea*), Kibler, (Table 2).

Spinach (cv. F-380) was planted in plots, 1.3 by 5 m, with six rows spaced 23 cm apart on 14 October 1998. PPI and PRE treatments were applied the same day (air 21°C; soil 19°C, moist; RH 72%). POST treatments were applied 5 November 1998 (air 9°C; soil 11°C, moist; RH 80%). Plots were harvested 1 April 1999.

The standard of metolachlor, at 1.12 or 2.24 kg/ha, applied PRE continued to be an excellent treatment by 9 wk on the weed spectrum present. However, cutleaf eveningprimrose control with 1.12 kg/ha metolachlor was marginal by 9 wk. Cutleaf eveningprimrose was effectively controlled with metolachlor at 1.12 kg/ha when followed by a POST application of phenmedipham at 0.56 kg/ha or tank-mixed with phenmedipham at 0.28 kg/ha in a total POST program. A POST application of phenmedipham at 0.56 kg/ha controlled the broadleaf weed population, but was less effective on annual bluegrass. Cycloate, at 2.24 kg/ha, applied PPI controlled 90% of annual bluegrass but marginally controlled the broadleaf weed spectrum present.

Dimethenamid at 0.56 kg/ha applied PRE provided excellent control of henbit, shepherdspurse, and annual bluegrass; fair control of sibara; and poor control of cutleaf eveningprimrose by 9 wk. Other herbicides evaluated included POST applications of halosulfuron at 0.02 and 0.04 kg/ha, fluroxypyr at 0.14 and 0.28 kg/ha, and triflusulfuron at 0.018 and 0.035 kg/ha. Fluroxypyr and triflusulfuron gave marginal control of the weed spectrum, and halosulfuron gave excellent control of sibara and shepherdspurse.

Spinach tolerance was observed with all herbicides at 5 wk, except with both rates of halosulfuron, which was very injurious to spinach. Dimethenamid at 0.56 kg/ha applied PRE had the highest spinach yield, but yield with cycloate at 2.24 kg/ha applied PPI or metolachlor at 1.12 kg/ha + phenmedipham at 0.28 kg/ha applied POST was statistically similar.

Response of Southernpeas [*Vigna unguiculata* (L.)] to Herbicides, Kibler (Table 3).

Southernpeas (cv. Encore) were planted 17 June 1998 in plots, 1.8- by 4.6 m, with two rows per plot spaced 0.9 m apart. Prior to planting the southernpeas, the entire area was sprayed with trifluralin applied PPI at 2.24 kg/ha to control all weeds other than yellow nutsedge. All PPI and PRE treatments were applied the day of planting (air 34°C; soil 31°C, dry; RH 65%). Cracking treatments were applied 22 June 1998 (air 36°C; soil 33°C, dry; RH 50%). POST treatments were applied 15 July (air 37°C; soil

33°C, dry; RH 88%).

There was a small, non-uniform population of yellow nutsedge in the test plots. Therefore, there were no ratings taken on yellow nutsedge control. Metolachlor was the only herbicide currently labeled for yellow nutsedge that injured the southernpeas. The southernpeas recovered, and no significant injury was observed by 9 WAT, and there was no significant decrease in yield. Sulfentrazone caused significant injury throughout the growing season when applied at the high rate of 0.42 kg/ha at all application times. The lower rate caused significant injury early when applied both PPI and CRAC, but caused no injury when applied PRE. Both rates of metolachlor + fomesafen caused significant injury early, but the plants recovered and there was no significant decrease in yield. Finally, halosulfuron applied PRE did not cause injury at any rate or rating time. However, when applied POST, southernpeas were significantly injured at the 9 WAP (5 WAT) rating time. Yields of these plots were not significantly lower than the untreated check.

Yellow Nutsedge (*Cyperus esculentus*) Control in Southernpeas [*Vigna unguiculata* (L.)], Fayetteville (Table 4).

Southernpeas (cv. '87-435-68') were planted 19 June 1998 in plots, 3 by 5 m, with two rows per plot spaced 0.9 m apart. Prior to planting, the entire area was sprayed with trifluralin applied PPI at 2.24 kg/ha to control all weeds other than yellow nutsedge. All PPI and PRE treatments were applied the day of planting (air 22°F; soil 27°F, moist; RH 100%). Cracking treatments were applied 23 June 1998 (air 27°F; soil 37°F, moist; RH 74%). POST treatments were applied 15 July (air 28°F; soil 28°F, dry; RH 96%).

Yellow nutsedge was the only weed present in any of the field plots. Bentazon and metolachlor provided good control of yellow nutsedge with only slight injury to the southernpeas. Metolachlor provided fair control of yellow nutsedge with no injury at any of the rating times. Overall, sulfentrazone provided good control of yellow nutsedge (68 to 85%), with little to no injury to the southernpeas. Metolachlor + fomesafen controlled yellow nutsedge up to 83% and caused no injury to the southernpeas. Halosulfuron applied PRE did not injure the southernpeas and controlled yellow nutsedge well (up to 90%). However, when applied POST, halosulfuron caused significant injury to the southernpeas throughout the season. Halosulfuron applied POST at 0.02 and 0.04 kg/ha was the only herbicide in the study that caused a significant decrease in yield from the untreated check.

Cultivar Tolerance of Southernpeas [*Vigna unguiculata* (L.)] to Sulfentrazone, Fayetteville (Table 5).

Five cultivars of southernpeas were evaluated for tolerance to sulfentrazone. The five varieties were chosen on the basis of acreage grown and included two indeterminate varieties ('Coronet' and 'Mississippi Silver') and three determinate cultivars ('Early Acre', 'Early Scarlet', and 'Encore'). The southernpeas were planted 19 June 1998 in plots, 2 by 3 m, with rows spaced 1 m apart. All treatments of sulfentrazone were applied PPI on the same day of planting (air 23°C; soil 27°C, moist; RH 100%). There were four replications.

