9. Plant foods consumed varied according to their availability on the basis of both season of the year and the extent and depth of water. The amount and distribution of rainfall are important in this latter respect.

10. Animal matter was consumed principally during spring and summer periods.

11. Ingested lead shot occurred in a minimum of 5.5 percent of the gizzards examined.

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A REPORT ON EXPERIMENTAL CONTROL OF GIANT CUTGRASS (Zizaniopsis miliacea), 1950-1954

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On Reelfoot Lake, giant cutgrass (*Zizaniopsis miliacea*) is the chief pest plant. It occupies more than 2,000 acres which, from a wildlife management standpoint, could be better utilized by desirable food plant species, particularly waterfowl food plant species. It is the dominant perimental plant in all areas not shaded by such species as baldcypress (*Taxodium distichum*), willow (*Salix* spp.) and buttonbush (*Cephalanthus occidentalis*). In sheltered pockets and shallow marsh localities, its rank growths stretch from shoreline to shoreline. Presumably giant cutgrass thrives in water depths of not more than 30 inches, but on Reelfoot it is not unusual along channel banks to find heavy stands in five feet of water. By late September as the water levels drop, the blades often extend seven feet above the waterline.

Its seeds are used to some extent by waterfowl, but in view of the heavy production—which is greatest along the outer stand margins—utilization is not what might be expected from desirable plants. Giant cutgrass rootstocks are fed upon to some degree by muskrats (*Ondatra zibethica*). Its greatest animal use, however, is as roosting cover for the many millions of blackbirds that choose Reelfoot for a wintering ground. Fish fry find protection in the spring among the flooded grass blades and stubble, but other preferred plant species would serve this same purpose with the additional value of furnishing food for migrant waterfowl.

As the lake bed shallows from deposition of sediment washed in from surrounding farms and bluffs and roadsides, giant cutgrass encroaches these filled areas. Opinions vary among old time residents, guides and local fishermen as to the spread or recession of giant cutgrass. Apparently there is reason for disagreement. The writer during the past five years has noted a decrease in some areas and an extended encroachment in others. Soft, mucky bottoms are the favored growth sites, but hard, windswept sandbars are far from free of cutgrass. On the less choice sites, however, the rank growths and extreme heights of cutgrass blades are not so evident. Probably the most extensive growths are found in the lake area known as Grassy Bend.

In 1950, Pittman-Robertson Project Number W-19-D was set up to include experimental research using herbicides in an attempt to effect a feasibly economic control of giant cutgrass. This project phase was later incorporated in Pittman-Robertson Project Number W-22-R and continued for four years, with additional observations on previous experimental results noted in 1955.

Underwater mowing with a Hockney type cutter had been tried prior to 1950, and had not proved satisfactory. Burning following the close of waterfowl season held some slight promise, but high water levels ordinarily preclude this management tool. By the time the cutgrass blades are sufficiently dead for burning, winter rains have raised lake levels well over cutgrass rootstocks and burning has little effect. Limited herbicide experimentation had been previously attempted, but results were largely of a negative nature. Hence, it was decided to "start from scratch."

All available literature was reviewed and studied, major herbicide manufacturing companies were contacted for suggestions and individuals in other regions who had had some experience with herbicide treatment of giant cutgrass were asked for information regarding their experiments. Forthcoming information was limited and discouraging.

Because of adverse weather conditions during the recommended spraying season (August 15 to September 15), only 14 plats were treated in 1950. These plats, as were all experimental plats, were set up as 100 square feet plats with 50 square feet control strips between. Plats were sprayed on foot or from boat depending on water levels. Sprayers were Hudson Orchard pressure sprayers. All chemicals were weighed carefully on postal scales or measured in graduated cylinders. Sufficient detergent (Tide, Dreft, or DuPont Spreader Sticker) was added to each solution to insure adherence to plant portions. Water was used as a base carrier in all cases not otherwise noted. Concentrations are given in strength per gallon of water or oil as the case might be, rather than in strength per acre. This is done because of the varying density of giant cutgrass stands—some acreages requiring heavier application than others. Complete blade coverage was attempted. No plats were treated in cloudy weather or when it appeared that less than three hours full sunlight would follow application. Notes were made of each plat with regard to water depth, soil type, air temperature, wind, blade heights, etc. In all subsequent experiments, this procedure was followed.

The 14 plats treated in 1950 gave the following results:

TABLE I

RESULTS OF GIANT CUTGRASS TREATMENT IN 1950 WITH 2, 4-D

Percent Concentration of 2, 4-D Per Gallon of Water	*Estimated Percent Kill*
.4	10–15
.6	15–20
.8	40–50
1.0	60–70
1.2	80–90

Examinations the following year indicated that even in the higher kill brackets of 1950, in 1951 regrowth was extensive enough to disregard the 1950 results as being impractical.

In 1951, 140 plats were treated with varying strengths of 2, 4-D, 2, 4, 5-T and ammonium sulphamate (Ammate) in single and combination sprayings. Twenty-six plats were set up as permanent plats and were sprayed with the most promising solutions in an oil and water base. See Tables II-VIII.

The following comments and observations were made at the close of the 1951 spraying season:

The spraying season for cutgrass, is so far as we now know, is brief—August 10-September 15. Conditions for best results must be near perfect and in this area are quite rare. There should be three hours of sunlight after a spray application is made in order for the plant to absorb the chemical through normal photosynthetic processes. The relative humidity should be high to avoid rapid evaporation and resultant loss from volatile action. A strong wind is both good and bad; good in that it aids coverage, bad in that it increases evaporation rate and may cause too great a dispersion.

Plants which are located in areas of low soil moisture content draw heavily from air moisture and transport such moisture to their roots. Conversely, plants with sufficient soil moisture have an upward streaming. Thus, in aquatics it is extremely difficult to obtain an adequate translocation of lethal chemical material to the root.

Spraying results are affected by human error, thoroughness of coverage and even the strength of the original chemical is subject to manufacturer's error and purity and deterioration of stock. At times, and for no apparent reason, the same chemical solution applied within minutes of the preceding will result in varying responses.

This past season 140 experimental plats were set up and sprayed by the project leader with various chemical solutions of 2, 4-D, 2, 4, 5-T and ammonium sulphamate (Tables II-VII). From the results of these experiments, solutions showing the most promise of success from both a "grass killed" and economic standpoint were selected and sprayed on 26 permanent plats (Table VIII).

Under no circumstances were double applications found to be of greater value than the sum of their combined strengths or the lethal effect of the more potent. Indeed it is possible that slight solution of 2, 4-D decreases the effect of a subsequent spraying with Ammate, possibly due to the invigorating effect of light dosages.

Both the 2, 4-D and 2, 4, 5-T were of 37% or 3.34 pounds per gallon acid equivalent and Ammate contained 80% active ingredients. From preliminary results, it appears that a killing strength of 2, 4-D must be in the neighborhood of at least 2.0%, 2, 4, 5-T about 2.5% and Ammate about ½ to ¾ pound per gallon, all dependent on the degree to which the plant is covered. Considering the costs of the chemicals on a 100-gallon water base solution, 2, 4, 5-T would be about $30.32, 2, 4-D, $13.34 and Ammate about $9.24. Costs of the chemicals will, of course, vary with supply and demand and purchase quantity, to say nothing of continuing inflation.

Coverage from 100 gallons will vary with the density of the cutgrass, wind velocity, method of application and the person applying. As a very rough guess, one might presume that under average conditions 100 gallons will cover about two acres. The more thorough the coverage, the more complete the kill.

Of the three chemicals, it was noted that 2, 4, 5-T indicated a tendency to kill only to the water line; Ammate gave a faster and more complete translocation of kill to or below the water line; and 2, 4-D was very inconsistent in results.

With regard to this latter, it can be noted from a comparison of 2, 4-D solutions in water chosen for permanent plats (Table VIII) and the same solutions as originally sprayed (Table II) that the results are greatly different. This may be due in part to the fact that the permanent plats were sprayed later in the season when perhaps the vulnerable stage for this particular chemical was passed. However, excellent results were obtained when the same amounts of 2, 4-D were used in an oil base. The 2, 4, 5-T and Ammate responded on the permanent plats about as was expected from preliminary experiments.

