

**HERBICIDE SELECTIVITY TRIALS  
WITH BANANAS  
(*MUSA SPP.*)  
IN HAWAII**

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Honolulu, Hawaii

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J. S. Tanaka<sup>3</sup>; and R. C. Barba<sup>4</sup>**

**INTRODUCTION**

Essentially all of the bananas consumed in Hawaii are grown locally; a few are imported in the spring when local production is limited. A majority of the acreage planted to banana is located on the Island of Oahu, the population center of the state.

Weeds have been a problem for many years in Hawaiian banana plantations. When the herbicide trials reported here were initiated in 1962, only aromatic oil and dalapon were registered with the Federal Food and Drug Administration (FDA) for use in banana plantings. The trials were conducted first, to evaluate several herbicides for crop and weed phytotoxicity response and second, to use the research data as supporting evidence in obtaining FDA registration for the more promising herbicides. The chemicals selected were already registered for use in other edible crops or appeared to be likely candidates for FDA registration in the future.

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## MATERIALS AND METHODS

Two of the three sites used for the experiments are located on the Island of Oahu. The Waimanalo Experimental Farm has a dark magnesium montmorillonite clay soil type which contains approximately 4 to 5 percent organic matter. The other, the Poamoho Experimental Farm, is located on soil belonging to the Low Humic Latosol soil groups and has a mineralogical composition of kaolinitic clay and iron oxides. The organic matter in the soil at Poamoho is approximately 2 percent. The third test site, the Kauai Branch Station, has the Hanamaulu silty clay soil series, which is a strongly leached soil depleted of bases and silica. This soil contains approximately 6 to 8 percent organic matter and has small pellets, either iron concretions or iron-coated aggregates.

Table 1. Description of the test locations

Experiment Station	Island	Elevation	Soil Type	Median Annual Rainfall in Inches
Kauai Branch Station	Kauai	530 feet	Halii gravelly silty clay	92
Poamoho Experimental Farm	Oahu	870 feet	Wahiawa silty clay	45
Waimanalo Experimental Farm	Oahu	70 feet	Waimanalo silty clay	45

The Kauai Branch Station is representative of commercial banana areas which receive high rainfall; the Oahu locations are in drier areas. The bananas at Poamoho and Waimanalo received supplemental furrow irrigation at weekly intervals on an as-needed basis. They received the necessary spray applications to reduce the incidence of disease and insect damage. Ample fertilizer was applied to the soil at each of the test locations according to the recommendations supplied by soil scientists of the Hawaii Agricultural Experiment Station and by the Cooperative Extension Service.

### Treatment Applications

All of the herbicides used in the test were applied as spray mixes with water as the diluent. Back-mounted fiberglass tanks were used, pressured with nitrogen gas and operated at 25 pounds per square inch of pressure. The spray was directed to the base of the plants at 80 gallons of spray mix per acre. No attempt was made to avoid spraying the young suckers just emerging from the soil surface. The sprays were applied on each side of the treatment row in 5-foot band widths at the Poamoho and Waimanalo Farms and in 6-foot band widths at the Kauai Station. In

general, most of the treatments were applied post-emergence to the weeds. Some resistant weeds were removed when necessary by shallow cultivations or mowing. Since the treatments were designed to determine the crop response to a single herbicide, often for FDA registration purposes, it was not possible to study interactions by using more than one herbicide when weed growth persisted. The continual shift to a mono-culture of weeds when using the same herbicide over a prolonged period of time has always been a problem when researching herbicides in plantation crops.

The chemicals used in the experiments are presented in Table 2. Details on the dates of application are given in the Appendix on a per-experiment basis.

Table 2. List of chemicals used in the experiments

Trade Name <sup>1</sup>	Temporary Designation or Common Name	Chemical Name
Ametryne	ametryne	2-ethylamino-4-isopropylamino-6-methylthio-s-triazine
Atrazine	atrazine	2-chloro-4-ethylamino-6-isopropylamino-s-triazine
Amino Triazole	amitrole	3-amino-1, 2, 4-triazole
Amitrol-T	amitrole-T	amitrole plus ammonium thiocyanate
Ansar 170	MSMA	monsodium acid methanearsonate
Aromatic oil	55 AR	
Caparol	prometryne	2, 4-bis (isopropylamino)-6-methylmercapto-s-triazine
Clobber	cypromid	N-(3, 4-dichlorophenyl) cyclopropane-carboxamide
Daxtron	pyriclor	2, 3, 5-trichloro-4-pyridinol
Ortho Diquat	diquat	1, 1 ethylene-2, 2'-dipyridylum cation dibromide
Dowicide G	PCP, sodium salt	Sodium pentachlorophenate
Dowpon	dalapon	sodium salt of 2, 2-dichloropropionic acid
Eptam	EPTC	ethyl N, N-di-n-propylthiolcarbamate
Herban	norea	3-(hexahydro-4, 7-methanoindan-5-yl)-1, 1-dimethylurea
Hyvar X	bromacil	5-bromo-3-sec-butyl-6-methyluracil
Karmex	diuron	3-(3, 4-dichlorophenyl)-1, 1-dimethylurea
Lorox	linuron	3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea
Multi-Film X-77	non-ionic Spreader Activator	alkylaryl polyoxyethylene glycols, free fatty acids and isopropanol
Paraquat	paraquat	1, 1'-dimethyl-4, 4'-dipyridylum cation
Tordon	pictoram	4-amino-3, 5, 6-trichloropicolinic acid

<sup>1</sup>Active ingredients of chemical formulations:

Emulsifiable concentrates (pounds per gallon)—Daxtron 1.5; Amitrol-T, Clobber, Diquat, Paraquat, and Tordon 2 lbs.; Eptam 6; Ansar 170 6.6

Wettable Powders—Amino Triazole and Lorox 50%; Ametryne, Atrazine, Caparol, Herban, Hyvar X, and Karmex 80%; Dowpon 85%; Dowicide G 90%.

## Methods of Evaluating and Reporting the Experimental Results

Essentially all of the weed data were recorded using a subjective rating scale. Since the experiments were advanced secondary screening trials, this degree of precision was thought sufficient as compared to the more time consuming, objective methods of stand counts, etc. The rating scale was as follows:

### Weed Control Ratings

- 1 = no control
- 2 = slight control
- 3 = fair control
- 4 = good control—commercially acceptable
- 5 = complete control

The procedure for the subjective rating was to study all of the check plots in an experiment before the evaluations were made; subsequently, the plots were rated without knowledge of the treatment. This unbiased method often resulted in check plot ratings greater than “1.” If more detailed data were thought necessary, a stand count was made to measure the weed control activity. Table 3 contains a listing of the weed species present in sufficient numbers to be evaluated.

The crop data results are expressed in pounds (lbs.) per bunch, number of hands per bunch, and, in two experiments, the number of days from planting to the first harvest. The banana yields were average at the Waimanalo and Poamoho Farms. Although large amounts of fertilizer were added to the soil at the Kauai location, the banana plant crop yields were below average. Sigatoka disease was present at this location and the excessive winter rains often prevented ideal conditions for the control of this disease.

The detailed experimental results are contained in the Appendix. Duncan’s Multiple Range Test was the statistic used to compare treatment means of the banana data and the L. S. D. (least significant difference) was selected as the main statistic for ease of comparing treatment means for the weed performance data. All of the detailed data are presented in the Appendix and a general presentation is made of the results in the remainder of the report.

## RESULTS AND DISCUSSION

The experimental results reported in the Appendix show that bananas tolerate several different herbicides. Ametryne, aromatic oil, atrazine, dalapon, diuron, and paraquat were tested to the greatest extent in the three experiments. Ametryne, aromatic oil, dalapon, and paraquat showed no evidence of reducing yield or delaying maturity of the bananas under the test conditions for the duration of the experiments.