The indeterminate cultivars ('Coronet' and 'Mississippi Silver') were more tolerant to sulfentrazone than were the determinate. These two indeterminate cultivars showed no injury from sulfentrazone when applied at 0.21 and 0.42 kg/ha. The high rate of 0.63 kg/ha caused significant injury to the southernpeas early in the season. The determinate varieties were more susceptible to sulfentrazone. The cultivar 'Encore' showed significant injury with all three rates early in the season. The plants treated with the low rate of 0.21 kg/ha recovered and showed no injury at the later rating times. Sulfentrazone applied at both 0.42 and 0.63 kg/ha caused significant injury throughout the growing season. The cultivar 'Early Scarlet' showed significant injury from sulfentrazone applied at 0.42 and 0.63 kg/ha throughout the growing season, and sulfentrazone caused significant injury to the cultivar 'Early Acre' at all rates and application times. There were no differences in yield with any cultivar.

Yellow Nutsedge Control in Watermelon (*Citrullus lanatus*), Fayetteville (Table 6).

Watermelon seeds (cv. Crimson Sweet) were planted 22 May 1998 in plots, 2 by 3.5 m, with one row per plot. Ethalfluralin was applied after planting at a rate of 1.68 kg/ha to suppress annual weeds other than yellow nutsedge. PRE treatments were applied on the same day (air 28°C; soil 27°C, moist; RH 68%) and POST treatments were applied 19 June 1998 (air 27°C; soil 31°C, dry; RH 78%). Yellow nutsedge control and crop injury evaluations were made 3, 6, and 9 WAP. Yield was assessed by counting the number of watermelons per plot. Weights were not taken due to fruit damage by coyotes.

Overall, halosulfuron provided more control of yellow nutsedge than did any of the other herbicides. When applied POST, halosulfuron controlled yellow nutsedge up to 83% and caused only slight injury to the watermelons. When applied PRE halosulfuron caused more early crop injury but controlled yellow nutedge up to 85%. Bentazon did not injure watermelon and provided up to 58% control of yellow nutsedge. Bensulide did not injure the watermelons but did not provide any yellow nutsedge control.

Yellow Nutsedge Control in Cantaloupe (*Cucumis melo*), Fayetteville (Table 7).

Cantaloupe seeds (cv. Mission Hybrid) were planted 22 May 1998 in plots, 2 by 3.5 m, with one row per plot. Ethalfluralin was applied after planting at a rate of 1.68 kg/ha to suppress annual weeds other than yellow nutsedge. PRE treatments were applied on the same day (air 28°C; soil 27°C, moist; RH 68%) and POST treatments were applied 19 June 1998 (air 27°C; soil 31°C, dry; RH 78%). Yellow nutsedge control and crop injury evaluations were made 3, 6, and 9 WAP. Yield was assessed by counting the number of cantaloupe per plot. Weights were not taken due to fruit damage by coyotes.

Overall, halosulfuron controlled yellow nutsedge better than any of the other herbicides. When applied PRE, it controlled yellow nutsedge up to 88% but caused significant crop injury (35 to 40%). The POST applications of halosulfuron caused slight injury (13 to 23%) to the cantaloupe and controlled yellow nutsedge up to 89%. Bentazon controlled only 30% of yellow nutsedge and did not injure the cantaloupe. Bensulide did not injure the cantaloupe but did not control yellow nutsedge.

Yellow Nutsedge Control in Summer Squash (*Cucurbita pepo*), Fayetteville (Table 8).

Squash seeds (cv. Dixie Hybrid) were planted 22 May 1998 in plots, 2 by 3.5 m, with one row per plot. PRE treatments were applied on the same day (air 28°C; soil 27°C, moist; RH 68%), and POST treatments were applied 19 June 1998 (air 27°C; soil 31°C, dry; RH 78%). Yellow nutsedge control and crop injury evaluations were made 3, 6, and 9 WAP. Yield was expressed as weights from the total of five harvesting dates.

Halosulfuron controlled yellow nutsedge better than any of the other herbicides. When applied PRE, it controlled yellow nutsedge up to 90%. The PRE applications caused significant injury early in the season, but the plants recovered, and no injury was observed at 6 or 9 weeks after treatment. The POST applications of halosulfuron controlled up to 83% yellow nutsedge and caused only slight injury to the squash. Bentazon controlled up to 58% yellow nutsedge and caused slight injury to the squash. Ethalfluralin and bensulide did not cause any injury to squash but did not control yellow nutsedge. Sulfentrazone controlled yellow nutsedge 33 to 53% but severely injured squash (25 to 53%).

Weed Control in Grapes (*Vitis labrusca*), Fayetteville (Table 8).

Grape (cv. Concord) plots were 2.5 by 8 m with two established vines per plot. All test plots were treated on 29 April (air 17°C; soil 7°C, moist; RH 68%) with a POST-DIR application of oryzalin, 2.24 kg/ha + diuron, 2.24 kg/ha. Sequential POST-DIR applications of glufosinate, glyphosate, and paraquat were applied 8 May (air 21°C; soil 16°C, moist; RH 78%), 25 June (air 33°C; soil 34°C, moist; RH 83%), and 24 July (air 36°C; soil 35°C, moist; RH 85%). Small trees found in the plots were clipped and treated with glyphosate on each application date.

Three sequential POST-DIR applications of glufosinate at 1.12 kg/ha; glyphosate at 1.12 kg/ha; or paraquat at 0.56 kg/ha + AG-98, 0.25 % v/v controlled bermudagrass, horseweed, large crabgrass, and dandelion by 14 wk. Sequential applications of glufosinate, glyphosate, and paraquat provided good control of trumpetcreeper by 14 wk, but never killed it. Glufosinate and glyphosate were comparative in control of grape suckers at the base of the vines (>89%) and control of wild grape (91%). No significant injury to the grape vines was evident throughout the experiment. All three herbicide treatments yielded greater than the untreated check. Yields were similar among the three herbicide treatments.

Evaluation of Herbicides for Geraniums (*Geranium* spp.), Fayetteville (Table 10).

Geraniums were purchased in 15-cm pots growing in Sunshine Potting Soil Mix™. Plot size was one pot, with one plant per pot.

All herbicides were applied POST on 24 July 1998 (air 26°C; soil 32°C, moist; RH 78%). Sprayable formulations were applied using a laboratory spray chamber. Granular oxyfluorfen + oryzalin was applied using a shaker jar applicator. The geraniums were 5.5 cm tall at the time of application.

There were no weeds present in any of the plots during the experiment.

Pendimethalin applied at 4.48 and 8.96 kg/ha caused significant injury early in the season, but the plants recovered and there was no injury by 56 DAT. Prodiamine at all rates caused significant injury early in the season, but injury had dissipated by the 56 DAT rating time. Oryzalin + oxyfluorfen did not injure the geraniums early, but the 6.72 and 13.26 kg/ha rates caused injury (20%) at 56 DAT.