However, one thing of the utmost importance must be stressed. Merely obtaining an apparent grass kill, even below the water line, means relatively little. To be deemed an adequate answer to the problem, the ROOTS of the plant must sustain a definite kill. With this in mind, 26 permanent plats were erected and sprayed. They are 100 feet long, 50 feet for spraying and 50 feet for a control. They are staked and wired so that next season it will be possible to determine whether or not the treated grass will come up again beneath the wires. If it does not, we may have an answer; if it does, we will still be looking for a control.

But in light of knowledge now on hand, Ammate seems to hold the greatest possibilities. And as pointed out, no double spraying in view of additional labor costs is believed to be advantageous. Also, chemical strengths increased beyond those used on permanent plats gave no greatly increased kill, merely a slightly broader coverage. And this was narrow at best since experimental plats were treated with hand sprayers.

With regard to the results given in the tables, it is realized that the terms are ambiguous, but considering their nature, a broad interpretation must be given. Percentages were obtained from comparing in an area of average spray results those grass blades in the best of spray which were untouched, spotted or killed but a few inches from their apices, with those blades in the same belt which revealed kill to or below the waterline.

All spraying operations were performed under conditions as much alike as possible and always with adequate sunlight. The diesel fuel was used in order to compare results of the oil and water bases. The oil reduces and slows evaporation and is in itself to some extent toxic, but the increase in cost over the water base appears not to be offset by increased efficiency.

Ammonium sulphamate is, of course, not soluble in oil; nevertheless, small quantities (Table VIII) were placed in oil and sprayed to obtain the results of such a combination. They were poor.

Cutgrass beds are so thick and extensive that a boat with power spray cannot push through them. For this reason, if one of the solutions under thought proves of value, a helicopter may be employed in the future to cover or open these inaccessible areas. Power sprays can then be used for smaller areas and touch up work.

In 1952, additional chemicals were obtained and tried with results (Tables IX-XVI) and observations given below.

Dow Chemical Company made available ten pounds of Dow Sodium TCA 90%; Dupont furnished ten pounds of 25% CMU pellets and ten pounds of 80% CMU powder, and Pittsburgh Agricultural Chemical Company contributed five gallons of Brush Killer No. 22. In addition, Borascu and Polybor-chlorate 88 were purchased from Chapman Chemical Company and tested on giant cutgrass. The results of these tests are given in Tables IX through XIV.

CMU, a wettable powder containing 80% 3-(p-chlorophenyl)-1, 1-dimethylurea as the active ingredient, was mixed in water in concentrations ranging from 1/16 pound per gallon to 1½ pounds per gallon, Table IX. CMU appears to hold no promise of giant cutgrass control. Regardless of the fact that entire leaf blades were thoroughly sprayed on the 100 square foot plats, the first affected part of the blade was the apex. CMU appears to bleach the blade, possibly removing chlorophyll. This bleaching effect progresses downward from the apex as concentrations are increased, but in no case was progression to and involving the rootstock evidenced. In view of this fact and the additional fact of its great cost, estimated at $3.50 as of July 25, 1952, CMU powder is not recommended in giant cutgrass control.

CMU pellets, containing 25% active ingredients, were broadcast by hand over eight plats in quantities varying from one ounce to 1½ pounds per 100 square feet (Table X). Only in concentrations of 12 ounces per 100 square feet was there any indication of the plant being affected. Then, as with CMU powder, it was the apices of the blades. Extent of bleaching at maximum was 18 inches from apex downward on the average five foot blade. CMU pellets are not recommended in giant cutgrass control.

TCA, a wettable powder containing 90% sodium trichloroacetate, was sprayed on six 100 square foot plats in quantities ranging from ¼ pound per gallon of water to two pounds per gallon (Table XI). On preliminary plats treated August 10, 1952, only a 20% kill was obtained for the highest concentration used. However, on the permanent plats which will be discussed later, an 80% kill was obtained for the 1½ pounds TCA per gallon of water solution. The reason for this inconsistency is not fully understood. Soil type, sand-muck, was the same; water depth average only about two inches less; and weather conditions during spraying were the same. It may be that the TCA sprayed on permanent plats September 9, 1952, more closely approximated the period of greatest toxicity for this particular chemical. In view of the disparity in experimentation results, it is recommended that TCA be further subjected to tests on giant cutgrass.

Brush Killer No. 22, containing low volatile tetrahydrofufuryl esters of 2, 4-Dichlorophenoxyacetic acid (28.9% total volume) and 2. 4, 5-Trichlorophenoxyacetic acid (27.8% total volume) and inert ingredients of 43.3%, was sprayed in a water base solution on nine plats. Concentrations varied from one ounce per gallon to 32 ounces per gallon, Table XII. On preliminary testing, an 80% kill was obtained from the 20 ounce solution, but on permanent plats, as with TCA, a variance was noted. Here a 95% kill was obtained using an eight ounce solution. Again as with TCA the difference is not understood, and it is recommended that further experimentation be made with Brush Killer No. 22.

Polybor-chlorate, a wettable powder, was sprayed in a water base solution on ten plats in concentrations ranging from one to ten pounds per gallon per 100 square feet (Table XIII). A 70% kill was obtained at the lowest concentration used, one pound per gallon. This increased to 90% at the 2½ pound dosage. Strengthening the solution beyond this point seemed of little value. Polybor-chlorate appears to have definite possibilities for control of giant cutgrass and rivals or exceeds Ammate both in cost ($10.90 per cwt. as compared to $16.75 per cwt.) and in effectiveness.

Borascu, a gritty-like substance, was broadcast by hand over five 100 square foot plats in quantities from 5 to 25 pounds per plat, Table XIV. Only on the plat receiving 25 pounds of Borascu were effects to giant cutgrass noticed. Here the apices were affected as with CMU, but to a far lesser extent. On the 25 pound plat they were bleached for only one inch.

Treated plats were kept under close observation until October 15, when early frosts so colored giant cutgrass that it was difficult to distinguish frost kill from contact herbicide kill. No increase in kill was noted, however, two weeks after the original spray applications. Soil type in most cases was sand with a light muck or debris covering. Water depth averaged about two feet. These preliminary plats were sprayed August 19, 20 and 27 in temperatures averaging about 88° F. These days were clear with no wind.

To correlate with Steenis' suggestion as to period of greatest vulnerability to contact herbicides, giant cutgrass was treated with Ammate (the previous year's best giant cutgrass herbicide) in dosages of ¾ pound per gallon of water, spraying one plat a week, from June 21 until August 16 and at the rate of one pound per gallon from September 20 to October 1. The dosage was increased as indicated in an attempt to offset the presumed lateness of the spraying season. Results of these sprayings are given in Table XV. The gap from August 16 to September 20 had been shown to be a period of vulnerability of giant cutgrass to Ammate. It is realized that this period of greatest effect may not be the same for all chemical formulations on this particular plant. But Ammate, being the most promising herebicide until this year, was a logical choice and may well serve the purpose. From this weekly experimentation, it appears that August 2, when giant cutgrass has usually completed heading, until September 25, when cool weather in this area and natural processes of the plant cause it to become less active, brackets the most opportune period for contact herbicide spraying. As has been pointed out, though, this period may vary with other herbicides.

The most promising solutions of each chemical tried, with the exception of Polybor-chlorate, were sprayed on the same type permanent plats described earlier in this report. Since Polybor-chlorate offered such promise, concentrations in less quantity than those used on preliminary plats were sprayed on permanent plats. Promising preliminary solutions of Polybor-chlorate were also used. For results of these permanent plat sprayings, see Table XVI.

Three chemicals of the six formations used showed some promise, but tentatively, an economic comparison seems to narrow the selection to one. Of the three, two (Brush Killer No. 22 and TCA) require further experimentation as had been previously pointed out. The other, Polybor-chlorate, needs little refinement except for determining its most effective use period unless future results do not live up to present expectations.

The three herbicides in quantities which gave 80-90% kill on permanent plats when compared on a cost basis per 100 square feet are as follows: eight ounces Brush Killer No. 22, $0.604 when purchased in 55 gallon drums at $9.70 per gallon; one pound Polybor-chlorate, $0.109 when purchased in 50 pound bags in lots of 40 or more; two pounds TCA, $0.79 when purchased in 100 pound drums. It must be realized that results on Brush Killer No. 22 and TCA were too erratic for accuracy and that with further refinement of experimentation the above comparison may be grossly inaccurate. There was an increase from 30 to 90% kill on the preliminary to permanent plat for Brush Killer No. 22, an increase from 20 to 90% for TCA, and a slight increase from 80 to 90% for Polybor-chlorate. It is not impossible that these formulations produce their most lethal effects at a time later than that of Ammate. This latter chemical which showed the greatest promise during the 1951 season on a cost-result comparison would be: one pound Ammate, $0.155, when purchased in 350 pound barrels.