**Table 3. Scientific names of the weed species discussed in this report**

Common Name (Hawaiian Islands)	Scientific Name
<b>Grasses</b>	
Crabgrass	<i>Digitaria sanguinalis</i>
Foxtail, bristly	<i>Setaria verticillata</i>
Lovegrass	<i>Eragrostis pectinacea</i>
Jungle ricegrass	<i>Echinocholoa colonum</i>
Nutsedge	<i>Cyperus rotundus</i>
Sandbur	<i>Cenchrus echinatus</i>
Wiregrass	<i>Eleusine indica</i>
<b>Broadleaves</b>	
Buttonweed	<i>Borreira laevis</i>
Flora's paint brush	<i>Emilia sonchifolia</i>
Fine leaved celery	<i>Apium tenuifolium</i>
Jamaica vervain	<i>Stachytarpheta jamaicensis</i>
Popolo	<i>Solanum nodiflorum</i>
Purslane	<i>Portulaca oleracea</i>
Spanish needle	<i>Bidens pilosa</i>
Swinecress	<i>Coronopus didymus</i>

Table 4. General summary of the relative tolerance of the weeds to post-emergence applications of the herbicides<sup>1</sup>

Grasses and Sedges							
Chemical	Crab-grass	Fox-tail	Jungle ricegrass	Love-grass	Nutsedge	Sandbur	Wire-grass
Ametryne	S	I-S	I-S	I-S	T	S	S
Amitrol		S	I-S				S
Atrazine	T-I	T	I	S	T	S	S
Cypromid		S	I				I
Dalapon		I-S	I-S				I-S
Diuron + X-77	I-S	S	I-S	S	T	S	S
MSMA		S	I		I	S	I
NaPCP		I-S	T-I		I	I-S	I
Paraquat + X-77	S	S	T-I	I-S	I	S	S
Pyriclor		S	S		I-S	S	S

  

Broadleaves							
	Flora's paint brush	Button-weed	Fine-leaved celery	Purslane	Smooth amaranth	Spanish needle	Swine-cress
Ametryne	I-S	T	T-I	S	S	S	S
Atrazine				S	S	S	S
Diuron + X-77	T-I	S	S	S	S	S	S
Paraquat + X-77	S	I-S	S	S	S	I-S	I

<sup>1</sup>Weed tolerance: T = Tolerant to herbicide  
 I = Intermediate (often influenced by soil type)  
 S = Susceptible



Diuron did not reduce the yield of the matured bananas at the three locations, but two mats were severely stunted at the Kauai Branch Station. This injury was attributed to the soil properties in the vicinity of the two mats, since the topsoil was removed during the initial field preparation. Studies have shown that diuron is adsorbed on the organic matter in the soil, often resulting in less crop phytotoxicity; hence, the exposed subsoil undoubtedly contributed to the banana injury because of low organic matter or other limiting factors.

Atrazine resulted in the lowest yielding bananas at Poamoho and delayed the maturity of bananas by 44 to 49 days on Kauai. Visual symptoms of marginal leaf chlorosis were severe at Poamoho, moderate at Kauai. No chlorosis was noted at Waimanalo in the atrazine tested plots. The observed differences in selectivity between atrazine and ametryne are extremely interesting since both compounds are identical except for the side chain substitutions. Atrazine is a chloro-substituted triazine and ametryne a methylthio-substituted triazine. Soil and plant studies are underway to determine the reasons for the differing selectivity of bananas to the two compounds.

Bromacil and picloram were the only compounds that severely injured the bananas in Experiment No. 1. Picloram was applied as a directed spray to the guard rows. In two weeks the banana suckers were distorted and in four to six weeks a majority of the pseudostems had fallen to the ground. Bromacil resulted in severe leaf chlorosis and in time most of the banana plants decayed. The two herbicides should be explored as possible banana eradicates in areas where disease infestations are prevalent.

The EPTC treatments appeared to reduce banana plant vigor with time, but this may have been due to the root pruning which resulted from the soil incorporation treatment. This herbicide would find only limited use in banana culture in Hawaii because of the necessity for soil incorporation.

The weed control experienced with the compounds is summarized in Table 4. The performance of the herbicides clearly shows that a rotation of herbicides is necessary when treating long-term fruit crops such as bananas. Ametryne and diuron, two herbicides of primary interest for use with bananas in Hawaii, were especially complementary to each other. Ametryne was superior in the control of Flora's paint brush and diuron excelled in the control of button weed and fine leaved celery. Grass control was somewhat similar with both compounds. Diuron provided a longer lasting control than ametryne at the three test locations.

Cypromid, MSMA, NaPCP, and paraquat were compared with aromatic oil for their removal of existing weeds. When aromatic oil was used near maturing bananas in the experiments a bleached appearance was noted on the banana fruits. In general, the weed control with paraquat compared favorably with oil and the ease of handling paraquat has stimulated interest in its potential use. Cypromid and

MSMA have to be evaluated more thoroughly before their use for fruit crops can be established in Hawaii. NaPCP is used in the form of an emulsion with oil and water. Since back-mounted hand-operated sprayers are the primary herbicide applicators used for bananas in Hawaii, NaPCP mixes are not always looked on with favor by banana growers.

Of the remaining chemicals tested, pyriclor looks especially interesting; unfortunately, it was tested for only a short time toward the termination of Experiment No. 1. The chemical was very active when applied post-emergence to the grasses. No visible symptoms of crop phytotoxicity were noted with pyriclor.

**Table 5. Suggested guide for chemical weed control with bananas in Hawaii**

Herbicide	Rate/Acre <sup>1</sup> (Commercial product)	Remarks
Aromatic oil	40 to 100 gals.	Use lower rate on small weeds. Be careful of bleaching fruits from vapors.
Dowpon (dalapon)	8 to 13 lbs.	Apply before grass heading stage in 80 to 100 gallons of spray mix per acre. Do not apply more than 26 lbs. per year.
Karmex (diuron)	4 to 5 lbs.	Apply only after the plants are established. Treat cautiously on lighter soils. Apply as a basal spray either as a pre-emergence treatment (no surfactant) in 40 gallons of spray mix per acre or as a post-emergence treatment on emerged weeds (with surfactant) in 80 to 100 gallons of spray mix per acre. Use 8 to 16 ounces of X-77 surfactant per 100 gallons of spray mix or equivalent. Do not apply more than 12 pounds of karmex per year. Do not plant other crops in the area for 2 years after last treatment.
<b>Trial Use<sup>2</sup></b>		
Ametryne	5 to 10 lbs.	Apply immediately after setting plants or any time thereafter. Apply as a basal spray either as a pre-emergence treatment in 40 gallons of spray mix per acre or as a post-emergence treatment on emerged weeds in 80 to 100 gallons of spray mix per acre. Apply ametryne at 3- to 4-month intervals if necessary.
Paraquat	1 to 2 qts.	Apply as a basal spray to emerged weeds in 80 to 100 gallons of spray mix per acre. Use 8 to 16 ounces of X-77 surfactant per 100 gallons of spray mix or the equivalent of a non-ionic spreader-sticker. Registered for use only in non-bearing plantings.

<sup>1</sup>Active ingredients of the commercial product are stated in Table 2.

<sup>2</sup>Trial Use: Ametryne and paraquat should be used only on an experimental basis until Federal registration is obtained. Discard treated fruit.

## SUMMARY

Ametryne, aromatic oil, dalapon, diuron, and paraquat are suggested as the primary herbicides for future use with bananas in Hawaii. Aromatic oil, dalapon, and diuron are the only herbicides registered for use in fruiting bananas by the Federal Food and Drug Administration. Studies are currently in progress so that ametryne and paraquat can be registered at the earliest possible date. Paraquat is registered for use in young non-bearing plantations.

Suggested chemicals for use and *for trial use* with bananas in Hawaii are contained in Table 5. The *trial use* suggestions are presented so that Extension personnel of the University of Hawaii can treat small areas and become familiar with the compounds; large-scale applications should be made only when FDA registration is obtained. Fruits from *trial use* areas should be discarded until registration is obtained.

## RELATED LITERATURE

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## APPENDIX

### BANANA EXPERIMENT NO. 1

(Permanent file copy WC-35)

Waimanalo Experimental Farm Field P-1

- Banana variety: *Musa acuminata* (Dwarf Cavendish)
- Experimental design: Randomized complete block, 4 replications, plot size 10' x 40' (5 mats per plot).
- Experimental procedure: Bananas transplanted to field November 29, 1962; initial herbicide treatments applied June 20, 1963 (See Table 1-1 for information on spray schedule); experiment terminated on March 16, 1966; The herbicides were applied to the base of the large plants and directly over the small suckers at the rate of 80 gallons of spray mixture per acre. The majority of treatments were made post-emergence to the weeds with the exception of Eptam, which was soil-incorporated. Excessive weed growth was removed by shallow cultivations or the use of 55 AR oil as shown in Table 1-1.
- Weed species: Most prevalent: Grasses—foxtail, nutsedge, jungle ricegrass, sandbur, wiregrass; broadleaves—purslane, smooth amaranth.
- Results: See Tables 1-1 to 1-14.

#### Discussion and Summary:

*Crop tolerance:* The crop phytotoxicity data in Tables 1-2 and 1-3 show that bananas are tolerant to several herbicides. This is especially evident when considering the diversity of herbicide chemistry applied to some of the plots. Bromacil and picloran (unreported data) were the only two compounds which severely injured the bananas. Bromacil was the only herbicide which resulted in plants exhibiting leaf chlorosis symptoms. The data show that all of the other compounds are distinct possibilities for use in bananas when evaluating only crop phytotoxicity. Amitrol significantly reduced the yield of bananas during the first harvesting cycle when compared with the cultivated check, but subsequent satisfactory yields with Amitrol-T imply that this observation needs further study before any conclusions can be drawn. The soil incorporation treatment of Eptam in the second harvest appears to have reduced the yield. The data for the third harvest, March 1965 to January 1966, should be evaluated with caution because of damaging winds during the course of the harvest period.