Evaluation of Herbicides for Gaillardia (*Gaillardia* spp.), Fayetteville (Table 11).

Gaillardia plants were transplanted 20 June into 15-cm pots. Sunshine Potting Soil Mix™ was used as the growing medium. Plot size was one pot, with one plant per pot.

All herbicides were applied POST on 24 July 1998 (air 26°C; soil 32°C, moist; RH 78%). Sprayable formulations were applied using a laboratory spray chamber. Granular oxyfluorfen + oryzalin was applied using a shaker jar applicator. The gaillardia were 6 cm tall at the time of application.

There were no weeds present in any of the plots during the experiment. Fluazifop caused slight early injury to the gaillardia when applied at 0.42, 0.84, and 1.68 kg/ha. Napropamide caused slight early injury (10 to 15%) from rates of 8.96 and 17.92 kg/ha, but the plants recovered and there was no injury by 28 or 56 DAT. There was no other injury from any of the herbicides evaluated.

Evaluation of Herbicides for Foxglove (*Digitalis* spp.), Fayetteville (Table 12).

Foxglove plants were transplanted 5 November 1998 into 15-cm pots. Sunshine Potting Soil Mix™ was used as the growing medium. Plot size was one pot, with one plant per pot.

All herbicides were applied POST 8 December 1998 (air 22°C; soil 26°C, moist; RH 50%). Sprayable formulations were applied using a laboratory spray chamber. Granular oxyfluorfen + oryzalin was applied using a shaker jar applicator. The foxglove were 5 cm tall at the time of application.

There were no weeds present in any of the plots during the experiment. Fluazifop at 1.68 kg/ha caused slight injury to the foxglove at all rating times. Additionally, pendimethalin at a rate of 4.48 and 8.96 kg/ha caused significant injury to the foxglove. None of the other herbicides caused any injury to the foxglove.

Table 1. Evaluation of herbicides for snapbeans, Lowell, 1998.

	Weed control[a]										Effect on snapbeans		
	AMAAL		AMACH		SOLCA		CHEAL		MOLVE	DIGSA	Injury		
Treatment description[b]	4 wk	6 wk	4 wk	6 wk	4 wk	6 wk	4 wk	6 wk	4 wk	4 wk	4 wk	6 wk	Yield
(kg/ha)	(%)												(mt/ha)
Weedy check	0	0	0	0	0	0	0	0	0	0	0	0	1.4
Hand-weeded check	100	100	100	100	100	100	100	100	100	100	0	0	1.9
Clomazone, 0.56 + lactofen, 0.14, PRE	74	100	74	100	40	80	79	99	74	99	8	5	1.9
Metolachlor, 1.12 + lactofen, 0.14, PRE	98	100	99	100	25	41	87	98	96	99	8	8	1.5
Metolachlor, 1.12 + lactofen, 0.28, PRE	99	100	99	100	43	55	75	100	94	99	13	9	1.6
Metolachlor, 1.12 + fomesafen, 0.14, PRE	82	98	82	98	15	38	60	76	68	99	3	3	1.6
Metolachlor, 1.12 + fomesafen, 0.28, PRE	90	95	90	94	15	46	38	81	80	99	10	6	1.5
Clomazone, 0.56, PRE fb fomesafen, 0.42 + AG-98 (0.25%), POST	65	98	65	98	35	83	87	100	50	74	5	8	1.2
Metolachlor, 1.12, PRE fb fomesafen, 0.42 + AG-98 (0.25%), POST	45	99	45	99	40	84	48	90	53	99	10	8	1.9
Lactofen, 0.28, PRE fb sethoxydim, 0.33 + Agri-Dex (1%), POST	87	100	87	100	18	48	85	100	90	0	20	8	1.2
Lactofen, 0.28, PRE fb quizalofop, 0.07 + Agri-Dex (1%), POST	95	100	95	100	15	76	60	96	82	0	5	6	1.6
Trifluralin, 0.56, PPI fb halosulfuron, 0.07 + AG-98 (0.25%), POST	68	98	68	96	38	55	80	98	85	74	10	6	1.5
Metolachlor, 1.12, PRE fb halosulfuron, 0.07 + AG-98 (0.25%), POST	67	95	67	98	28	83	57	94	65	74	10	16	1.4

continued

Table 1. Continued.

Treatment description[b]	Weed control[a] AMAAL 4 wk	AMAAL 6 wk	AMACH 4 wk	AMACH 6 wk	SOLCA 4 wk	SOLCA 6 wk	CHEAL 4 wk	CHEAL 6 wk	MOLVE 4 wk	DIGSA 4 wk	Effect on snapbeans Injury 4 wk	Injury 6 wk	Yield
(kg/ha)	(%)												(mt/ha)
Trifluralin, 0.56, PPI fb imazethapyr, 0.07 + bentazon, 0.84 + AG-98 (0.25%), POST	82	93	82	98	30	81	53	98	68	32	18	5	2.3
Metolachlor, 1.12, PRE fb imazethapyr, 0.07 + bentazon, 0.84 + AG-98 (0.25%) POST	65	95	65	100	15	70	33	95	60	50	9	6	1.9
Trifluralin, 0.56, PPI fb bentazon, 0.84 + fomesafen, 0.42 + AG-98 (0.25%), POST	82	100	85	100	10	74	97	100	67	50	18	11	1.8
Sethoxydim, 0.33 + fomesafen, 0.42 + bentazon, 0.84, POST	0	94	0	94	0	73	0	81	0	0	0	1	1.5
Imazethapyr, 0.07 + bentazon, 0.84 + 28% N (2%) + AG-98 (0.25%)	0	74	0	83	0	81	0	93	0	0	0	10	0.1
Trifluralin, 0.56, PPI fb lactofen, 0.14, PRE	97	100	97	99	55	81	82	100	87	74	8	3	1.4
Halosulfuron, 0.06 + bentazon, 0.84 + sethoxydim, 0.33 + Agri-Dex (1%), POST	–[c]	80	--	79	--	75	--	93	--	--	--	0	1.3
LSD (0.05)[d]	28	10	28	8	37	22	34	10	22	44	10	6	1.1

[a] Evaluations were made 4 and 6 wk after planting. The 6-wk evaluation corresponds to 2 wk after POST applications.
[b] PPI = preplant incorporated; PRE = preemergence; and POST = postemergence.
[c] "–" = no data recorded.
[d] LSD values may be used to compare means within the same column.