Thus, in view of these experiments and temporarily discounting the discrepancies in Brush Killer No. 22 and TCA results, Polybor-chlorate and Ammate appear to offer the greatest economically lethal control of giant cutgrass. Lasting effects cannot be checked until next summer when permanent plats will be closely scrutinized.

Results on permanent plats from 1953 observations may alter the entire picture brought out above. This happened when 1952 observations were made on 1951 permanent plats. Of the three chemicals used on the 1951 plats, 2, 4-D, 2, 4, 5-T, and Ammate, only the Ammate in concentrations of ½, 1¼, and 1½ pounds per gallon of water produced results consistent with excellent kill observations made following treatment. Fair residual effects were observed in 1952 for plats sprayed in 1951 with 2, 4-D in 2½ and 3½% (3.37 pounds acid equivalent per gallon) concentrations using a diesel oil base. This would make the cost of 2, 4-D treatment per 100 square feet at least approximately $0.20 plus the cost of diesel fuel, a total perhaps of $0.34. All costs, of course, will vary with supply and demand and the ever increasing cost of living.

In 1953, in cooperation with the Fish and Wildlife Service, the lake level was dropped 1.2 feet in an effort to expose cutgrass rootstocks and thus create "a spraying on dry ground situation." Due to inadequate lake drainage beyond the spillway gates, this drop was experienced only after the spillway gates had been open from late August until they were directed to be closed on October 1. Hence, for the critical Ammate spraying season, rootstocks were not exposed. In a few isolated situations where cutgrass was exposed to and below the rootstock, a 100% kill was obtained when sprayed with Ammate, one pound per gallon of water.

Results (Tables XVII-XIX) of experimental herbicide treatment on giant cutgrass in 1953 are presented below:

Herbicide control of giant cutgrass during the summer and fall of 1953 was limited entirely to chemicals previously used since inquiries to various chemical companies had produced no information relative to new formulations which might feasibly be used on giant cutgrass.

As shown in Table XVII, three chemical formulations showing promise in 1952 were applied from June 24 to October 31 in an attempt to determine the most vulnerable giant cutgrass period to those chemicals and to try to correlate cutgrass height, water depth, soil habitat type, and anthesis. As in previous cutgrass experimentation, results were somewhat erratic. It does appear, however, that better results are obtained when water depth in which the cutgrass is growing is one foot or less in depth and the peak of anthesis is over. Although scattered blooming and heading were noted until the middle of October, the peak was concluded by the first of July. From that time onward, only the outer scattered cutgrass patches evidenced anthesis. During the peak, the marginal periphery heads profusely with scattered heading in the dense inner growths. Low water seems to benefit this interior heading.

The 1953 spraying season was one of very low water levels and extremely mild weather which prevailed through October. That in part probably accounts for the excellent apparent results obtained in October when normally poor to fair apparent results can be expected from late September onward. However, permanent plats sprayed October 27, for the most part, gave poor results, Table XIX. This may be a reflection of the fact that these plats had been situated in dry areas since the middle of August. Permanent plats sprayed August 29, Table XVIII, with the exception of CMU, all resulted in excellent apparent kills. All experiments with CMU have given poor kills. Plats listed in Table XVIII had been in dry situations only a short time in contrast with those listed in Table XIX.

Soil types in which cutgrass thrives on Reelfoot Lake are sand, sand-muck, or muck. Soil type appears to play a minor part in herbicide kill for this pest plant.

All plats were 100 square feet in area with 50 square feet control plats between. The same amount of each chemical was used each time and was mixed and applied by the same individual with the same type spray equipment, Hudson Orchard pressure sprayers. Air temperatures during time of spraying averaged 80° F., water temperatures about the same. All sprayings were made on clear days with at least eight hours of following sunlight. Plats were kept under constant observation until November 15, when killing frosts and natural plant processes were discoloring giant cutgrass blades until little differentiation could be observed from herbicide effects.

As water levels continued to recede in late fall, large clumps of cutgrass rootstocks, by which they primarily propagate, were exposed. This rootstock exposure and the following access by contact sprays to entire cutgrass blades may be another factor in addition to mild weather and low water which influenced late October kills.

In early sprayed areas where little kill was noted, Table XVII, two effects were noted—an increase in heading in inner marginal areas possibly due to a fertilization effect of hormones in the chemical applications or the retardation of surrounding growths which previously denied full sunlight to the plant, and a stunting of outer (lakeside) new growth. Falling water levels also probably contributed to the stunting effect. New growth usually is apparent in early sprayed areas about six weeks after herbicide application. Except for slow acting herbicides such as CMU no further lethal action is apparent three weeks after treatment.

Of the three herbicides selected from 1952 experimental results and whose 1953 results are shown in Table XVII, Brush Killer No. 22, containing low volatile tetrahydrofufuryl esters of 2, 4-Dichlorophenoxyacetic acid (28.9% total volume) and 2, 4, 5-Trichlorophenoxyacetic acid (27.8% total volume) and inert ingredients of 43.3%, gave the most erratic and poorest overall results.

TCA, a wettable powder containing 90% sodium trichloroacetate, produced fairly consistent results with regard to those results achieved by the other two chemicals and for the most part gave excellent kills from September 12 on, Table XVII.

Polybor-chlorate, made up of sodium pentaborate 44%, sodium tetraborate 11%, sodium chlorate 22%, an dinert ingredients 23%, produced the most comparatively constant relative results and gave excellent kill ratings from September 5 onward. In 1952, this same chemical applied in the same rates was giving excellent results in late August. On a cost-efficiency basis, Polybor-chlorate, of all herbicides thus far used, is recommended for giant cutgrass control. This formulation sells for approximately $11.00 per 100 pounds.

However, this project leader does not consider Polybor-chlorate the final answer and does not intimate that results obtained in other areas under different conditions from those experienced at Reelfoot will be the same.

It should be further understood that all results categorically listed in Table XVII are APPARENT results and cannot be considered definite and thorough KILL results. Apparently the entire grass blade may be dead and the rootstock affected, but if next spring it develops that the residual rootstock is capable of producing heavy blade growth, the apparent kill means little more than temporary reduction in grass height obtained by mowing one's lawn.

For the above reasons, permanent plats have been set out in previous years as well as the past season. Such plats in the lake proper are permanent in name only. Passing fishermen needing stakes for trotlines or hoop nets pull them indiscriminately; sport fishermen anchor to and break them off in rough water; ice and high water take their toll; and changing water levels of an unusual nature disrupt herbicide effects. On August 29, 1953 (Table XVIII) permanent plats were erected on the north side of the borrow pit directly in front of project headquarters. Here they can be under year-round supervision of the project leader and should indeed be permanent plats. Though they were sprayed when the water level had withdrawn from the giant cutgrass rootstocks, the results obtained should be indicative of what might be accomplished if the lake level could be drawn down to a comparative cutgrass level. Permanent plats continually in an aquatic situation are another problem. In Table XVIII it will be noted that all chemicals used except CMU gave excellent results apparently. When new growth begins next spring, apparent results should be revealed as actual results, either more or less than previously noted.

Permanent plats were set up as shown in Table XIX as a check against the seemingly excellent results obtained from late lake plat spraying. These plats are located in the same area and conditions applying to those plats discussed in Table XVIII will apply for plats listed in Table XIX.

Results (Tables XX through XXII) and observations and comments on these experiments are given below:

In August and September of 1954, 36 additional experimental giant cutgrass plats were set up along the edges of a dry borrow pit located directly in front of project headquarters. These plats contain approximately 100 square feet of cutgrass with a 50-square foot control strip separating them. Each formulation applied was used on the basis of 100 square feet coverage: hence, the concentration given in Table XX can be assumed to be "amount of herbicide per 100 square feet." Twelve of these plats were treated with chemicals used in 1953 dry ground plat tests to check the 1953 results. It should be understood that apparent results at the end of the first spraying season do not necessarily reflect the permanent results. This is clearly shown in Table XXII.

In Table XXII it can be noted that apparent results at the end of the 1953 season were excellent for all herbicides except CMU. However, at the close of the 1954 season, a close check having been kept on the 1953 plats, only 2, 4, 5-T, TCA, and CMU powder had an excellent rating. All other plats evidenced heavy regrowth. CMU, which at the close of the 1953 season showed no great promise, gave the most complete control on dry ground giant cutgrass plats. Absolutely no regrowth in the treated area was observed. TCA and 2, 4, 5-T also prevented most regrowth.