*Weed tolerance:* Essentially all of the herbicides performed satisfactorily under the experimental conditions. Diuron plus surfactant, ametryne, and pyriclor controlled the weed species for periods of 4 to 9 months. Paraquat was effective as a contact spray for periods up to 8 weeks. Cypromid, norea, linuron, prometryne, and MSMA were studied for a short time; hence, their weed-killing properties were not thoroughly evaluated. Eptam provided excellent nutsedge and grass control, but the need for soil incorporation limits its use in bananas because of root damage.

**Table 1-1. Treatment descriptions and dates of application, Experiment No. 1 (All bold face dates represent the removal of weeds by shallow cultivation)**

Treatment lbs active/acre	Date of Application
1. Check, 55 AR oil 80 gals.  Na PCP 4 lbs. + 55 AR oil Ametryne 16 lbs.	6/20/63, 7/24/63, 8/15/63, 10/10/63, 1/27/64, 2/12/64, 3/4/64, 6/15/64, 7/16/64, 10/10/64, 11/13/64, 1/12/64, 2/14/65, 3/2/65, 4/15/65. 6/1/65, 6/23/65, 8/12/65, 9/17/65. 11/24/65.
2. Check, cultivated  Check, mowed	7/31/63, 8/19/63, 10/10/63, 1/27/64, 3/4/64, 6/2/64, 7/13/64, 10/10/64, 11/13/64, 2/14/65. 3/9/65, 6/15/65, 9/20/65, 11/24/65.
3. Atrazine 2 lbs. 55 AR oil 80 gals. Ametryne 4 lbs.	6/20/63. 7/24/63, 8/15/63, 10/10/63. 8/29/63, 1/27/64, 2/12/64, 6/12/64, 10/10/64, 11/13/64, 3/9/65, 6/23/65, 8/16/65, 11/24/65.
4. Atrazine 4 lbs. 55 AR oil 80 gals. Atrazine 4 lbs. Ametryne 4 lbs. + Dalapon 10 lbs.	6/20/63. 8/15/63, 10/10/63, 1/27/64. 2/12/64, 4/6/64, 6/12/64, 7/13/64, 10/10/64. 11/13/64, 3/9/65, 6/23/65, 8/16/65, 11/24/65.
5. Atrazine 4 lbs. + Dalapon 5 lbs. 55 AR oil 80 gals. Atrazine 4 lbs. + Dalapon 5 lbs. Atrazine 4 lbs. + Dalapon 10 lbs. 55 AR oil 80 gals. Ametryne 12 lbs. Pyriclor 2 lbs.	6/20/63. 8/15/63, 10/10/63, 1/27/64. 2/12/64, 6/12/64, 10/10/64. 11/13/64. 2/14/65, 3/2/65. 3/9/65. 8/16/65.
6. Dalapon 10 lbs. 55 AR oil 80 gals. Dalapon 10 lbs.  55 AR oil 80 gals. Diuron 4 lbs. + Dalapon 10 lbs.	6/20/63. 8/15/63, 8/29/63, 10/10/63, 1/27/64. 2/12/64, 4/6/64, 6/12/64, 7/13/64, 10/10/64, 11/13/64. 1/12/65, 2/14/65, 3/2/65. 3/9/65, 6/23/65, 8/16/65.

Table 1-1. (Continued)

Treatment lbs. active/acre	Date of Application
7. PCP 2 lbs. + 55 AR oil	6/20/63, 7/12/63.
Na PCP 8 lbs. + 55 AR oil	8/16/63, 8/29/63.
55 AR oil 80 gals.	10/10/63, 1/27/64.
Norea 4 lbs.	2/12/64.
Norea 4 lbs. + .5% X-77	6/12/64.
55 AR oil 80 gals.	7/16/64, 10/10/64.
Diuron 8 lbs. + .5% X-77	11/13/64, 3/9/65.
Diuron 8 lbs. + .2% X-77	8/16/65.
8. Prometryne 4 lbs.	6/20/63.
55 AR oil 80 gals.	7/24/63, 8/15/63, 10/10/63, 1/27/64.
Prometryne 4 lbs.	2/12/64.
Ametryne 8 lbs.	6/12/64, 10/10/64, 11/13/64, 3/9/65, 8/16/65, 11/24/65.
9. Paraquat 1/2 lb. + Diquat 1/2 lb. + 1% X-77	7/3/63, 8/16/63.
55 AR oil 80 gals.	10/10/63, 1/27/64.
Paraquat 1 lb. + Diquat 1 lb. + 15% X-77	2/12/64, 4/6/64, 6/12/64.
Paraquat 1 lb. + .5% X-77	7/16/64, 10/10/64, 11/13/64, 1/12/65, 3/9/65, 6/1/65.
Paraquat 1 lb. + .2% X-77	6/23/65, 8/12/65, 9/17/65, 11/24/65.
10. Diuron 3 lbs. + 1% X-77	6/20/63.
55 AR oil 80 gals.	8/15/63, 10/10/63, 1/27/64.
Diuron 3 lbs. + .5% X-77	2/12/64, 6/12/64, 10/10/64.
Diuron 4 lbs. + .5% X-77	11/13/64, 3/9/65.
Diuron 4 lbs. + .2% X-77	8/16/65.
11. Bromacil 2 lbs.	6/20/63.
55 AR oil 80 gals.	8/15/63, 10/10/63, 1/27/64, 3/4/64, 4/6/64, 6/4/64, 7/16/64, 10/10/64, 11/13/64, 12/1/64, 1/12/65.
55 AR oil 80 gals.	2/14/65, 3/9/65, 4/15/65.
Na PCP 16 lbs. + 55 AR oil	6/1/65, 6/23/65, 8/12/65, 9/16/65.
MSMA 6.6 lbs. + .2% X-77	11/24/65.
12. Amitrol 8 lbs.	6/20/63.
55 AR oil 80 gals.	10/10/63, 1/27/64.
Amitrol 8 lbs.	2/12/64.
Amitrol-T 4 lbs.	6/12/64, 10/10/64.
Amitrol-T 5 1/2 lbs. + .5% X-77	11/18/64, 1/12/65, 2/14/65.
Linuron 4 lbs.	3/9/65.
Na PCP 8 lbs. + 55 AR oil	6/23/65, 8/12/65, 9/16/65.
Paraquat 2 lbs. + .2% X-77	11/24/65.
13. EPTC 6 lbs.	7/3/63.
55 AR oil 80 gals.	10/10/63, 1/27/64.
EPTC 6 lbs.	2/12/64, 6/12/64, 6/12/64, 10/10/64, 11/18/64, 11/18/64.
Diuron 4 lbs. + Paraquat 1 lb.	2/14/65, 3/9/65, 6/1/65.
Cyprimid 2 lbs.	8/16/65.
Pyriclor 4 lbs.	11/24/65.

Table 1-2. Banana yield data, Experiment No. 1

Treatment lbs. active/acre	11/63 to 6/64		6/64 to 3/65		3/65 to 1/66	
	Lbs./ bunch	Hands/ bunch	Lbs./ bunch	Hands/ bunch	Lbs./ bunch	Hands/ bunch
1. Check, oil (13) <sup>1</sup> , PCP 4 lbs. (4), Ametryne 16 lbs. (1).	45.5ab <sup>2</sup>	8.1a	41.4	8.5	35.7	6.0
2. Check, cultivated (10), mowed (4).	52.0a	8.5a	34.7	6.9	36.8	6.2
3. Atrazine 2 lbs. (1), oil (3), Ametryne 4 lbs. (8).	48.9ab	7.9a	47.7	8.9	37.0	6.2
4. Atrazine 4 lbs. (3), oil (2), Ametryne 4 lbs. + Dalapon 10 lbs. (5).	47.4ab	7.7a	37.5	7.5	42.2	6.4
5. Atrazine 4 lbs. + Dalapon 5 lbs. (3), oil (4), Atrazine 4 lbs. + Dalapon 10 lbs. (1), Ametryne 12 lbs. (1), Pyriclor 2 lbs. (1).	43.0ab	7.4a	38.8	7.5	38.5	6.2
6. Dalapon 10 lbs. (4), oil (6), Diuron 4 lbs. + Dalapon 10 lbs. (3).	47.2ab	7.5a	35.7	6.4	37.6	6.2
7. PCP 2 lbs. (2), Na PCP 8 lbs. (2), oil (2), Norea 4 lbs. (2), Diuron 8 lbs. + X-77 (3).	48.9ab	8.1a	50.6	9.2	37.7	6.0
8. Prometryne 4 lbs. (2), oil (3), Ametryne 8 lbs. (5).	45.1ab	7.8a	48.5	9.7	37.4	6.2
9. Paraquat ½-1 lb. + Diquat ½-1 lb. + X-77 (4), oil (1), Paraquat 1 lb. + X-77 (8).	45.4ab	7.9a	36.5	6.2	39.0	6.6
10. Diuron 3-4 lbs. + X-77 (6), oil (2).	43.1ab	7.4a	39.7	6.8	28.3	5.4
11. Bromacil 2 lbs. (1), oil (10), Na PCP 16 lbs., MSMA 6.6 lbs., + X-77 (1).	0	0	18.1	3.5	32.5	5.5
12. Amitrol 8 lbs. (2), oil (1), Amitrol-T 4-5½ lbs. + X-77 (3), Linuron 4 lbs. (1), Na PCP 8 lbs. (3), Paraquat 2 lbs. + X-77 (1).	41.9b	7.6a	51.5	9.2	40.6	6.4
13. EPTC 6 lbs. (4), oil (2), Diuron 4 lbs. + Paraquat 1 lb. (2), Cypromid 2 lbs. (1), Pyriclor 4 lbs. (1).	44.6ab	7.8a	30.6	6.4	30.4	5.4
			n. s.	n. s.	n. s.	n. s.