Table 2. Evaluation of herbicides in over-wintered spinach, Kibler, 1998.

Treatment description[b]	Weed control[a]											
	SIBVI			LAMAM			OEOLA			MATMT		
	3 wk	5 wk	9 wk	3 wk	5 wk	9 wk	3 wk	5 wk	9 wk	3 wk	5 wk	9 wk
(kg/ha)	(%)											
Untreated check	0	0	0	0	0	0	0	0	0	0	0	0
Cycloate, 2.24, PPI	53	68	79	56	92	90	53	78	61	44	58	56
Dimethenamid, 0.45, PRE	88	93	72	80	92	92	80	85	45	96	93	92
Metolachlor, 1.12, PRE	92	94	93	88	96	95	88	86	67	85	96	87
Metolachlor, 2.24, PRE	96	99	95	95	99	93	93	99	89	94	99	94
Metolachlor, 1.12, PRE fb clopyralid, 0.08, POST	83	96	91	91	96	90	93	79	65	90	96	90
Metolachlor, 1.12, PRE fb phenmedipham, 0.56, POST	93	99	98	96	99	95	87	99	98	94	99	98
Phenmedipham, 0.56, POST	0	85	90	0	84	91	0	84	89	0	48	74
Phenmedipham, 0.28 + metolachlor, 1.12, POST	0	83	95	0	87	95	0	83	95	0	60	86
Phenmedipham, 0.28 + sethoxydim, 0.28, POST	0	75	75	0	81	93	0	74	83	0	55	48
Halosulfuron, 0.02, POST	0	63	91	0	51	26	0	60	40	0	48	93
Halosulfuron, 0.04, POST	0	53	94	0	46	31	0	61	53	0	55	93
Fluroxypyr, 0.14, POST	0	33	26	0	29	78	0	30	71	0	34	35
Fluroxypyr, 0.28, POST	0	45	79	0	59	80	0	38	38	0	36	40
Triflusulfuron, 0.0175, POST	0	29	38	0	23	28	0	16	24	0	23	35
Triflusulfuron, 0.035, POST	0	45	83	0	48	25	0	38	23	0	33	39
LSD (0.05)[c]	4	14	12	4	16	11	4	16	17	4	16	21

continued

Table 2. Continued.

Treatment description[b]	Weed control[a] POANN 3 wk	POANN 5 wk	POANN 9 wk	CAPBP 3 wk	CAPBP 5 wk	CAPBP 9 wk	Effect on spinach Injury 3 wk	Injury 5 wk	Injury 9 wk	Yield
(kg/ha)	(%)									(mt/ha)
Untreated check	0	0	0	0	0	0	0	0	0	17.7
Cycloate, 2.24, PPI	65	83	90	59	79	85	0	6	3	26.9
Dimethenamid, 0.45, PRE	94	93	94	87	93	92	12	13	3	31.5
Metolachlor, 1.12, PRE	88	89	93	88	96	93	13	8	0	22.8
Metolachlor, 2.24, PRE	91	99	93	89	99	94	10	23	14	21.5
Metolachlor, 1.12, PRE fb clopyralid, 0.08, POST	91	91	91	86	91	88	10	23	14	17.1
Metolachlor, 1.12, PRE fb phenmedipham, 0.56, POST	98	99	97	75	99	97	12	17	0	17.7
Phenmedipham, 0.56, POST	0	35	76	0	84	90	0	9	5	22.3
Phenmedipham, 0.28 + metolachlor, 1.12, POST	0	76	97	0	80	96	0	8	1	26.9
Phenmedipham, 0.28 + sethoxydim, 0.28, POST	0	36	91	0	83	89	0	10	4	16.6
Halosulfuron, 0.02, POST	0	25	59	0	63	91	0	70	95	1.0
Halosulfuron, 0.04, POST	0	31	33	0	61	93	0	78	96	0.0
Fluroxypyr, 0.14, POST	0	28	73	0	31	20	0	23	13	21.9
Fluroxypyr, 0.28, POST	0	23	55	0	53	25	0	28	16	9.5
Triflusulfuron, 0.0175, POST	0	15	35	0	23	45	0	8	15	23.4
Triflusulfuron, 0.035, POST	0	30	46	0	43	79	0	11	49	9.7
LSD (0.05)[c]	5	19	14	6	13	10	3	8	7	7.6

[a] Evaluations were made 3, 5, 9, and 16 wk after planting. The 5-, 9-, and 16-wk evaluations correspond to 2, 6, and 13 wk after POST applications.
[b] PPI = preplant incorporated; PRE = preemergence; and POST = postemergence.
[c] LSD values may be used to compare means within the same column.

Table 3. Response of southernpeas to herbicides, Kibler, 1998.

Treatment description[b]	Southernpeas injury[a]			Yield
	3 wk	6 wk	9 wk	
(kg/ha)	----------(%)----------			(mt/ha)
Untreated check	0	0	0	0.8
Bentazon, 0.84 + sethoxydim, 0.45 + Agri-Dex (1.25%), POST	0	3	3	0.8
Imazethapyr, 0.07, PPI	0	0	5	0.9
Metolachlor, 2.24, PPI	25	28	10	0.8
Sulfentrazone, 0.42, PRE	45	50	28	0.5
Sulfentrazone, 0.42, PPI	25	33	23	0.7
Sulfentrazone, 0.21, PRE	13	13	5	0.9
Sulfentrazone, 0.21, PPI	15	15	8	0.9
Metolachlor, 2.24 + fomesafen, 0.28, PRE	20	18	3	0.8
Metolachlor, 2.24 + fomesafen, 0.14, PRE	18	15	10	0.9
Halosulfuron, 0.039, PRE	9	8	3	0.9
Halosulfuron, 0.019, PRE	0	8	3	0.9
Halosulfuron, 0.039 + AG-98 (0.25%), POST	0	0	18	0.9
Halosulfuron, 0.019 + AG-98 (0.25%), POST	5	5	20	0.9
Sulfentrazone, 0.42, CRAC	45	45	20	0.7
Sulfentrazone, 0.21, CRAC	25	20	13	0.8
LSD (0.05)[c]	14	12	11	0.2

[a]Evaluations were made 3, 6, and 9, wk after planting. The 6- and 9-wk evaluations correspond to 2 and 5 wk after POST applications.
[b]PPI = preplant incorporated; PRE = preemergence; CRAC = cracking stage; and POST = postemergence.
[c]LSD values may be used to compare means within the same column.