In past experiments, however, these three chemicals which showed up so well on dry plats produced varying results on aquatic plats. TCA, Polybor-chlorate and Brush Killer No. 22 have given the best results where giant cutgrass was growing in water up to 18″ deep. Results from 2, 4, 5-T and CMU powder on aquatic plats were only "fair" at best. From the above, it would appear that there are definite differences in translocating properties of the herbicides used with relation to aquatic or dry situations. Because experimental herbicide results are often so erratic, tests using the same formulation concentrations used in 1953 were repeated in 1954. It is hoped that these "tests on tests" will aid in substantiating the information outlined above.

Dalapon and Kuron, Dow Chemical Company products, were used singly and in combination on both aquatic and dry plats to test their effectiveness against giant cutgrass. These herbicides were furnished gratuitously. Dalapon, a 2-2-(Dichloropropionic) 68% acid equivalent formulation, gave excellent apparent results in concentrations of at least eight ounces per gallon of water per 100 square feet on dry ground plats (Table XX) and in concentrations of 36 ounces per gallon of water per 100 square feet on aquatic plats (Table XXI). Kuron, a combination of low volatile esters of 2-(2, 4, 5-Trichlorophenoxy) propionic, acid equivalent 42.8 percent, produced excellent results in concentrations of four ounces per gallon of water per 100 square feet on dry plats (Table XX), but was rated as only "good" on aquatic plats in concentrations up to 16 ounces per gallon of water per 100 square feet. Dalapon and Kuron used in combination gave excellent apparent results in minimum combination of four ounces of Dalapon and one ounce of Kuron per gallon of water per 100 square feet on dry plats (Table XX), but on aquatic plats gave no better rating than "fair" in any combination (Table 21). Dalapon-TCA combinations (Tables 20 and 21) gave a poored kill than would be expected from TCA alone, both on aquatic and on dry plats.

Chlorax liquid, containing 18.2 percent of Sodium chlorate and 10 percent sodium metaborate gave excellent results in concentrations of one pint per gallon of water per 100 square feet on dry plats (Table XX), but only fair at four pints. On aquatic plats, Chlorax liquid produced excellent results (apparent) at concentrations of 48 ounces per gallon of water per 100 square feet. Chlorax powder, containing 43 percent sodium chlorate and 53 percent sodium pentaborate, gave excellent apparent results in concentration of 12 ounces per gallon of water per 100 square feet on dry plats and at a three pound per gallon rate for aquatic plats. Chlorax liquid and powder were furnished gratuitously by Chapman Chemical Company.

Since apparent results have little meaning in actuality, no attempt at cost comparison will be made until apparent results can be checked in 1955 against those observed in 1954. It can be stated that from examinations and observation thus far that for dry plats, CMU, a DuPont product containing 80 percent 3-(p-chlorophenyl)-1, 1-dimethylurea, gives the best results, but the cost at present, $3.50 a pound, precludes its use on a large scale for the Reelfoot Lake area. For aquatic plats, Polybor-chlorate, at approximately $0.115 per pound, a Chapman Chemical Company product, containing sodium pentaborate 44%, sodium tetraborate 11%, sodium chlorate 22%, and inert ingredients 23%, gives the most economical possibilities and at the same time, results. It may develop future observations on Dalapon, Kuron, and Chlorax liquid and powder will reveal possibilities not presently apparent.

It should be noted also that apparent results, if not closely followed, may reveal an excellent kill, but closer and subsequent examinations often show new and fresh growth thriving beneath the dead outer leaf sheaves. This plainly indicates a poor or negligible root kill. Lateness of seasonal spraying using Kuron and Dalapon may have restricted their effectiveness, but a delayed fall this year and healthy condition of the giant cutgrass at the time sprayed casts doubt on this supposition.

As of July 1, 1955, Federal Aid to Wildlife Restoration Project W-22-R ceased to exist as such. No further experimentation is planned at this time on giant cutgrass, but observations will be continued of past experiments. Should important developments worthy of a subsequent report arise, they will be written and channeled to interested persons.

Tables XXIII through XXV present apparent 1955 results of plats treated in 1954.

In Table XXIII it might be noted of the chemical preparations used before 1954 on dry or moist ground plats, TCA at a concentration of 12 ounces per gallon of water per roughly 100 square feet, CMU at eight ounces, and 2, 4, 5-T at one to two ounces produced the most lasting results. This also is demonstrated in Table XXV. Of the three, CMU is considered the best, but because of its high cost, approximately $3.50 a pound, is not economically feasible for areas having such extensive growths as Reelfoot Lake. On a cost comparative basis of chemicals alone, labor being considered equal in all cases, for each 100 square feet treated, CMU would cost $1.75; TCA, $0.345; and 2, 4, 5-T at two ounces approxiately $0.21. However, if Polybor-chlorate were stepped up to two pounds per gallon, a cost approximating that of two ounces of 2, 4, 5-T, it is felt that similar results would be obtained. And probably at a lower concentration—one pound to 1¼ pounds, making Polybor-chlorate the cheapest to use.

Of the chemicals first used in 1954, Chlorax liquid at a concentration of two pints per gallon of water (Table XXIII) and a cost of about $0.25; Dalapon at four ounces and a cost of about $0.20; Kuron at four ounces and a cost of about $0.47 gave best following-season results. This would place Dalapon on an economic par with 2, 4, 5-T and Polybor-chlorate, with the latter herbicide having the edge. However, at concentrations of ¾ pound per gallon, Polybor-chlorate appears to lose its effectiveness in a year or so.

The combination sprayings presented in Table XXIII appear to have no particular value over single applications of the individual herbicides used in the combinations.

Where experimental plats were located in aquatic areas with cutgrass rootstocks submerged from six inches to two feet, results are different from those experienced on moist ground plats. TCA and 2, 4, 5-T have very little effect on cutgrass in these plats while Polybor-chlorate gives better results than it does on the drier plats. Of the aquatic plats treated in 1954, only Dalapon at 24 ounces, Dalapon at six ounces and TCA at four ounces, and Dalapon at eight ounces and Kuron at two ounces produced results that might be considered excellent in 1955. The cost of these herbicides and their combinations is greater than the recommended quantity of Polybor-chlorate.

It is realized that most of the results presented in Tables I through XXV are negative results, but in many cases negative results are of just as great importance as positive results. It is also realized that the results obtained at Reelfoot might vary in other areas because of soil, water, temperature and other differences. This work, however, should be of value and furnish a suggestive basic guide for persons interested in giant cutgrass control.

The project leader is not satisfied with the end results in so far as determining an adequate economically feasible control of giant cutgrass is concerned. Each year new herbicides are developed and eventually one will probably be developed which will control cutgrass. On the basis of the foregoing information it is suggested that experiments with Dalaphon, Kuron and Chlorax liquid be continued on moist or dry ground areas and for aquatic situations that Dalapon and Chlorax liquid be studied further.

At the present writing, if recommendations for control were made, and considering that these would be made with tongue in cheek, the following would be suggested: For aquatic plats, Polybor-chlorate at not less than ¾ pound per gallon of water and preferably at least one pound per gallon. For moist ground plate, 2, 4, 5-T at two ounces per gallon of water, Dalapon at four ounces or Polybor-chlorate at not less than one pound and preferably 1½ pounds per gallon of water.

All applications should be made on warm, sunny days of little or no wind with reasonable assurance of at least three hours sunshine following application. Suggested spraying season follows the peak of anthesis, in the Reelfoot Lake area from August 10 to September 25.

Table II

Single Application of 2,4-D (37% or 3.34 Pounds Per Gallon Acid Equivalent). Water Base. 1951

Plat No.	*Treatment (%)*	*Date*	*Result**
1	1.5	8/17	F
2	2.0	8/17	G
3	2.5	8/17	E
4	3.0	8/17	E
5	3.5	8/17	G
6	4.0	8/17	E
7	4.5	8/15	E
8	5.0	8/15	E
9	7.0	8/15	E
10	10.0	8/15	G
11	15.0	8/15	E
12	20.0	8/15	E
13	30.0	8/15	E
14	50.0	8/15	E
15	100.0	8/15	E
16	1.0	8/17	F

* P—Poor, 0-25% kill to or below waterline.
F—Fair, 25-50% kill to or below waterline.
G—Good, 50-75% kill to or below waterline.
E—Excellent, 75-100% kill to or below waterline.