<sup>1</sup>The numbers in parentheses refer to the number of treatment applications.

<sup>2</sup>Any means not followed by a common letter are statistically different at Duncans Multiple Range Test 5% level.



**Table 1-3. Total number of suckers produced per mat,  
Experiment No. 1**

Treatment lbs. active/acre	11/29/62 to 1/31/64	1/31/64 to 9/17/64
1. Check, oil (8) <sup>1</sup>	8.9a <sup>2</sup>	8.3
2. Check, cultivated (7)	10.5a	8.7
3. Atrazine 2 lbs. (1), oil (3), Ametryne 4 lbs. (3).	10.0a	10.2
4. Atrazine 4 lbs. (3), oil (2).	9.5a	9.3
5. Atrazine 4 lbs. + Dalapon 5 lbs. (3), oil (2).	9.6a	11.0
6. Dalapon 10 lbs. (3), oil (3).	8.9a	8.0
7. PCP 2 lbs. (2), Na PCP 8 lbs. (2), oil (2), Norea 4 lbs. (2).	10.7a	7.7
8. Prometryne 4 lbs. (2), oil (3), Ametryne 8 lbs. (1).	9.4a	9.5
9. Paraquat ½-1 lb. + Diquat ½-1 lb. + X-77 (4), oil (1), Paraquat 1 lb. + X-77 (1).	9.9a	10.0
10. Diuron 3-4 lbs. + X-77 (3), oil (2).	9.4a	10.2
11. Bromacil 2 lbs. (1), oil (4).	2.8	3.9
12. Amitrol 8 lbs. (2), oil (1), Amitrol-T 4 lbs. (1).	9.2a	9.8
13. EPTC 6 lbs. (3), oil (2).	9.0a	6.8

n. s.

<sup>1</sup>The numbers in parentheses refer to the number of treatment applications.

<sup>2</sup>Any means not followed by a common letter are statistically different at Duncans Multiple Range Test 5% level.

Table 1-4. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/area	No. of weeks after treatment	No. of weeds/sq. ft. (7/12/63)				
		Fox- tail	Rice- grass	Wire- grass	Pur- slane	Smooth amaranth
1. Check, 55 AR oil	3	0.4	2.0	1.8	2.3	3.5
2. Check, cultivated	2	0	0.4	0.1	0.2	0.2
3. Atrazine 2 lbs.	3	0.5	4.3	1.0	0	0.3
4. Atrazine 4 lbs.	3	0.5	1.7	2.8	0	0
5. Atrazine 4 lbs. + Dalapon 5 lbs.	3	0.3	0.6	1.4	0.1	0.1
6. Dalapon 10 lbs.	3	0.2	1.1	0.6	1.7	2.1
7. PCP 2 lbs. + 55 AR oil	3	0.4	1.6	0.7	2.2	4.5
8. Prometryne 4 lbs.	3	0.3	1.9	0.6	0.2	0
9. Paraquat ½ lb. + Diquat ½ lb. + X-77	1	0.3	0.8	0.6	1.1	0.5
10. Diuron 3 lbs. + X-77	3	0.2	0.6	0	0	0
11. Bromacil 2 lbs.	3	0.3	1.7	0.4	0.3	0.1
12. Amitrol 8 lbs.	3	0	0.1	0	0	0
13. EPTC 6 lbs.	1	0	0	0	0	0
L. S. D. 5% (1%)		n. s.	1.5 (2.0)	0.8 (1.1)	0.8 (1.1)	1.0 (1.4)

Table 1-5. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (8/15/63) <sup>1</sup>			
		Fox- tail	Rice- grass	Purslane	Smooth amaranth
1. Check, 55 AR oil	7	3.3	1.3	1.8	2.8
2. Check, cultivated	6	4.3	2.3	2.8	2.0
3. Atrazine 2 lbs; (55 AR oil)	8 (3)	2.5	1.3	5.0	5.0
4. Atrazine 4 lbs.	8	3.0	2.8	5.0	5.0
5. Atrazine 4 lbs. + Dalapon 5 lbs.	8	5.0	4.3	5.0	5.0
6. Dalapon 10 lbs.	8	4.3	4.0	1.0	1.5
7. PCP 2 lbs. + 55 AR oil	4	4.0	2.5	3.5	3.8
8. Prometryne 4 lbs; (55 AR oil)	8 (3)	4.0	2.3	5.0	5.0
9. Paraquat ½ lb. + Diquat ½ lb. + X-77	6	1.5	2.0	2.3	3.0
10. Diuron 3 lbs. + X-77	8	4.5	1.3	5.0	5.0
11. Bromacil 2 lbs.	8	4.5	2.0	5.0	5.0
12. Amitrol 8 lbs.	8	3.8	3.0	3.3	3.8
13. EPTC 6 lbs.	6	5.0	5.0	2.0	3.3
L. S. D. 5%		1.8	1.6	1.0	1.2
L. S. D. 1%		2.4	2.1	1.4	1.6

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-6. Weed response to the herbicides, Experiment No. 1.

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (7/9/64) <sup>1</sup>			
		Fox- tail	Rice- grass	Purslane	Smooth amaranth
1. Check, 55 AR oil 80 gals.	1	4.3	3.5	3.0	4.0
2. Check, cultivated	1	4.0	4.0	3.0	2.8
3. Ametryne 4 lbs.	4	5.0	5.0	5.0	5.0
4. Atrazine 4 lbs.	4	2.0	3.8	4.8	5.0
5. Atrazine 4 lbs. + Dalapon 5 lbs.	4	4.3	4.0	5.0	5.0
6. Dalapon 10 lbs.	4	3.3	3.3	2.3	2.3
7. Norea 4 lbs. + .5% X-77	4	4.3	2.8	5.0	4.3
8. Ametryne 8 lbs.	4	5.0	4.8	5.0	5.0
9. Paraquat 1 lb. + Diquat 1 lb. + .5% X-77	4	4.0	2.3	4.8	4.0
10. Diuron 3 lbs. + .5% X-77	4	5.0	4.3	5.0	5.0
11. 55 AR oil 80 gals.	5	3.8	4.0	3.3	4.3
12. Amitrol-T 4 lbs.	4	3.0	3.0	3.0	3.0
13. EPTC 6 lbs.	4	5.0	5.0	3.8	3.8
L. S. D. 5%		1.2	1.0	0.9	1.0
L. S. D. 1%		1.7	1.4	1.2	1.3