Table 4. Yellow nutsedge control in southernpeas, Fayetteville, 1998.

	Weed control[a]			Effect on southernpeas			
	CYPES			Injury			
Treatment description[b]	3 wk	6 wk	9 wk	3 wk	6 wk	9 wk	Yield
(kg/ha)	(%)						(mt/ha)
Untreated check	0	0	0	0	0	0	1.0
Bentazon, 0.84 +							
sethoxydim, 0.45 +							
Agri-Dex (1.25%), POST	0	78	78	0	5	13	0.9
Imazethapyr, 0.07, PPI	58	63	63	0	8	13	0.9
Metolachlor, 2.24, PPI	78	78	83	3	5	5	1.0
Sulfentrazone, 0.42, PRE	80	80	80	0	5	5	1.0
Sulfentrazone, 0.42, PPI	75	75	85	3	5	13	0.9
Sulfentrazone, 0.21, PRE	75	75	80	3	3	8	1.0
Sulfentrazone, 0.21, PPI	73	73	83	5	5	8	0.9
Metolachlor, 2.24 +							
fomesafen, 0.28, PRE	83	73	80	3	5	10	1.0
Metolachlor, 2.24 +							
fomesafen, 0.14, PRE	78	83	83	3	0	10	1.1
Halosulfuron, 0.039, PRE	78	80	85	0	3	3	0.8
Halosulfuron, 0.019, PRE	83	85	88	0	0	0	0.9
Halosulfuron, 0.039 +							
AG-98 (0.25%), POST	0	88	90	0	40	33	0.5
Halosulfuron, 0.019 +							
AG-98 (0.25%), POST	0	75	90	0	30	25	0.5
Sulfentrazone, 0.42, CRAC	80	75	83	8	8	10	0.8
Sulfentrazone, 0.21, CRAC	68	75	85	0	3	5	1.0
LSD (0.05)[c]	13	12	12	5	7	9	0.3

[a]Evaluations were made 3, 6, and 9, wk after planting. The 6- and 9-wk evaluations correspond to 2 and 5 wk after POST applications.
[b]PPI = preplant incorporated; PRE = preemergence; CRAC = cracking stage; and POST = postemergence.
[c]LSD values may be used to compare means within the same column.

Table 5. Cultivar tolerance of southernpeas to sulfentrazone, Fayetteville, 1998.

Treatment description[b]	Southernpeas injury [a]			Yield
	3 wk	6 wk	9 wk	
(kg/ha)	-------	(%)	-------	(mt/ha)
ENCORE:				
Untreated check	0	0	0	0.9
Sulfentrazone, 0.21, PPI	8	3	5	1.1
Sulfentrazone, 0.42, PPI	13	10	13	1.0
Sulfentrazone, 0.63, PPI	23	20	20	1.0
CORONET:				
Untreated check	0	0	0	0.4
Sulfentrazone, 0.21, PPI	0	0	3	0.6
Sulfentrazone, 0.42, PPI	3	5	8	0.5
Sulfentrazone, 0.63, PPI	10	10	18	0.4
EARLY SCARLET:				
Untreated check	0	0	0	0.8
Sulfentrazone, 0.21, PPI	5	5	10	1.0
Sulfentrazone, 0.42, PPI	10	10	13	0.9
Sulfentrazone, 0.63, PPI	23	23	28	0.9
EARLY ACRE:				
Untreated check	0	0	0	0.7
Sulfentrazone, 0.21, PPI	15	15	18	0.6
Sulfentrazone, 0.42, PPI	25	20	18	0.7
Sulfentrazone, 0.63, PPI	35	35	33	0.6
MISSISSIPPI SILVER:				
Untreated check	0	0	0	0.2
Sulfentrazone, 0.21, PPI	3	0	0	0.4
Sulfentrazone, 0.42, PPI	8	3	3	0.3
Sulfentrazone, 0.63, PPI	20	10	5	0.4
LSD (0.05)[c]	8	6	7	0.2

[a] Evaluations were made 3, 6, and 9 wk after PPI applications.
[b] PPI = preplant incorporated.
[c] LSD values may be used to compare means within the same column.

Table 6. Yellow nutsedge control in watermelon, Fayetteville, 1998.

	Weed control[a]			Effect on watermelon			
	CYPES			Injury			
Treatment description[b]	3 wk	6 wk	9 wk	3 wk	6 wk	9 wk	Yield
(kg/ha)	----------	----------	----------	(%)	----------	----------	(no./plot)
Untreated check	0	0	0	0	0	0	4
Bentazon, 0.84 + Agri-Dex (1.25%), POST	0	30	58	0	10	5	4
Sulfentrazone, 0.28, PRE	55	40	38	50	40	23	4
Halosulfuron, 0.039 + AG-98 (0.25%), POST	0	48	83	0	10	15	3
Halosulfuron, 0.019 + AG-98 (0.25%), POST	0	58	75	0	5	20	6
Halosulfuron, 0.027, PRE	80	78	68	20	0	15	3
Halosulfuron, 0.053, PRE	85	85	83	25	0	10	5
Bensulide, 6.73, PRE	0	0	0	5	0	0	4
LSD (0.05)[c]	6	16	14	14	5	14	NS[d]

[a]Evaluations were made 3, 6, and 9, wk after planting. The 6- and 9-wk evaluations correspond to 2 and 5 wk after POST applications.
[b]PRE = preemergence; and POST = postemergence.
[c]LSD values may be used to compare means within the same column.
[d]Not Significant.

Table 7. Yellow nutsedge control in cantaloupe, Fayetteville, 1998.