Table III

Double Spraying, 2,4-D Followed by Ammate. Water Base. 1951

Plat No.	*1st Treatment 2,4-D (%)*	*Date*	*2nd Treatment Lbs./Gal. Ammate*	*Date*	*Result†*
17	.2	8/17	¼	8/31	F
18	.2	8/17	½	8/31	F
19	.2	8/17	¾	8/31	E
20	.2	8/17	1	8/31	E
21	.2	8/17	1¼	8/31	E
22	.2	8/17	1½	8/31	E
23	.4	8/17	¼	8/31	P
24	.4	8/17	½	8/31	F
25	.4	8/17	¾	8/31	E
26	.4	8/17	1	8/31	G
27	.4	8/17	1¼	8/31	E
A-1	.4	8/17	1½	8/31	E
A-2	.6	8/17	¼	9/1	P
A-3	.6	8/17	½	9/1	F
A-4	.6	8/17	¾	9/1	E
A-5	.6	8/17	1	9/1	E
A-6	.6	8/17	1¼	9/1	P
A-7	.6	8/17	1½	9/1	P
A-8	.8	8/22	¼	9/1	P
A-9	.8	8/22	½	9/1	P
A-10	.8	8/22	¾	9/1	E
A-11	.8	8/22	1	9/1	G
A-12	.8	8/22	1¼	9/1	F
A-13	.8	8/22	1½	9/1	P
A-14	1.0	8/22	¼	9/1	F
A-15	1.0	8/22	½	9/1	P
A-16	1.0	8/22	¾	9/1	P
A-17	1.0	8/22	1	9/1	E
A-18	1.0	8/22	1¼	9/1	E
A-19	1.0	8/22	1½	9/1	E

† See Footnote *, Table II.

TABLE IV

DOUBLE SPRAYING, 2,4-D FOLLOWED BY 2,4-D. WATER BASE. 1951

Plat No.	*1st Treat. (%)*	*Date*	*2nd Treat. (%)*	*Date*	*Result*†
A-20	.4	8/22	.4	9/10	P
A-21	.4	8/22	.6	9/10	P
A-22	.4	8/22	.8	9/10	P
A-23	.4	8/22	1.0	9/10	P
A-24	.4	8/22	1.2	9/10	P
A-25	.4	8/22	1.5	9/10	P
A-26	.6	8/22	.4	9/10	P
A-27	.6	8/22	.6	9/10	P
A-28	.6	8/22	.8	9/10	P
A-29	.6	8/22	1.0	9/10	P
A-30	.6	8/22	1.2	9/10	P
A-31	.6	8/22	1.5	9/10	P
A-32	.8	8/22	.8	9/10	P
A-33	.8	8/22	.6	9/10	P
A-34	.8	8/22	.4	9/10	P
A-35	.8	8/22	1.0	9/10	P
A-36	.8	8/22	1.2	9/10	P
A-37	.8	8/22	1.5	9/10	P
A-38	1.2	8/22	.8	9/10	P
A-39	1.2	8/22	.6	9/10	P
A-40	1.2	8/22	.4	9/10	P
A-41	1.2	8/22	1.0	9/10	F
A-42	1.2	8/22	1.2	9/10	P
A-43	1.2	8/22	1.5	9/10	P
A-44	1.0	8/22	.8	9/10	F
A-45	1.0	8/22	.6	9/10	P
A-46	1.0	8/22	.4	9/10	P
A-47	1.0	8/22	1.0	9/10	P
A-48	1.0	8/22	1.2	9/10	G
A-49	1.0	8/22	1.5	9/10	P
A-50	1.5	8/22	.8	9/10	P
A-51	1.5	8/22	.6	9/10	P
A-52	1.5	8/22	.4	9/10	F
A-53	1.5	8/22	1.0	9/10	P
A-54	1.5	8/22	1.2	9/10	P
A-55	1.5	8/22	1.5	9/10	F

† See Footnote *, Table II.

TABLE V

SINGLE SPRAYING, 2,4,5-T, 37% ACID EQUIVALENT. WATER BASE. 1951

Plat No.	*Treatment (%)*	*Date*	*Result*†
A-56	.1	8/23	P
A-57	.3	8/25	P
A-58	.5	8/23	P
A-59	.7	8/23	P
A-60	1.0	8/23	P
A-61	1.5	8/23	P
A-62	2.0	8/23	P
A-63	2.5	8/23	F
A-64	3.0	8/23	E
A-65	3.5	8/23	E
A-66	4.0	8/23	E
A-67	4.5	8/23	E
A-68	5.0	8/23	E
A-69	7.0	8/23	E
A-70	10.0	8/23	E
A-71	15.0	8/23	E
A-72	20.0	8/23	G
A-73	50.0	8/23	F
A-74	100.0	8/23	E

† See Footnote *, Table II.

TABLE VI

SINGLE SPRAYING, AMMATE (AMMONIUM SULPHAMATE—$NH_4SO_3NH_2$). WATER BASE. 1951

Plat No.	*Treatment Lbs./Gal.*	*Date*	*Result*†
A-75	⅛	8/24	F
A-76	¼	8/24	P
A-77	½	8/24	G
A-78	¾	8/24	E
A-79	1	8/24	E
A-80	1¼	8/24	E
A-81	1½	8/24	E
A-82	1¾	8/24	E
A-83	2	8/24	E
A-84	2½	8/24	E
A-85	3	8/24	E
A-86	4	8/24	E
A-87	5	8/24	E
A-88	1/16	8/24	P

† See Footnote *, Table II.

TABLE VII

DOUBLE SPRAYING, AMMATE ON AMMATE. WATER BASE. 1951

Plat No.	*1st Treatment Lbs./Gal.*	*Date*	*2nd Treatment Lbs./Gal.*	*Date*	*Result*†
A-89	¼	8/24	¼	9/12	G
A-90	¼	8/24	½	9/12	F
A-91	¼	8/24	¾	9/12	G
A-92	¼	8/24	1	9/12	E
A-93	¼	8/24	1¼	9/12	E
A-94	½	8/24	¼	9/12	E
A-95	½	8/24	½	9/12	E
A-96	½	8/24	¾	9/12	E
A-97	½	8/24	1	9/12	E
A-98	½	8/24	1¼	9/12	G
A-99	¾	8/31	¼	9/12	E
A-100	¾	8/31	½	9/12	F
A-101	¾	8/31	¾	9/12	E
A-102	¾	8/31	1	9/12	E
A-103	¾	8/31	1¼	9/12	G
A-104	¾	8/31	¼	9/12	E
A-105	¾	8/31	½	9/12	E
A-106	¾	8/31	¾	9/12	G
A-107	¾	8/31	1	9/12	F
A-108	¾	8/31	1¼	9/12	G
A-109	1¼	8/31	¼	9/12	E
A-110	1¼	8/31	½	9/12	G
A-111	1¼	8/31	¾	9/12	E
A-112	1¼	8/31	1	9/12	G
A-113	1¼	8/31	1¼	9/12	E

† See Footnote *, Table II.

Table VIII

Permanent Plats. Singly Sprayed with most Promising Solutions. 1951

Plat No.‡	*Treatment*	*Date*	*Location*	*Result*†
P-W-A-1.......	¼ Lb./Gal.	9/6	Left Pt. Green Island	P
P-W-A-2.......	⅜ Lb./Gal.	9/6	Left Pt. Green Island	P
P-W-A-3.......	½ Lb./Gal.	9/6	Pocket Rt. Long Pocket	G
P-W-A-4.......	¾ Lb./Gal.	9/6	Long Pocket	E
P-W-A-5.......	1 Lb./Gal.	9/6	Long Pocket	E
P-W-A-6.......	1¼ Lb./Gal.	9/6	Green Point	E
P-W-A-7.......	1½ Lb./Gal.	9/6	Left Sandy Beach	E
P-W-D-1.......	2%	9/6	2nd Pocket, Sandy Beach	E
P-W-D-2.......	2.5%	9/6	Right Po-jo Pt.	F
P-W-D-3.......	3.0%	9/6	N. Champey's Pocket	P
P-W-D-4.......	3.5%	9/6	Center Champey's Pocket	F
P-W-D-5.......	4.0%	9/6	W. Champey's Pocket	G
P-W-T-1.......	2.0%	9/7	W. Champey's Pocket	E
P-W-T-2.......	2.5%	9/7	W. Champey's Pocket	E
P-W-T-3.......	3.0%	9/7	W. Champey's Pocket	P
P-O-T-1	2.0%	9/7	W. Champey's Pocket	F
P-O-T-2	2.5%	9/7	W. Champey's Pocket	G
P-O-T-3	3.0%	9/7	W. Champey's Pocket	E
P-O-A-1	⅛ Lb./Gal.	9/7	W. Champey's Pocket	P
P-O-A-2	¼ Lb./Gal.	9/7	W. Champey's Pocket	P
P-O-A-3	½ Lb./Gal.	9/7	W. Champey's Pocket	P
P-O-D-1	2.0%	9/8	American Legion Home	E
P-O-D-2	2.5%	9/8	American Legion Home	E
P-O-D-3	3.0%	9/8	American Legion Home	E
P-O-D-4	3.5%	9/8	American Legion Home	E
P-O-D-5	4.0%	9/8	American Legion Home	E

‡ P—Permanent W—Water base. O—Diesel fuel base. A—Ammate.
D—2, 4-D. T—2, 4, 5-T.
† See Footnote *, Table II.