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-7. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (8/18/64) <sup>1</sup>		
		Foxtail	Ricegrass	Wiregrass
1. Check, 55 AR oil 80 gals.	5	4.0	2.8	4.0
2. Check, cultivated	5	4.3	3.8	3.0
3. Ametryne 4 lbs.	10	4.8	2.8	4.3
4. Atrazine 4 lbs. (cultivated)	10 (5)	(4.8)	(4.8)	4.0
5. Atrazine 4 lbs. + Dalapon 5 lbs.	10	3.0	3.3	3.0
6. Dalapon 10 lbs. (cultivated)	10 (5)	(3.8)	(3.0)	(2.5)
7. Norea 4 lbs. + .5% X-77 (55 AR oil 80 gals.)	10 (5)	(4.5)	(3.0)	(4.0)
8. Ametryne 8 lbs.	10	4.8	3.3	4.3
9. Paraquat 1 lb. + .5% X-77	5	5.0	2.3	4.0
10. Diuron 3 lbs. + .5% X-77	10	5.0	3.0	4.0
11. 55 AR oil 80 gals.	5	5.0	3.3	3.8
12. Amitrol-T 4 lbs.	10	5.0	1.8	2.3
13. EPTC 6 lbs.	10	4.3	2.3	3.8
L. S. D. 5% (1%)		1.1 (1.5)	n. s.	1.2 (1.6)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-8. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (12/18/64) <sup>1</sup>				
		Fox- tail	Rice- grass	Wire- grass	Pur- slane	Smooth amaranth
1. Check, 55 AR oil 80 gals.	5	4.3	3.8	4.3	4.3	3.3
2. Check, cultivated	5	5.0	4.3	4.8	4.5	4.0
3. Ametryne 4 lbs.	5	4.8	4.0	4.8	5.0	5.0
4. Ametryne 4 lbs. + Dalapon 10 lbs.	5	5.0	5.0	5.0	5.0	5.0
5. Atrazine 4 lbs. + Dalapon 10 lbs.	5	4.3	4.3	4.8	5.0	5.0
6. Dalapon 10 lbs.	5	4.8	4.0	4.3	4.0	3.5
7. Diuron 8 lbs. + .5% X-77	5	5.0	4.8	5.0	5.0	4.8
8. Ametryne 8 lbs.	5	5.0	4.8	5.0	5.0	5.0
9. Paraquat 1 lb. + .5% X-77	5	4.3	3.0	4.5	4.3	3.3
10. Diuron 4 lbs. + .5% X-77	5	5.0	5.0	5.0	5.0	5.0
11. 55 AR oil 80 gals.	5	5.0	4.5	5.0	5.0	4.5
12. Amitrol-T 5½ lbs. + .5% X-77	4	4.5	3.8	4.0	4.5	4.3
13. EPTC 6 lbs.	4	4.8	4.8	5.0	3.8	2.0
L. S. D. 5%		n. s.	0.8	0.6	0.6	1.0
L. S. D. 1%			1.1	0.9	0.9	1.4

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-9. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (6/16/65) <sup>1</sup>			
		Fox- tail	Rice- grass	Sandbur	Wire- grass
1. Na PCP 4 lbs. + 55 AR oil	2	2.8	2.5	4.0	2.8
2. Check, mowed	1	5.0	5.0	5.0	5.0
3. Ametryne 4 lbs.	14	4.0	1.3	4.3	2.0
4. Ametryne 4 lbs. + Dalapon 10 lbs.	14	3.8	3.0	4.3	3.3
5. Ametryne 12 lbs.	14	4.8	4.8	5.0	5.0
6. Diuron 4 lbs. + Dalapon 10 lbs.	14	3.8	3.3	5.0	3.5
7. Diuron 8 lbs. + .5% X-77	14	4.8	4.8	5.0	5.0
8. Ametryne 8 lbs.	14	5.0	4.0	4.8	5.0
9. Paraquat 1 lb. + .5% X-77	14	3.5	3.0	4.5	3.0
10. Diuron 4 lbs. + .5% X-77	14	5.0	4.5	5.0	5.0
11. Na PCP 16 lbs. + 55 AR oil	2	2.0	2.8	5.0	2.0
12. Linuron 4 lbs.	14	2.8	1.5	4.0	1.3
13. Diuron 4 lbs. + Paraquat 1 lb.	2	3.0	3.0	5.0	3.0
L. S. D. 5% (1%)		1.3 (1.7)	1.3 (1.7)	n. s.	1.2 (1.6)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-10. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (8/11/65) <sup>1</sup>			
		Fox- tail	Rice- grass	Sandbur	Wire- grass
1. Na PCP 4 lbs. + 55 AR oil	7	3.3	1.3	3.3	2.5
2. Check, mowed	8	4.3	3.8	4.5	4.3
3. Ametryne 4 lbs.	7	4.5	1.3	4.0	4.0
4. Ametryne 4 lbs. + Dalapon 10 lbs.	7	4.5	3.8	3.8	3.3
5. Ametryne 12 lbs.	22	2.5	2.8	4.3	3.5
6. Diuron 4 lbs. + Dalapon 10 lbs.	7	4.3	3.8	4.3	4.0
7. Diuron 8 lbs. + .5% X-77	22	5.0	4.5	5.0	4.8
8. Ametryne 8 lbs.	22	4.8	2.5	4.3	3.5
9. Paraquat 1 lb. + .2% X-77	7	4.0	2.0	4.0	3.0
10. Diuron 4 lbs. + .5% X-77	22	5.0	3.8	5.0	3.8
11. Na PCP 16 lbs. + 55 AR oil	7	4.0	2.0	4.0	2.8
12. Na PCP 8 lbs. + 55 AR oil	7	3.5	1.5	3.5	2.5
13. Diuron 4 lbs. + Paraquat 1 lb.	10	3.3	1.8	3.8	2.5
L. S. D. 5% (1%)		1.1 (1.5)	1.6 (2.1)	n. s.	1.4 (1.8)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.



Table 1-11. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (9/16/65) <sup>1</sup>			
		Fox- tail	Rice- grass	Sandbur	Wire- grass
1. Na PCP 4 lbs. + 55 AR oil	5	2.3	1.8	2.0	2.3
2. Check, mowed	13	1.3	1.3	1.5	1.3
3. Ametryne 4 lbs.	4	4.8	2.5	4.3	4.0
4. Ametryne 4 lbs. + Dalapon 10 lbs.	4	5.0	5.0	4.3	4.0
5. Pyriclor 2 lbs.	4	5.0	5.0	5.0	5.0
6. Diuron 4 lbs. + Dalapon 10 lbs.	4	4.8	5.0	5.0	5.0
7. Diuron 8 lbs. + .2% X-77	4	5.0	5.0	5.0	5.0
8. Ametryne 8 lbs.	4	5.0	4.3	5.0	4.8
9. Paraquat 1 lb. + .2% X-77	5	4.3	3.0	4.3	3.3
10. Diuron 4 lbs. + .2% X-77	4	5.0	4.8	5.0	5.0
11. Na PCP 16 lbs. + 55 AR oil	5	4.8	3.0	4.8	3.5
12. Na PCP 8 lbs. + 55 AR oil	5	4.0	2.3	3.5	2.5
13. Cypromid 2 lbs.	4	4.5	3.3	4.3	3.3
L. S. D. 5% (1%)		0.8 (1.1)	0.8 (1.1)	1.0 (1.4)	1.0 (1.4)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-12. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating <sup>1</sup> (12/30/65)	
		Ricegrass	Nutsedge
1. Ametryne 16 lbs.	5	5.0	2.3
2. Check, mowed	5	1.0	1.0
3. Ametryne 4 lbs.	5	3.0	1.5
4. Ametryne 4 lbs. + Dalapon 10 lbs.	5	4.0	2.0
5. Pyriclor 2 lbs.	19	4.0	1.8
6. Diuron 4 lbs. + Dalapon 10 lbs.	19	4.5	1.3
7. Diuron 8 lbs. + .2% X-77	19	5.0	1.0
8. Ametryne 8 lbs.	5	4.5	2.5
9. Paraquat 1 lb. + .2% X-77	5	5.0	3.0
10. Diuron 4 lbs. + .2% X-77	19	4.5	2.0
11. MSMA 6.6 lbs. + .2% X-77	5	3.3	2.5
12. Paraquat 2 lbs. + .2% X-77	5	5.0	2.8
13. Pyriclor 4 lbs.	5	5.0	5.0
L. S. D. 5% (1%)		1.0 (1.4)	1.0 (1.4)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-13. Weed response to the herbicides, Experiment No. 1

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (4/27/66) <sup>1</sup>				
		Fox- tail	Nut- sedge	Rice- grass	Sandbur	Wire- grass
1. Ametryne 16 lbs.	22	5.0	1.8	5.0	5.0	5.0
2. Check, mowed	22	2.8	1.5	1.8	2.5	2.0
3. Ametryne 4 lbs.	22	5.0	1.8	2.5	4.3	4.5
4. Ametryne 4 lbs. + Dalapon 10 lbs.	22	3.8	1.3	2.5	2.3	2.8
5. Pyriclor 2 lbs.	36	3.0	1.5	2.8	4.5	3.8
6. Diuron 4 lbs. + Dalapon 10 lbs.	36	4.3	1.0	3.5	4.8	4.3
7. Diuron 8 lbs. + .2% X-77	36	5.0	1.0	3.8	4.5	5.0
8. Ametryne 8 lbs.	22	5.0	1.0	4.5	5.0	4.8
9. Paraquat 1 lb. + .2% X-77	22	3.8	1.8	2.3	4.3	2.8
10. Diuron 4 lbs. + .2% X-77	36	5.0	1.0	3.5	5.0	4.5
11. MSMA 6.6 lbs. + .2% X-77	22	4.3	2.5	1.5	4.8	3.0
12. Paraquat 2 lbs. + .2% X-77	22	4.5	2.5	2.5	5.0	3.0
13. Pyriclor 4 lbs.	22	4.5	3.0	3.5	5.0	4.8
L. S. D. 5%		1.1	0.9	1.3	1.2	0.8
L. S. D. 1%		1.5	1.2	1.7	1.6	1.1

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 1-14. General summary of the relative tolerance of the weeds to post-emergence applications of the herbicides, Experiment No. 1<sup>1</sup>

Herbicide	Weed Species						
	Fox-tail	Nut-sedge	Rice-grass	Sandbur	Wire-grass	Purslane	Smooth amaranth
Ametryne	S	T	I-S	S	S	S	S
Amitrol	S		I-S		S	S	S
Atrazine	T	T	I			S	S
Cypromid	S		I	S	I		
Dalapon	I-S		I-S		I-S	T	T-I
Diuron + X-77	S	T	I-S	S	S	S	S
MSMA	S	I	I	S	I		
Na PCP	I-S	I	T-I	I-S	I	T-I	I-S
Paraquat + X-77	S	I	T-I	S	S	S	S
Pyriclor	S	I-S	S	S	S		

<sup>1</sup>T = Weeds were tolerant to the herbicides.