	Weed control[a]			Effect on cantaloupe			
	CYPES			Injury			
Treatment description[b]	3 wk	6 wk	9 wk	3 wk	6 wk	9 wk	Yield
(kg/ha)	(%)						(no/plot)
Untreated check	0	0	0	0	0	0	2
Bentazon, 0.84 + Agri-Dex (1.25%), POST	0	30	30	0	10	15	8
Sulfentrazone, 0.28, PRE	53	50	40	50	30	33	7
Halosulfuron, 0.039 + AG-98 (0.25%), POST	0	50	80	0	13	23	8
Halosulfuron, 0.019 + AG-98 (0.25%), POST	0	65	73	0	8	13	8
Halosulfuron, 0.027, PRE	78	78	78	40	15	8	7
Halosulfuron, 0.053, PRE	88	85	83	35	20	25	4
Bensulide, 6.73, PRE	3	0	0	18	0	0	6
LSD (0.05)[c]	6	15	14	11	12	13	4

[a]Evaluations were made 3, 6, and 9, wk after planting. The 6- and 9-wk evaluations correspond to 2 and 5 wk after POST applications.
[b]PRE = preemergence; and POST = postemergence.
[c]LSD values may be used to compare means within the same column.

Table 8. Yellow nutsedge control in summer squash, Fayetteville, 1998.

	Weed control[a]			Effect on squash			
	CYPES			Injury			
Treatment description[b]	3 wk	6 wk	9 wk	3 wk	6 wk	9 wk	Yield
(kg/ha)	(%)						(mt/ha)
Untreated check	0	0	0	0	0	0	4.1
Ethalfluralin, 1.68, PRE, hand-weeded	0	0	0	0	8	10	3.7
Bentazon, 0.84 + Agri-Dex (1.25%), POST	0	38	58	0	23	20	2.5
Sulfentrazone, 0.28, PRE	53	33	43	53	25	33	3.2
Halosulfuron, 0.039 + AG-98 (0.25%), POST	0	75	78	0	20	23	3.6
Halosulfuron, 0.019 + AG-98 (0.25%), POST	0	78	83	0	13	20	5.3
Halosulfuron, 0.027, PRE	78	85	80	30	3	8	6.0
Halosulfuron, 0.053, PRE	85	90	88	40	0	5	7.2
Bensulide, 6.73, PRE	5	0	0	0	5	5	5.1
LSD (0.05)[c]	6	8	12	10	10	13	3.3

[a]Evaluations were made 3, 6, and 9, wk after planting. The 6- and 9-wk evaluations correspond to 2 and 5 wk after POST applications.
[b]PRE = preemergence; and POST = postemergence.
[c]LSD values may be used to compare means within the same column.

Table 9. Weed control in grapes, Fayetteville, 1998.

	Weed control[a]									
	Wild grape		CMIRA		CYNDA		DIGSA		ERICA	
Treatment description[b]	9 wk	14 wk	9 wk	14 wk	9 wk	14 wk	9 wk	14 wk	9 wk	14 wk
(kg/ha)	(%)									
Untreated check	0	0	0	0	0	0	0	0	0	0
Glufosinate, 1.12, POST-DIR fb glufosinate, 1.12, POST-DIR fb glufosinate, 1.12, POST-DIR	90	91	83	86	86	89	97	99	96	98
Glyphosate, 1.12, POST-DIR fb glyphosate, 1.12, POST-DIR fb glyphosate, 1.12, POST-DIR	86	91	79	90	94	91	97	96	99	99
Paraquat, 0.56 + AG-98 (0.25%), POST-DIR fb paraquat, 0.56 + AG-98 (0.25%), POST-DIR fb paraquat, 0.56 + AG-98 (0.25%), POST-DIR	81	78	71	81	89	86	93	84	91	99
LSD (0.05)[c]	8	9	7	10	5	12	5	8	6	5

continued

Table 9. Continued.

Treatment description[b]	Weed control[a] TAROF 9 wk	Weed control[a] TAROF 14 wk	Weed control[a] OXAST 14 wk	Weed control[a] CONAR 14 wk	Effect on grapes Injury 9 wk	Effect on grapes Injury 14 wk	Effect on grapes Suckers 9 wk	Effect on grapes Suckers 14 wk	Yield
(kg/ha)	(%)								(mt/ha)
Untreated check	0	0	0	0	0	14	0	0	4.4
Glufosinate, 1.12, POST-DIR fb glufosinate, 1.12, POST-DIR fb glufosinate, 1.12, POST-DIR	91	94	98	98	4	13	89	86	7.5
Glyphosate, 1.12, POST-DIR fb glyphosate, 1.12, POST-DIR fb glyphosate, 1.12, POST-DIR	96	96	98	98	1	13	91	76	8.3
Paraquat, 0.56 + AG-98 (0.25%), POST-DIR fb paraquat, 0.56 + AG-98 (0.25%), POST-DIR fb paraquat, 0.56 + AG-98 (0.25%), POST-DIR	89	90	91	97	3	11	78	73	7.3
LSD (0.05)[c]	8	10	8	5	NS[d]	NS	7	20	1.5

[a]Evaluations were made 9 and 14 weeks after the first POST-DIR treatments. The 9- and 14-wk evaluations correspond to 3 and 8 wk after the second POST-DIR treatment. The 14-wk evaluation corresponds to 3 wk after the third POST-DIR treatment.

[b]POST-DIR = postemergence directed to basal portion of the crop.

[c]LSD values may be used to compare means within the same column.

[d]Not significant.

Table 10. Evaluation of herbicides for geraniums, Fayetteville, 1998.

Treatment description[b]	Geranium injury[a]		
	10 DAT	28 DAT	56 DAT
(kg/ha)	---------------------(%)---------------------		
Untreated check	0	0	0
Oryzalin + oxyfluorfen, 3.36, POST-TP	0	0	5
Oryzalin + oxyfluorfen, 6.72, POST-TP	0	0	20
Oryzalin + oxyfluorfen, 13.46, POST-TP	0	0	20
Pendimethalin, 2.24, POST-TP	13	10	8
Pendimethalin, 4.48, POST-TP	28	30	13
Pendimethalin, 8.96, POST-TP	20	25	5
Prodiamine, 1.68, POST-TP	18	13	5
Prodiamine, 3.36, POST-TP	15	13	10
Prodiamine, 6.72, POST-TP	38	18	8
LSD (0.05)[c]	9	8	13

[a]Evaluations were made 10, 28, and 56 days after treatment.
[b]POST-TP = over-the-top of transplants preemergence to weeds.
[c]LSD values may be used to compare means within the same column.

Table 11. Evaluation of herbicides for gaillardia, Fayetteville, 1998.