Table IX

CMU (80%) Wettable Powder. Water Base. 1952

Plat No.	*Treatment Lbs./Gal. Water*	*Date*	*Result*†
A-74..........................	1/16	8/19	P
A-75..........................	¼	8/19	P
A-76..........................	⅜	8/19	P
A-77..........................	½	8/19	P
A-78..........................	¾	8/19	P
A-79..........................	1	8/19	P
A-80..........................	1¼	8/19	P
A-81..........................	1½	8/19	P

Table X

CUM (25%) Pellets. Hand Broadcast. 1952

Plat No.	*Treatment Per 100 Sq. Ft.*	*Date*	*Result*†
A-88..........................	1 oz.	8/19	P
A-89..........................	2 oz.	8/19	P
A-90..........................	4 oz.	8/19	P
A-91..........................	8 oz.	8/19	P
A-92..........................	12 oz.	8/19	P
A-93..........................	16 oz.	8/19	P
A-94..........................	20 oz.	8/19	P
A-95..........................	24 oz.	8/19	P

Table XI

TCA (90%) Wettable Powder. Water Base. 1952

Plat No.	Treatment Lbs./Gal. Water	Date	Result†
A-82	¼	8/19	P
A-83	½	8/19	P
A-84	¾	8/19	P
A-85	1	8/19	P
A-86	1½	8/19	P
A-87	2	8/19	P

† See Footnote *, Table II.

Table XII

Brush Killer #22 (28.9% 2,4-D, 27.8% 2,4,5-T). Water Base. 1952

Plat No.	Treatment Oz./Gal. Water	Date	Result†
A-96	1	8/20	P
A-97	2	8/20	P
A-98	4	8/20	P
A-99	8	8/20	F
A-100	16	8/20	G
A-101	20	8/20	E
A-102	24	8/20	G
A-73	28	8/20	G
A-72	32	8/20	G

Table XIII

Polybor-Chlorate, Wettable Powder. Water Base. 1952

Plat No.	Treatment Lbs./Gal. Water	Date	Result†
A-71	1	8/27	G
A-70	1½	8/27	E
A-69	2	8/27	E
A-68	2½	8/27	E
A-67	3	8/27	E
A-66	3½	8/27	E
A-65	4	8/27	E
A-64	6	8/27	E
A-63	8	8/27	E
A-62	10	8/27	E

Table XIV

Borascu. Hand Broadcast. 1952

Plat No.	Treatment Lbs./100 Sq. Ft.	Date	Result†
A-61	5	8/27	P
A-60	10	8/27	P
A-59	15	8/27	P
A-58	20	8/27	P
A-57	25	8/27	P

† See Footnote *, Table II.

TABLE XV

DETERMINATION OF MOST VULNERABLE PERIOD OF GIANT CUTGRASS TO AMMATE. 1952

Plat No.	*Concentration Lbs./Gal. Water*	*Date*	*Grass Condition*	*Result†*	
A-114.........	¾	6/21	Heading	P	What kill
A-115.........	¾	6/28	Heading	P	(slight)
A-116.........	¾	7/5	Heading	P	occurred,
A-117.........	¾	7/12	Heading	P	replaced by
A-118.........	¾	7/19	Heading	P	new growth
A-119.........	¾	7/26	Slight heading	F	
A-120.........	¾	8/2	Heading over	F	
A-121.........	¾	8/9	Heading over	G	
A-122.........	¾	8/16	Heading over	G	
A-103.........	1	9/9	Heading over	E	
A-56..........	1	9/18	Heading over	E	
A-55..........	1	9/25	Heading over	E	
				—Killing frost	
A-54..........	1	10/1	Heading over	P	

† See Footnote *, Table II.

TABLE XVI

PERMANENT PLATS SPRAYED WITH MOST PROMISING SOLUTIONS OF CHEMICALS USED DURING SPRAYING SEASON OF 1952. CONCENTRATIONS INDICATED PER 100 SQUARE FEET

Plat No.	*Herbicide*	*Treatment*	*Date*	*Location*	*Result†*
P-W-U-1	CMU powder	1 lb.	9/9	American Legion Home	P
P-W-U-2	CMU powder	1¼ lbs.	9/9	S. Lasiter's Inlet	P
P-W-U-3	CMU powder	1½ lbs.	9/9	N. Lasiter's Inlet	P
P-W-C-1	TCA	1½ lbs.	9/9	N. Lasiter's Inlet	E
P-W-C-2	TCA	2 lbs.	9/9	N. Past Lasiter's Inlet	E
P-W-B-1	Borascu	25 lbs.	9/9	N. Past Lasiter's Inlet	P
P-W-P-1	CMU pellets	¾ lb.	9/9	North Keystone Pocket	P
P-W-P-2	CMU pellets	1 lb.	9/9	N. Keystone Bon. Patch	P
P-W-P-3	CMU pellets	1¼ lbs.	9/9	W. of 138	P
P-W-2-1	Brush Killer #22	8 oz.	9/9	N. of 138	E
P-W-2-2	Brush Killer #22	16 oz.	9/9	W. Nigger Beach	E
P-W-2-3	Brush Killer #22	20 oz.	9/9	W. Green Cypress	E
P-W-L-1	Polybor-chlorate	1/16 lb.	9/9	N. Green Cypress	P
B-O-A-4	Polybor-chlorate	⅛ lb.	9/9	N. Green Cypress	P
B-O-A-3	Polybor-chlorate	¼ lb.	9/9	W. Nigger Beach	F
B-O-A-2	Polybor-chlorate	½ lb.	9/9	N. Nigger Beach	E
B-O-A-1	Polybor-chlorate	¾ lb.	9/9	W. Champey's Pocket	G
B-O-T-2	Polybor-chlorate	1 lb.	9/9	W. Champey's Pocket	E
B-O-T-1	Polybor-chlorate	1¼ lbs.	9/10	W. Champey's Pocket	E
B-W-T-3	Polybor-chlorate	1½ lbs.	9/10	W. Champey's Pocket	E
B-W-T-2	Polybor-chlorate	2 lbs.	9/10	W. Champey's Pocket	E
B-W-T-1	Polybor-chlorate	2½ lbs.	9/10	Champey's Pocket	E
B-W-D-5	Polybor-chlorate	3 lbs.	9/10	Upper Champey's P'ket	E
B-W-D-4	Polybor-chlorate	3½ lbs.	9/10	Champey's Pocket	E
B-W-D-3	Polybor-chlorate	4 lbs.	9/10	Hog-wire Fence	E

† See Footnote *, Table II.