I = Intermediate.

S = Susceptible.

## BANANA EXPERIMENT NO. 2

(Permanent file copy WC-50)  
Kauai Branch Station Field G

- Banana variety: *Musa* spp. (Brazilian)
- Experimental design: Randomized complete block, 3 replications, plot size 12' x 72' (6 mats per plot).
- Experimental procedure: Bananas transplanted to field March 31, 1964; initial herbicide treatments applied July 2, 1964; experiment report terminated on December 31, 1966. The herbicides were applied to the base of the large plants and directly over the small suckers at the rate of 80 gallons of spray mixture per acre. The first treatment applications were made pre-emergence to the weeds; thereafter, most treatments were applied post-emergence to the weeds. Table 2-1 lists the treatments and cultural practices used to remove the weeds.
- Weed species: Most prevalent: Grasses—crabgrass, Flora's paint brush, jamaica vervain, button weed, fine leaved celery.
- Results: See Tables 2-2 to 2-7.

### Discussion and Summary:

*Crop tolerance:* The data (Table 2-2) show that ametryne, atrazine, diuron, dalapon, aromatic oil, and paraquat did not reduce the yield of bananas. However, the atrazine-treated bananas matured 44 to 49 days later than the check treatment. This delay in harvest with atrazine is very interesting in that the ametryne treatments matured at the same time as the oil check. Diuron stunted two mats which were growing in an area that had the topsoil removed in field preparation. Nevertheless, the diuron-treated bananas which were grown in the native topsoil showed no evidence of herbicide damage.

*Weed control:* Diuron plus surfactant and ametryne 8 lbs./acre were considered the superior treatments over the entire experimental period. It was interesting to note that the two compounds complemented each other as regards weed selectivity. Ametryne was superior to diuron in controlling crabgrass and Flora's paint brush, while the latter compound was superior on button weed and fine leaved celery. Paraquat provided commercially acceptable control of the weed species for periods of 6 to 8 weeks.

**Table 2-1. Treatment descriptions and dates of application Experiment No. 2 (All bold face dates represent the removal of excessive weed foliage by mowing).**

Treatment lbs. active/acre	Date of Application
1. Check, 55 AR oil 80 gals. Check, mowed	7/2/64, 9/22/64, 1/11/65, 6/2/65, 7/28/65, 8/26/65, 11/10/65. 4/29/66, 9/1/66, 10/13/66, 11/30/66.
2. Ametryne 4 lbs. 55 AR oil 80 gals. Ametryne 4 lbs.	7/2/64, 9/22/64, 4/28/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> , 11/9/65. 11/10/65, 5/5/66, 9/1/66, 11/23/66.
3. Ametryne 8 lbs. 55 AR oil 80 gals. Ametryne 8 lbs.	7/2/64, 9/22/64, 4/28/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> , 11/9/65. 11/10/65, 5/5/66, 9/1/66, 11/23/66.
4. Atrazine 7.5 lbs. Atrazine 4 lbs. 55 AR oil 80 gals. Atrazine 8 lbs. Paraquat 4 lbs. + .2% X-77	7/2/64. 9/22/64. 2/24/65, 8/26/65. 4/28/65, <b>6/24/65</b> , <b>8/23/65</b> , <b>9/29/65</b> . 11/10/65, 5/5/66, 6/20/66, 9/1/66, 10/13/66, 11/30/66.
5. Atrazine 7.5 lbs. + Dalapon 10 lbs. Dalapon 10 lbs. Diuron 8 lbs. + .2% X-77 55-AR oil 80 gals. Diuron 8 lbs. + .2% X-77	7/2/64. 9/22/64, <b>2/24/65</b> . 4/28/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> . 11/10/65, 5/5/66, 9/1/66, 11/23/66.
6. Dalapon 10 lbs. Dalapon 10 lbs. + Ametryne 4 lbs. Paraquat 1 lb. + .2% X-77 Paraquat 2 lbs. + .2% X-77 55 AR oil 80 gals. Paraquat 2 lbs. + .2% X-77	7/2/64. 9/22/64. 2/24/65. 6/15/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> . 11/10/65, 5/5/66, 6/20/66, 9/1/66, 10/13/66, 11/30/66.
7. Diuron 4 lbs. + .2% X-77 55 AR oil 80 gals. Diuron 4 lbs. + .2% X-77	7/2/64, 9/22/64, 4/28/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> . 11/10/65, 5/5/66, 9/1/66, 11/23/66.
8. Paraquat 1 lb. + .2% X-77 55 AR oil 80 gals. Paraquat 1 lb. + .2% X-77	7/2/64, 9/22/64, 2/24/65, 6/15/65, <b>6/24/65</b> , <b>8/23/65</b> . 8/26/65, <b>9/29/65</b> . 11/10/65, 5/5/66, 6/20/66, 9/1/66, 10/13/66, 11/30/66.

Table 2-2. Banana yield data, Experiment No. 2

Treatment lbs. active/acre	May 26 to Dec. 31, 1965			Jan. 1 to Dec. 31, 1966	
	Lbs./ bunch	Hands/ bunch	Days to harvest <sup>2</sup>	Lbs./ bunch	Hands/ bunch
1. Check, oil (7) <sup>1</sup> , Check, mowed (4)	24.8	8.1	391c	38.3a	8.8
2. Ametryne 4 lbs. (7), oil (2)	26.1	8.2	386c	36.4a	8.6
3. Ametryne 8 lbs. (7), oil (2)	26.6	8.3	388c	35.8a	8.7
4. Atrazine 7.5 lbs. (1), Atrazine 4 lbs. (1), oil (2), Atrazine 8 lbs. (1), Paraquat 4 lbs. + X-77 (6)	24.8	7.7	440ab	30.1b	8.3
5. Atrazine 7.5 lbs. + Dalapon 10 lbs. (1), Dalapon 10 lbs. (1), Diuron 8 lbs. + X-77 (5), oil (1).	25.7	7.9	435 ab	31.3b	8.4
6. Dalapon 10 lbs. (1), Dalapon 10 lbs. + Ametryne 4 lbs. (1), Paraquat 1 lb. + X-77 (1), Paraquat 2 lbs. + X-77 (7), oil (1)	27.7	8.3	393c	35.1ab	8.8
7. Diuron 4 lbs. + X-77 (7), oil (1)	27.9	8.2	405bc	36.4a	8.8
8. Paraquat 1 lb. + X-77 (10), oil (1)	27.8	8.3	401bc	37.9a	8.7
	n.s.	n.s.			n.s.

<sup>1</sup>The numbers in parentheses refer to the number of treatment applications.

<sup>2</sup>Any means not followed by a common letter are statistically different at Duncans Multiple Range Test 5% level.

Table 2-3. Weed response to the herbicides, Experiment No. 2

Treatment lbs. active/acre	Subjective Weed Rating <sup>1</sup>	
	8/25/64 (8 weeks)	9/11/64 (10½ weeks)
1. Check, 55 AR oil 80 gals.	1.0	1.3
2. Ametryne 4 lbs.	3.7	4.0
3. Ametryne 8 lbs.	5.0	4.7
4. Atrazine 7.5 lbs.	3.7	3.5
5. Atrazine 7.5 lbs. + Dalapon 10 lbs.	4.7	4.8
6. Dalapon 10 lbs.	2.3	2.8
7. Diuron 4 lbs. + .2% X-77	4.0	4.0
8. Paraquat 1 lb. + .2% X-77	3.3	3.1
L. S. D. 5% (1%)	1.3 (1.9)	0.8 (1.1)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.