Treatment description[b]	Gaillardia injury[a]		
	10 DAT	28 DAT	56 DAT
(kg/ha)	--------------------(%)---------------------		
Untreated check	0	0	0
Fluazifop-P, 0.42 + AG-98 (0.25%), POST-TP	8	0	0
Fluazifop-P, 0.84 + AG-98 (0.25%), POST-TP	8	0	0
Fluazifop-P, 1.68 + AG-98 (0.25%), POST-TP	18	0	0
Napropamide, 4.48, POST-TP	0	0	0
Napropamide, 8.96, POST-TP	10	0	0
Napropamide, 17.92, POST-TP	15	5	3
Oryzalin + oxyfluorfen, 3.36, POST-TP	0	0	0
Oryzalin + oxyfluorfen, 6.72, POST-TP	0	0	0
Oryzalin + oxyfluorfen, 13.46, POST-TP	0	0	0
LSD (0.05)[c]	6	0.2	NS[d]

[a]Evaluations were made 10, 28, and 56 days after treatment.
[b]POST-TP = over-the-top of transplants preemergence to weeds.
[c]LSD values may be used to compare means within the same column.
[d]Not Significant.

Table 12. Evaluation of herbicides for foxglove, Fayetteville, 1998.

Treatment description[b]	Foxglove injury[a]		
	10 DAT	28 DAT	56 DAT
(kg/ha)	------------------(%)------------------		
Untreated check	0	0	0
Fluazifop-P, 0.42 + AG-98 (0.25%), POST-TP	0	0	3
Fluazifop-P, 0.84 + AG-98 (0.25%), POST-TP	0	5	5
Fluazifop-P, 1.68 + AG-98 (0.25%), POST-TP	0	20	20
Oryzalin + oxyfluorfen, 3.36, POST-TP	0	0	0
Oryzalin + oxyfluorfen, 6.72, POST-TP	0	0	0
Oryzalin + oxyfluorfen, 13.46, POST-TP	0	13	0
Pendimethalin, 2.24, POST-TP	8	5	0
Pendimethalin, 4.48, POST-TP	25	10	8
Pendimethalin, 8.96, POST-TP	30	15	15
Prodiamine, 1.68, POST-TP	0	0	0
Prodiamine, 3.36, POST-TP	0	0	0
Prodiamine, 6.72, POST-TP	0	3	0
LSD (0.05)[c]	3	9	4

[a]Evaluations were made 10, 28, and 56 days after treatment.
[b]POST-TP = over-the-top of transplants preemergence to weeds.
[c]LSD values may be used to compare means within the same column.

Appendix Table 1. Common, trade, and chemical names of herbicides used.

Designation and trade names	Chemical name and formulation
bensulide (Prefar®)	*O,O*-bis(1-methylethyl) *S*-[2-[(phenylsulfonyl)amino]ethyl]phosphorodithioate, 480 g/L
bentazon (Basagran®)	3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide, 480 g/L
clomazone (Command®)	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone, 360 g/L
clopyralid (Stinger®)	3,6-dichloro-2-pyridinecarboxylic acid, 360 g/L
cycloate (Roneet®)	*S*-ethyl cyclohexylethylcarbamothioate, 720 g/L
dimethenamid (Frontier®)	2-chloro-*N*-[(1-methyl-2-methoxy)ethyl]-N-(2,4-dimethyl-thien-3-yl)-acetamide, 720 g/L
ethalfluralin (Curbit®)	*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine, 360 g/L
fluroxypyr (Starane®)	[(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetic acid, 200 g/L
fluazifop-P (Fusilade®)	(*R*)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid. 2 lb/gal
fomesafen (Reflex®)	5-[2-chloro-4-(trifluoromethyl)phenoxy]-*N*-(methylsulfonyl)-2-nitrobenzamide, 240 g/L
glyphosate (Roundup Ultra®)	*N*-(phosphonomethyl)glycine, 360 g ae/L
glufosinate (Finale®)	2-amino-4-(hydroxymethylphosphinyl)butanoic acid, 120 g/L
halosulfuron (Permit®)	5-[2-chloro-6-fluoro-4-(trifluoromethyl)phenoxy]-*N*-(ethylsulfonyl)-2-nitrobenzamide, 75% W
imazethapyr (Pursuit®)	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid, 240 g/L
lactofen (Cobra®)	(+)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate, 240 g/L
metolachlor (Dual®)	2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide, 960 g/L
napropamide (Devrinol®)	*N,N*-diethyl-2-(1-naphthalenyloxy)propanamide, 50 WP
oryzalin (Surflan®)	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide, 480 g/L
oryzalin + oxyfluorfen (Rout®)	see oryzalin and oxyfluorfen
oxyfluorfen (component of Rout®)	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene
paraquat (Gramoxone Extra®)	1,1'-dimethyl-4,4'-bipyridinium ion, 300 g/L
pendimethalin	*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine (396 g/L)
phenmedipham (Spin Aid®)	3-[(methoxycarbonyl)amino]phenyl(3-methylphenyl)carbamate, 156 g/L
prodiamine (Barricade®)	2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine, 65% WG
quizalofop-P (Assure II®)	(*R*)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid, 96 g/L
sethoxydim (Poast®)	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one, 180 g/L
sulfentrazone (Authority®)	*N*-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl] phenyl]methanesulfonamide, 75% DF
trifluralin (Treflan®)	2,6-dinitro-*N,N*-dipropyl-4-(trifluoromethyl)benzenamine, 480 g/L
triflusulfuron (Upbeet®)	2-[[[[4-(dimethylamino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl]amino]carbonyl]amino]sulfonyl] -3-methylbenzoic acid

Appendix Table 2. Climatological data, Arkansas Agricultural Experiment Station, Fayetteville, 1998.