TABLE XVII
EXPERIMENTAL RESULTS OF CONTACT SPRAYING ON GIANT CUTGRASS WITH THREE SELECTED HERBICIDES IN AN ATTEMPT TO DETERMINE THE MOST VULNERABLE PLANT PERIOD. 1953

Date	*Plat No.*	*Treatment**	*Cutgrass** (Feet)*	*Water Depth (Inches)*	*Bottom Type*	*Final Apparent Results†*	*Anthesis*
6/24	A-75	TCA	3	2	Sand	P	Peak
6/24	A-76	BK	3½	2	Sand-Muck	P	Peak
6/24	A-77	PBC	3	2½	Sand	P	Peak
7/4	A-74	PBC	3	1½	Sand	P	Peak
7/4	A-78	BK	4	1½	Sand	P	Peak
7/4	A-73	TCA	4	1½	Sand	P	Peak
7/11	A-72	TCA	3	2	Sand	P	Decreasing
7/11	A-79	BK	3	1½	Sand	P	Decreasing
7/11	A-80	PBC	3	1	Sand	P	Decreasing
7/18	A-81	BK	3	1	Sand	P	Slight
7/18	A-82	PBC	3	11	Sand	F	Slight
7/18	A-83	TCA	3	1	Sand	F	Slight
7/25	A-84	BK	3½	1½	Sand	F	Slight
7/25	A-85	PBC	3½	1½	Sand	F	Slight
7/25	A-86	TCA	4	1¾	Sand-Muck	F	Slight
8/1	A-87	BK	3½	1	Sand	G	Fair
8/1	A-88	PBC	3	1	Sand	G	Good
8/1	A-89	TCA	3½	10	Sand	G	Fair
8/8	A-90	BK	3½	8	Sand	G	Good
8/8	A-91	PBC	3½	8	Sand	G	Good
8/8	A-92	TCA	3½	8	Sand	G	Good
8/15	A-93	BK	4	10	Sand	G	Fair
8/15	A-94	PBC	3½	8	Sand	G	Fair
8/15	A-95	TCA	3½	10	Sand	G	Fair
8/22	A-96	BK	4	11	Sand	G	Poor
8/22	A-97	PBC	3½	10	Sand	G	Fair
8/22	A-98	TCA	3½	10	Sand	E	Poor
8/29	A-99	BK	4	11	Sand	E	Poor
8/29	A-100	PBC	3½	10	Sand	G	Poor
8/29	A-101	TCA	3½	10	Sand	G	Fair
9/5	A-102	BK	3½	10	Sand	G	Fair
9/5	A-103	PBC	3½	10	Sand	E	Fair
9/5	A-104	TCA	3½	10	Sand	F	Good
9/12	A-105	BK	4	4	Sand	F	Fair
9/12	A-112	PBC	4	6	Sand	E	Good
9/12	A-113	TCA	4	4	Sand-Muck	E	Good
9/19	A-114	BK	4	0	Muck	G	Poor
9/19	A-115	PBC	4	3	Sand	E	Fair
9/19	A-116	TCA	4	4	Sand	E	Fair
9/26	A-117	BK	4	5	Muck	E	Fair
9/26	A-118	PBC	4	4	Muck	E	Fair
9/26	A-119	TCA	4	4	Muck	E	Good

* PBC—Polybor-chlorate, ¾ pound per gallon of water per 100 square feet.
BK —Brush Killer #22, 4 ounces per gallon of water per 100 square feet.
TCA—Sodium trichloroacetate, ¾ pound per gallon of water per 100 square feet.
** Height above water line.
† See Footnote *, Table II.

TABLE XVII—*Continued*

EXPERIMENTAL RESULTS OF CONTACT SPRAYING ON GIANT CUTGRASS WITH THREE SELECTED HERBICIDES IN AN ATTEMPT TO DETERMINE THE MOST VULNERABLE PLANT PERIOD. 1953

Date	*Plat No.*	*Treat-ment**	*Cut-grass*** *(Feet)*	*Water Depth (Inches)*	*Bottom Type*	*Final Apparent Results*†	*Anthesis*
10/3	A-120	BK	4	3	Muck	E	Good
10/3	A-121	PBC	4	3	Muck	E	Fair
10/3	A-122	TCA	4	3	Muck	E	Fair
10/10	A-123	BK	4	4	Muck	G	Fair
10/10	A-124	PBC	4	6	Muck	E	Fair
10/10	A-125	TCA	4	0	Muck	P	Poor
10/17	A-126	BK	4	0	Muck	E	Fair
10/17	A-127	PBC	4	0	Muck	E	Poor
10/17	A-128	TCA	4	3	Muck	E	Poor
10/24	A-129	BK	6	0	Sand	G	None
10/24	A-130	PBC	6	0	Sand	E	None
10/24	PWP-1	TCA	6	0	Sand	E	None
10/31	BWP-1	BK	5	0	Sand	G	None
10/31	A-132	PBC	5	0	Sand	E	None
10/31	A-133	TCA	5	0	Sand	E	None

TABLE XVIII

PERMANENT, DRY GROUND, GIANT CUTGRASS PLATS* SPRAYED WITH THE MOST PROMISING HERBICIDE SOLUTIONS, AUGUST 29, 1953

Plat No.	*Herbicide*	*Concentration*	*Anthesis*	*Apparent Results*†
A-1	2, 4, 5-T	2 oz./gal. water/100 sq. ft.	Slight	E
A-2	Brush Killer #22	2 oz./gal. water/100 sq. ft.	Slight	E
A-3	Ammate	¾ lb./gal. water/100 sq. ft.	Slight	E
A-4	Polybor-chlorate	¾ lb./gal. water/100 sq. ft.	Slight	E
A-5	TCA	¾ lb./gal. water/100 sq. ft.	Slight	E
A-6	2, 4-D	2 oz./gal. water/100 sq. ft.	Slight	E
A-7	CMU powder	¾ lb./gal. water/100 sq. ft.	Slight	G
A-8	CMU pellets	¾ lb./100 sq. ft.	Slight	P

* All plats located on north side of borrow pit in front of project headquarters.
† See Footnote *, Table II.

TABLE XIX

PERMANENT, DRY GROUND, GIANT CUTGRASS PLATS* SPRAYED WITH THE MOST PROMISING HERBICIDE SOLUTIONS, OCTOBER 27, 1953, IN ORDER TO DETERMINE LATE SPRAYING EFFECTS

Plat No.	*Herbicide*	*Concentration*	*Anthesis*	*Apparent Results*†
A-25	Brush Killer #22	2 oz./gal. water/100 sq. ft.	None	F
A-26	2, 4-D	2 oz./gal. water/100 sq. ft.	None	P
A-27	Polybor-chlorate	¾ lb./gal. water/100 sq. ft.	None	G
A-28	TCA	¾ lb./gal. water/100 sq. ft.	None	P
A-29	CMU powder	¾ lb./gal. water/100 sq. ft.	None	P
A-30	Ammate	¾ lb./gal. water/100 sq. ft.	None	P
A-31	CMU pellets	¾ lb./gal. water/100 sq. ft.	None	P

* All plats located on north side of borrow pit in front of project headquarters.
† See Footnote *, Table II.

Table XX
Permanent, Dry Ground, Giant Cutgrass Experimental Plats*
Treated in 1954

Plat No.	*Date Treated*	*Herbicide***	*Concentration Per Gal. Water*	*Results*†
1-1	8/24	Ammate	12 oz.	F
1-2	8/24	PBC	12 oz.	G
1-3	8/24	2, 4-D	2 oz.	F
1-4	8/24	TCA	12 oz.	E
1-5	8/24	BK #22	2 oz.	G
1-6	8/24	Cx. L.	1 pt.	E
1-7	8/24	Cx. L.	2 pt.	E
1-8	8/24	Cx. L.	3 pt.	E
1-9	8/24	Cx. L.	4 pt.	E
1-10	8/24	Cx. P.	1 oz.	F
1-11	8/24	Cx. P.	4 oz.	G
1-12	8/24	Cx. P.	8 oz.	G
1-13	8/24	Cx. P.	12 oz.	E
1-14	8/24	Dalapon	4 oz.	F
1-15	8/24	Dalapon	8 oz.	E
1-16	8/24	Dalapon	12 oz.	E
1-17	8/24	Dalapon	16 oz.	E
1-18	8/24	CMU	4 oz.	P
1-19	8/24	CMU	8 oz.	P
1-20	8/24	CMU	12 oz.	P
1-21	8/24	TCA	4 oz.	E
1-22	8/24	TCA	8 oz.	F
A-26	8/24	2, 4, 5-T	1 oz.	E
A-27	8/24	2, 4, 5-T	2 oz.	E
A-30	8/24	Cx. L.	4 oz.	E
A-28	8/24	Cx. L.	8 oz.	E
0-1	9/25	Kuron	1 oz.	F
0-2	9/25	Kuron	2 oz.	G
0-4	9/25	Kuron	4 oz.	E
0-4	9/25	Kuron	8 oz.	E
0-5	9/25	Dalapon	8 oz.	
		Kuron	6 oz.	G
0-6	9/25	Dalapon	6 oz.	
		TCA	4 oz.	F
0-7	9/25	Dalapon	8 oz.	
		Kuron	1 oz.	E
A-31	9/25	Dalapon	4 oz.	
		Kuron	1 oz.	E
0-8	9/27	Dalapon	4 oz.	
		Kuron	2 oz.	E
0-9	9/27	Dalapon	8 oz.	
		Kuron	2 oz.	P

* Plats located on borrow pit, south side of project headquarters.
** PBC—Polybor-chlorate; BK #22—Brush Killer #22; Cx. L.—Chlorax liquid; Cx. P.—Chlorax powder.
† See Footnote *, Table II.