**Table 2-4. Weed response to the herbicides, Experiment No. 2**

Treatment lbs. active/acre	Subjective Weed Rating <sup>1</sup>	
	10/23/64 (4 weeks)	12/22/64 (13 weeks)
1. Check, 55 AR oil 80 gals.	4.1	2.2
2. Ametryne 4 lbs.	4.2	3.5
3. Ametryne 8 lbs.	4.7	4.3
4. Atrazine 4 lbs.	3.3	1.5
5. Dalapon 10 lbs.	4.0	1.7
6. Dalapon 10 lbs. + Ametryne 4 lbs.	3.8	2.8
7. Diuron 4 lbs. + .2% X-77	4.3	4.7
8. Paraquat 1 lb. + .2% X-77	4.2	2.6
L. S. D. 5% (1%)	n.s.	1.3 (1.8)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

**Table 2-5. Weed response to the herbicides, Experiment No. 2**

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (6/9/65) <sup>1</sup>				
		Crab- grass	Button- weed	Flora's paint brush	Jamaica vervain	Fine leaved celery
1. Check, 55 AR oil 80 gals.	19	4.0	5.0	5.0	5.0	5.0
2. Ametryne 4 lbs.	6	4.3	1.0	3.7	2.3	2.7
3. Ametryne 8 lbs.	6	4.7	1.7	3.7	4.0	2.3
4. 55 AR oil 80 gals. (Atrazine 8 lbs.)	16 (6)	(1.0)	(4.0)	(4.0)	(5.0)	(4.0)
5. Diuron 8 lbs. + .2% X-77	6	4.0	4.3	3.0	5.0	5.0
6. Paraquat 1 lb. + .2% X-77	16	3.0	1.0	2.3	5.0	4.0
7. Diuron 4 lbs. + .2% X-77	6	3.7	4.7	2.7	4.7	4.3
8. Paraquat 1 lb. + .2% X-77	16	3.0	2.7	1.0	4.3	4.3
L. S. D. 5% (1%)		0.7 (1.0)	1.1 (1.5)	0.9 (1.2)	1.1 (1.5)	1.2 (1.6)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 2-6. Weed response to the herbicides, Experiment No. 2

Treatment lbs. active/acre	Subjective Weed Rating (1/3/66 – 9 weeks)		
	Button- weed	Flora's paint brush	Fine leaved celery
1. Check, 55 AR oil 80 gals.	4.3	4.0	3.3
2. Ametryne 4 lbs.	3.3	4.3	3.3
3. Ametryne 8 lbs.	3.0	4.0	3.7
4. Paraquat 4 lbs. + .2% X-77	4.7	5.0	5.0
5. Diuron 8 lbs. + .2% X-77	4.7	4.3	5.0
6. Paraquat 2 lbs. + .2% X-77	4.3	4.3	4.7
7. Diuron 4 lbs. + .2% X-77	5.0	3.3	4.7
8. Paraquat 1 lb. + .2% X-77	4.0	4.3	4.7
L. S. D. 5% (1%)	0.8 (1.1)	0.8 (1.1)	1.0 (1.4)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 2-7. General summary of the relative tolerance of the weeds to post-emergence applications of the herbicides, Experiment No. 2

Chemicals	Weed Species			
	Crabgrass	Flora's paint brush	Button- weed	Fine leaved celery
Ametryne	S	I-S	T	T-I
Diuron + X-77	I-S	T-I	S	S
Paraquat + X-77	I-S	S	I-S	S

T = Weeds were tolerant to the herbicides.

I = Intermediate.

S = Susceptible.

### BANANA EXPERIMENT NO. 3

(Permanent file copy WC-60)  
Poamoho Experiment Farm Field H-3

- Banana variety: *Musa acuminata* (Dwarf Cavendish)
- Experimental design: Randomized complete block, 4 replications, plot size 10' x 32' (4 mats per plot).
- Experimental procedure: Plantation started April 27, 1964; initial herbicide treatments sprayed on December 3, 1964; experimental report terminated on December 31, 1966. The spray mix was directed to the base of the large plants but no attempt was made to keep the spray off the suckers. Eighty gallons of spray mix were applied per acre at 25 pounds per square inch of pressure. The detailed treatment dates are listed in Table 3-1.
- Weed species: Most prevalent: Grasses—crabgrass, foxtail, lovegrass, sandbur; Broadleaves—Flora's paint brush, popolo, purslane, smooth amaranth, Spanish needle, swinecress.
- Results: See Tables 3-1 to 3-10.

#### Discussion and Summary:

*Crop tolerance:* No injury or delay in harvest was experienced with the use of ametryne, dalapon, diuron, and paraquat when compared with the check treatment (Table 3-2). Atrazine was the lowest-yielding treatment, but it was only significantly different than the high-yielding diuron treatment. Leaf chlorosis was evident throughout the experimental period in the atrazine treatments, hence atrazine is not suggested for use on soils similar to the Wahiawa silty clay loam. Ametryne was definitely superior to atrazine because of its better weed control and complete absence of leaf chlorosis.

*Weed control:* Diuron 4 lbs./acre plus surfactant and ametryne at 4 to 8 lbs./acre resulted in excellent weed control under the test conditions. Although diuron afforded a longer-lasting weed control than ametryne, both chemicals are worthy of consideration for use in bananas. Paraquat at the higher rate of 1 lb./acre controlled many of the weeds effectively for periods of 6 to 8 weeks. The ametryne alone was equal in performance to the mixture of ametryne plus dalapon.

**Table 3-1. Treatment descriptions and dates of application, Experiment No. 3**  
**(All bold face dates represent the removal of weeds by shallow**  
**cultivation or mowing)**

Treatment lbs. active/acre	Date of Application
1. Check, oil 80 gals.	12/3/64 .
Paraquat 1 lb. + .5% X-77	2/24/65 .
Cultivated	3/16/65, 4/17/65.
Mowed	6/17/65, 8/13/65, 12/20/65, 2/3/66, 6/28/66, 8/24/66, 10/5/66, 11/18/66, 12/28/66.
2. Ametryne 4 lbs.	12/3/64 .
Ametryne 2 lbs.	3/16/65 .
Ametryne 4 lbs.	6/17/65, 12/20/65, 2/3/66, 6/28/66, 8/24/66, 11/16/66.
3. Ametryne 8 lbs.	12/3/64 .
Ametryne 4 lbs.	3/16/65 .
Ametryne 8 lbs.	6/17/65, 2/3/66, 6/28/66, 8/24/66, 11/16/66.
4. Atrazine 8 lbs.	12/3/64 .
Atrazine 4 lbs.	3/16/65 .
Cultivated	5/17/65 .
Atrazine 8 lbs.	6/17/65 .
Paraquat ½ lb. + .2% X-77	9/22/65, 11/5/65, 2/3/66, 3/31/66, 6/3/66, 6/20/66.
Paraquat 2 lbs. + .2% X-77	8/24/66, 10/5/66, 11/18/66, 12/28/66.
5. Diuron 4 lbs. + .5% X-77	12/3/64 .
Diuron 2 lbs. + .5% X-77	3/16/65 .
Diuron 4 lbs. + .2% X-77	6/17/65, 3/25/66, 8/24/66, 11/16/66.
6. Ametryne 4 lbs. + Dalapon 10 lbs.	12/3/64 .
Ametryne 2 lbs. + Dalapon 5 lbs.	3/16/65 .
Diuron 8 lbs. + .2% X-77	6/17/65, 3/25/66, 8/24/66, 11/16/66.
7. Paraquat 1 lb. + .5% X-77	12/3/64, 2/24/65.
Paraquat ½ lb. + .5% X-77	3/16/65, 5/17/65.
Paraquat 1 lb. + .2% X-77	6/17/65, 8/10/65, 9/22/65, 11/5/65, 2/3/66, 3/31/66, 6/3/66, 6/20/66.
Paraquat 4 lbs. + .2% X-77	8/24/66, 10/5/66, 11/18/66, 12/28/66.

Table 3-2. Banana yield data, Experiment No. 3

Treatment lbs. active/acre	May 5 to Dec. 31, 1965			Jan. 1 to Dec. 31, 1966	
	Lbs./ bunch <sup>2</sup>	Hands/ bunch	Days to harvest	Lbs./ bunch	Hands/ bunch
1. Check, oil (1) <sup>1</sup> , Paraquat 1 lb. + X-77 (1), cultivated (2), mowed (9)	43.4ab	7.7	452	40.0	7.0
2. Ametryne 2 lbs. (1), Ametryne 4 lbs. (6)	43.9ab	7.4	446	39.7	7.2
3. Ametryne 4 lbs. (1), Ametryne 8 lbs. (6)	46.4ab	7.7	448	42.8	7.2
4. Atrazine 4 lbs. (1), Atrazine 8 lbs. (2), Paraquat ½ lb. + X-77 (6), Paraquat 2 lbs. + X-77 (4).	36.1b	7.0	459	36.5	6.9
5. Diuron 2 lbs. + X-77 (1), Diuron 4 lbs. + X-77 (5)	49.4a	7.6	421	39.9	7.0
6. Ametryne 4 lbs. + Dalapon 10 lbs. (1), Ametryne 2 lbs. + Dalapon 5 lbs. (1), Diuron 8 lbs. + X-77 (4)	46.4ab	7.6	452	34.4	6.9
7. Paraquat ½ lb. + X-77 (2), Paraquat 1 lb. + X-77 (10), Paraquat 4 lbs. + X-77 (4)	44.0ab	7.6	430	38.5	7.0
		n. s.	n. s.	n. s.	n. s.