Day	April Temp. Max	April Temp. Min	April Rain-fall	May Temp. Max	May Temp. Min	May Rain-fall	June Temp. Max	June Temp. Min	June Rain-fall	July Temp. Max	July Temp. Min	July Rain-fall
	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)
1	14	5	0.03	12	9	0.23	32	18		27	19	0.25
2	20	4		21	9		30	22		28	18	0.81
3	24	11	0.30	22	7	0.23	33	23		31	19	
4	17	7		22	9		32	24		34	21	
5	14	1		26	12		31	13	0.13	36	22	
6	19	8		25	13	1.07	17	8		34	23	
7	23	12	0.76	28	12	0.51	20	8		36	26	
8	22	7		26	10	0.46	23	18		34	24	0.10
9	17	7		24	15		24	18	1.14	32	23	0.15
10	12	4		23	11	1.70	30	22		37	26	
11	18	1		25	12		29	22	0.80	36	25	
12	23	14		27	15		28	21	0.18	28	22	0.38
13	23	16		29	16		33	17		31	23	1.24
14	26	8		29	18		33	24		32	21	
15	27	11		27	22		30	18		32	21	
16	27	7	0.30	28	12		26	13		33	21	
17	11	6		29	15		30	19		33	18	
18	17	6		29	21		33	23	0.46	34	19	
19	18	4		31	19		31	20	0.30	34	22	
20	20	6		32	19		32	20		34	25	
21	19	3	0.03	32	20		34	23		37	26	
22	16	3	0.30	32	23		31	24	0.94	37	26	
23	19	3		31	22		33	21		37	23	
24	22	5		32	21		33	24		36	23	0.13
25	24	17		32	16	2.03	33	25		32	22	
26	22	17		26	17	1.75	33	25		35	25	
27	26	9	3.43	27	16	0.57	33	24		39	27	
28	15	9	0.08	29	17		31	24		38	25	
29	17	7		27	17		34	24		32	24	
30	13	9		28	18	1.35	34	22		38	26	
31				32	25					39	23	0.03

Appendix Table 3. Climatological data, Vegetable Substation, Kibler, 1998.

	April			May			June			July		
	Temp.		Rain-	Temp.		Rain-	Temp.		Rain-	Temp.		Rain-
Day	Max	Min	fall	Max	Min	fall	Max	Min	fall	Max	Min	fall
	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)	(°C)	(°C)	(cm)
1	22	6		24	7		36	22		28	22	0.30
2	28	7	0.03	26	10		37	23		31	23	3.20
3	21	10		24	9		34	22		37	23	
4	15	7		28	9	0.48	34	21		36	26	
5	21	4		27	15		20	13	1.02	37	26	
6	25	8	0.91	29	17	2.84	23	12		37	26	
7	27	11	0.03	28	14	0.20	28	11		39	26	
8	21	10		28	14		24	19		36	26	0.51
9	17	8		24	16		33	19	1.96	38	27	
10	22	5		28	14		33	20	0.20	40	27	
11	26	3		31	14	0.36	31	22	0.10	33	26	
12	26	9		33	18		36	20	1.80	32	25	
13	29	14		33	17		37	22		35	26	1.14
14	30	9		29	20		33	22		34	24	
15	28	16	0.18	32	17		31	20		37	25	
16	18	8	0.08	32	13		33	16		35	24	
17	17	7		33	15		36	21		37	22	
18	19	8		36	19		34	21		39	23	
19	24	7		35	18		34	21	1.63	40	24	
20	24	8	0.05	34	18		37	25		41	26	
21	21	7		36	21		36	25		40	26	
22	23	5		33	23		37	23		40	27	
23	24	6		31	20		36	23		38	25	
24	27	7		33	19		37	23		36	25	
25	28	16		31	19		37	24		40	26	
26	23	14	1.14	28	19	1.91	38	23		43	27	
27	21	13	0.15	26	20	1.50	36	26		42	26	
28	20	8		27	20	1.32	37	26		36	26	
29	16	7		29	20		38	26		42	26	
30	18	10		35	21	0.36	35	25		42	26	
31				36	23					42	27	

Appendix Table 4. Standardized plant (Bayer) codes, Weed Science Society of America, for weeds appearing in this report.

Code	Scientific Name	Common Name
AMAAL	*Amaranthus albus* L.	tumble pigweed
AMACH	*Amaranthus hybridus* L.	smooth pigweed
CAPBP	*Capsella bursa-pastoris* L.	shepherdspurse
CHEAL	*Chenopodium album* L.	common lambsquarters
CMIRA	*Campsis radicans* (L.) seem. ex Bureau	trumpetcreeper
CONAR	*Convolvulus arvensis* L.	field bindweed
CYNDA	*Cynodon dactylon* (L.) Pers.	bermudagrass
CYPES	*Cyperus esculentus* L.	yellow nutsedge
DIGSA	*Digitaria sanguinalis* (L.) Scop.	large crabgrass
ERICA	*Conyza canadensis* (L.) Cronq.	horseweed
LAMAM	*Lamium amplexicaule* L.	henbit
MATMT	*Matricaria matricariodes* (Less.) C. L. Porter	pineappleweed
MOLVE	*Mallugo verticillata* L.	carpetweed
OEOLA	*Oenothera laciniata* Hill	cutleaf eveningprimrose
OXAST	*Oxalis stricta* L.	yellow woodsorrel
POANN	*Poa annua* L.	annual bluegrass
SIBVI	*Sibara virginica* (L.) Rollins	sibara
SOLCA	*Solanum carolinense* L.	horsenettle
TAROF	*Taraxacum officinale* Weber in Wiggers	dandelion

Conversion Table

		U.S. to Metric	Metric to U.S.		
to convert from	to	multiply U.S. unit by	to convert from	to	multiply metric unit by
length			**length**		
miles	kilometers	1.61	kilometers	miles	.62
yards	meters	.91	meters	yards	1.09
feet	meters	.31	meters	feet	3.28
inches	centimeters	2.54	centimeters	inches	.39
area and volume			**area and volume**		
sq yards	sq meters	.84	sq meters	sq yards	1.20
sq feet	sq meters	.09	sq meters	sq feet	10.76
sq inches	sq centimeters	6.45	sq centimeters	sq inches	.16
cu inches	cu centimeters	16.39	cu centimeters	cu inches	.06
acres	hectares	.41	hectares	acres	2.47
liquid measure			**liquid measure**		
cu inches	liters	.02	liters	cu inches	61.02
cu feet	liters	28.34	liters	cu feet	.04
gallons	liters	3.79	liters	gallons	.26
quarts	liters	.95	liters	quarts	1.06
fluid ounces	milliliters	29.57	milliliters	fluid ounces	.03
weight and mass			**weight and mass**		
pounds	kilograms	.45	kilograms	pounds	2.21
ounces	grams	28.35	grams	ounces	.04
temperature			**temperature**		
F	C	5/9(F-32)	C	F	9/5(C+32)