<sup>1</sup>The numbers in parentheses refer to the number of treatment applications.

<sup>2</sup>Any means not followed by a common letter are statistically different at Duncans Multiple Range Test 5% level.

Table 3-3. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	Subjective Weed Rating (1/26/65-7 weeks) <sup>1</sup>									
	Crabgrass	Lovegrass	Sandbur	Wiregrass	Flora's paint brush	Purslane	Smooth amaranth	Spanish needle		
1. Check, oil 80 gals.	4.5	4.3	4.3	4.8	5.0	4.8	4.8	3.3		
2. Ametryne 4 lbs.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		
3. Ametryne 8 lbs.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		
4. Atrazine 8 lbs.	4.3	4.5	4.8	5.0	5.0	5.0	5.0	5.0		
5. Diuron 4 lbs. + .5% X-77	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		
6. Ametryne 4 lbs. + Dalapon 10 lbs.	5.0	4.8	4.8	5.0	5.0	5.0	5.0	5.0		
7. Paraquat 1 lb. + .5% X-77	5.0	3.8	4.0	4.3	4.8	4.8	4.3	3.3		
L. S. D. 5% (1%)	0.4(0.6)	n. s.	0.7(0.9)	n. s.	n. s.	n. s.	0.4(0.5)	1.1(1.5)		

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 3-4. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	No. of Weeds/sq. ft. (2/17/65-11 weeks)			
	Crabgrass	Lovegrass	Wiregrass	Spanish needle
1. Check, oil 80 gals.	0.37	2.06	1.31	0.75
2. Ametryne 4 lbs.	0.06	0.37	0.19	0.00
3. Ametryne 8 lbs.	0.00	0.44	0.00	0.00
4. Atrazine 8 lbs.	0.25	0.00	0.06	0.00
5. Diuron 4 lbs. + .5% X-77	0.00	0.00	0.00	0.00
6. Ametryne 4 lbs. + Dalapon 10 lbs.	0.00	0.75	0.81	0.13
7. Paraquat 1 lb. + .5% X-77	0.25	3.31	2.18	1.19
L. S. D. 5% (1%)	n. s.	n. s.	1.48(2.02)	1.01(5.52)

Table 3-5. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	Subjective Weed Rating (5/6/65-7 weeks) <sup>1</sup>									
	Crabgrass	Lovegrass	Sandbur	Wiregrass	Purslane	Smooth amaranth	Spanish needle	Swinecress		
1. Check, cultivated	1.8	2.0	3.5	1.3	1.5	2.3	1.5	4.0		
2. Ametryne 2 lbs.	5.0	4.3	5.0	5.0	5.0	5.0	5.0	5.0		
3. Ametryne 4 lbs.	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0		
4. Atrazine 4 lbs.	1.8	3.8	5.0	5.0	5.0	5.0	5.0	5.0		
5. Diuron 2 lbs. + .5% X-77	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		
6. Ametryne 2 lbs. + Dalapon 5 lbs.	5.0	5.0	4.5	4.8	5.0	4.5	5.0	5.0		
7. Paraquat ½ lb. + .5% X-77	2.8	2.3	2.8	1.8	2.0	2.5	2.3	3.0		
L. S. D. 5% (1%)	1.3(1.8)	1.3(1.8)	1.7(2.3)	0.9(1.3)	1.1(1.4)	1.6(2.2)	1.2(1.6)	1.4(1.9)		

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.



Table 3-6. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	Subjective Weed Rating (8/10/65-8 weeks) <sup>1</sup>			
	Crabgrass	Wiregrass	Smooth amaranth	Spanish needle
1. Check, mowed	2.0	1.3	1.5	2.0
2. Ametryne 4 lbs.	5.0	4.8	5.0	5.0
3. Ametryne 8 lbs.	5.0	5.0	5.0	5.0
4. Atrazine 8 lbs.	2.0	4.3	5.0	5.0
5. Diuron 4 lbs. + .2% X-77	5.0	5.0	5.0	5.0
6. Diuron 8 lbs. + .2% X-77	5.0	4.8	5.0	5.0
7. Paraquat 1 lb. + .2% X-77	3.5	3.8	5.0	4.5
L. S. D. 5% (1%)	1.9(2.6)	0.8(1.1)	0.5(0.6)	1.2(1.7)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 3-7. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (9/22/65) <sup>1</sup>					
		Crab- grass	Sand- bur	Wire- grass	Purs- lane	Smooth amaranth	Spanish needle
1. Check, mowed	6	1.0	1.0	1.0	1.0	1.3	1.3
2. Ametryne 4 lbs.	14	3.8	5.0	4.5	5.0	5.0	5.0
3. Ametryne 8 lbs.	14	4.8	5.0	5.0	5.0	5.0	5.0
4. Atrazine 8 lbs.	14	1.8	4.5	5.0	5.0	5.0	5.0
5. Diuron 4 lbs. + .2% X-77	14	5.0	5.0	4.8	5.0	5.0	5.0
6. Diuron 8 lbs. + .2% X-77	14	5.0	4.5	5.0	5.0	5.0	5.0
7. Paraquat 1 lb. + .2% X-77	6	4.8	5.0	4.3	4.3	5.0	5.0
L. S. D. 5% (1%)		1.0(1.4)	0.8(1.1)	0.5(0.6)	0.3(0.4)	0.3(0.4)	0.3(0.4)

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 3-8. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (11/5/65)								
		Crab- grass	Fox- tail	Love- grass	Sand- bur	Wire- grass	Popolo	Purs- lane	Smooth amaranth	Spanish needle
1. Check, mowed	12	2.8	2.5	2.8	2.5	1.3	2.3	2.3	2.3	1.5
2. Ametryne 4 lbs.	20	4.3	3.0	5.0	4.8	4.3	4.5	5.0	5.0	4.8
3. Ametryne 8 lbs.	20	5.0	4.0	5.0	4.3	4.0	5.0	5.0	5.0	5.0
4. Paraquat ½ lb. + .2% X-77	6	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
5. Diuron 4 lbs. + .2% X-77	20	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0
6. Diuron 8 lbs. + .2% X-77	20	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
7. Paraquat 1 lb. + .2% X-77	6	4.8	4.0	5.0	4.5	4.5	4.5	4.3	4.3	4.3
L. S. D. 5%		1.6	1.6	1.2	1.4	1.9	1.2	1.1	1.1	0.8
L. S. D. 1%		2.1	2.1	1.6	1.9	2.6	1.6	1.4	1.4	1.1

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

Table 3-9. Weed response to the herbicides, Experiment No. 3

Treatment lbs. active/acre	No. of weeks after treatment	Subjective Weed Rating (2/3/66) <sup>1</sup>							
		Crab- grass	Fox- tail	Love- grass	Sand- bur	Wire- grass	Purs- lane	Smooth amaranth	Spanish needle
1. Check, mowed	6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2. Cultivated	6	2.0	3.8	2.8	4.8	3.0	4.8	5.0	4.0
3. Ametryne 8 lbs.	33	2.5	4.0	3.8	3.8	3.5	4.0	3.8	3.5
4. Paraquat ½ lb. + .2% X-77	13	3.3	3.3	3.8	5.0	3.8	4.5	4.5	4.3
5. Diuron 4 lbs. + .2% X-77	33	4.0	5.0	4.5	5.0	4.5	5.0	4.8	4.5
6. Diuron 8 lbs. + .2% X-77	33	4.5	5.0	4.8	5.0	5.0	5.0	4.5	5.0
7. Paraquat 1 lb. + .2% X-77	13	4.0	4.8	2.8	4.0	3.5	3.0	4.0	3.0
L. S. D. 5%		1.6	1.3	1.2	1.5	1.2	1.2	1.1	1.7
L. S. D. 1%		2.1	1.8	1.7	2.0	1.7	1.6	1.4	2.2

<sup>1</sup>Rating scale: 1 = no control, 2 = slight, 3 = fair, 4 = good (commercially acceptable), 5 = complete control.

**Table 3-10. General summary of the relative tolerance of the weeds to post-emergence applications of the herbicides, Experiment No. 3**

Chemicals	Weed Species									
	Crab-grass	Fox-tail	Love-grass	Sand-bur	Wire-grass	Purs-Popolo	Smooth lane	Spanish amaranth	Spanish needle	Swine-cress
Ametryne	S	I-S	I-S	S	S	S	S	S	S	S
Atrazine	T-I		S	S	S	S	S	S	S	S
Diuron + X-77	S	S	S	S	S	S	S	S	S	S
Paraquat + X-77	S	S	I-S	S	I-S	S	S	S	I-S	I

T = Weeds were tolerant to the herbicides.

I = Intermediate.

S = Susceptible.

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