TABLE XXI

PERMANENT, GIANT CUTGRASS PLATS, AQUATIC SITUATION, TREATED IN 1954

Plat No.	*Date Treated*	*Herbicide**	*Concentration Per Gal. Water*	*Results†*
A-49	8/25	Cx. P.	4 lbs.	G
A-50	8/25	Cx. P.	3 lbs.	E
A-52	8/25	Cx. L.	8 oz.	F
A-53	8/25	Cx. L	16 oz.	F
A-54	8/25	Cx. L.	32 oz.	F
A-55	8/25	Cx. L.	48 oz.	E
A-56	8/25	Cx. L.	64 oz.	E
A-57	8/25	Cx. L.	80 oz.	E
A-74	8/25	Dalapon	4 oz.	F
A-75	8/25	Dalapon	8 oz.	F
A-76	8/25	Dalapon	12 oz.	G
A-77	8/25	Dalapon	16 oz.	G
A-78	8/25	Dalapon	20 oz.	G
A-79	8/25	Dalapon	24 oz.	G
A-80	8/25	Dalapon	36 oz.	E
A-81	8/25	Cx. P.	1 oz.	P
A-82	8/25	Cx. P.	4 oz.	F
A-83	8/25	Cx. P.	8 oz.	F
A-84	8/25	Cx. P.	12 oz.	F
A-85	8/25	Cx. P.	16 oz.	G
A-86	8/25	Cx. P.	20 oz.	G
A-87	8/25	Cx. P.	24 oz.	G
A-88	8/25	Cx. P.	32 oz.	G
A-89	8/25	Cx. L.	1 gal.	E
A-90	9/27	Kuron	1 oz.	P
A-91	9/27	Kuron	2 oz.	F
A-92	9/27	Kuron	4 oz.	F
A-93	9/27	Kuron	6 oz.	F
A-94	9/27	Kuron	8 oz.	G
A-95	9/27	Kuron	16 oz.	G
A-96	9/27	Dalapon	10 oz.	
		TCA	8 oz.	F
A-97	9/27	Dalapon	8 oz.	
		TCA	6 oz.	G
A-98	9/27	Dalapon	6 oz.	
		TCA	4 oz.	G
A-99	9/27	Dalapon	1 oz.	
		Kuron	1 oz.	F
A-100	9/27	Dalapon	2 oz.	
		Kuron	1 oz.	P
A-101	9/27	Dalapon	8 oz.	
		Kuron	1 oz.	P
A-102	9/27	Dalapon	1 oz.	
		Kuron	2 oz.	F
A-103	9/27	Dalapon	2 oz.	
		Kuron	2 oz.	F
A-104	9/27	Dalapon	8 oz.	
		Kuron	2 oz.	F
A-105	9/27	Dalapon	1 oz.	
		Kuron	4 oz.	F
A-106	9/27	Dalapon	2 oz.	
		Kuron	4 oz.	F
A-107	9/27	Dalapon	8 oz.	
		Kuron	4 oz.	F

* See Footnote **, Table XX.
† See Footnote *, Table II.

TABLE XXII

REGROWTH RESULTS OF DRY GROUND PLATS TREATED IN 1953

Plat No.	*Date Treated*	*Herbicide**	*Concentration Per Gal. Water*	*Appar. '53 Results†*	*Appar. '54 Results†*
A-1	9/24	2, 4, 5-T	2 oz.	E	E
A-2	9/24	BK #22	2 oz.	E	F
A-3	9/24	Ammate	12 oz.	E	G
A-4	9/24	PBC	12 oz.	E	P
A-5	9/24	TCA	12 oz.	E	E
A-6	9/24	2, 4-D	2 oz.	E	F
A-7	9/24	CMU powder	12 oz.	G	E
A-8	9/24	CMU pellets	12 oz.	P	G

* See Footnote **, Table XX.
† See Footnote *, Table II.

TABLE XXIII

PERMANENT, DRY GROUND, GIANT CUTGRASS EXPERIMENTAL PLATS* TREATED IN 1954 AND APPARENT RESULTS AS THEY APPEAR IN 1955

Plat No.	*Date Treated*	*Herbicide‡*	*Concentration Per Gal. Water*	*Appar. '54 Results†*	*Appar. '55 Results†*
1-1	8/24	Ammate	12 oz.	F	P-F
1-2	8/24	PBC	12 oz.	G	F
1-3	8/24	2, 4-D	2 oz.	F	P
1-4	8/24	TCA	12 oz.	E	G-E
1-5	8/24	BK #22	2 oz.	G	F-G
1-6	8/24	Cx. L.	1 pt.	E	P
1-7	8/24	Cx. L.	2 pt.	E	E
1-8	8/24	Cx. L.	3 pt.	E	E
1-9	8/24	Cx. L.	4 pt.	E	E
1-10	8/24	Cx. P.	1 oz.	F	P
1-11	8/24	Cx. P.	4 oz.	G	P
1-12	8/24	Cx. P.	8 oz.	G	P
1-13	8/24	Cx. P.	12 oz.	E	P
1-14	8/24	Dalapon	4 oz.	F	E
1-15	8/24	Dalapon	8 oz.	E	E
1-16	8/24	Dalapon	12 oz.	E	E
1-17	8/24	Dalapon	16 oz.	E	E
1-18	8/24	CMU	4 oz.	P	F
1-19	8/24	CMU	8 oz.	P	E
1-20	8/24	CMU	12 oz.	P	E
1-21	8/24	TCA	4 oz.	E	G-E
1-22	8/24	TCA	8 oz.	F	P
A-26	8/24	2, 4, 5-T	1 oz.	E	G-E
A-27	8/24	2, 4, 5-T	2 oz.	E	G-E
A-30	8/24	Cx. L.	4 oz.	E	P
A-28	8/24	Cx. L.	8 oz.	E	P-F
0-1	9/25	Kuron	1 oz.	F	F
0-2	9/25	Kuron	2 oz.	G	G
0-3	9/25	Kuron	4 oz.	E	E
0-4	9/25	Kuron	8 oz.	E	E
0-5	9/25	Dalapon	8 oz.		
		Kuron	6 oz.	G	E
0-6	9/25	Dalapon	6 oz.		
		TCA	4 oz.	F	F
0-7	9/25	Dalapon	8 oz.		
		Kuron	1 oz.	E	E
A-31	9/25	Dalapon	4 oz.		
		Kuron	1 oz.	E	E
0-8	9/27	Dalapon	4 oz.		
		Kuron	2 oz.	E	E
0-9	9/27	Dalapon	8 oz.		
		Kuron	2 oz.	P	G

* See Footnote *, Table XX.
‡ See Footnote **, Table XX.
† See Footnote *, Table II.

TABLE XXIV

PERMANENT, GIANT CUTGRASS PLATS, AQUATIC SITUATION, TREATED IN 1954, AND APPARENT RESULTS AS THEY APPEAR IN 1955

Plat No.	*Date Treated*	*Herbicide**	*Concentration Per Gal. Water*	*Appar.'54 Results†*	*Appar.'55 Results†*
A-49.......	8/25	Cx. P	4 lbs.	G	P
A-50.......	8/25	Cx. P.	3 lbs.	E	P
A-52.......	8/25	Cx. L.	8 oz.	F	P
A-53.......	8/25	Cx. L.	16 oz.	F	P
A-54.......	8/25	Cx. L.	32 oz.	F	F
A-55.......	8/25	Cx. L.	48 oz.	E	F
A-56.......	8/25	Cx. L.	64 oz.	E	F-G
A-57.......	8/25	Cx. L.	80 oz.	E	P
A-74.......	8/25	Dalapon	4 oz.	F	F
A-75.......	8/25	Dalapon	8 oz.	F	F
A-76.......	8/25	Dalapon	12 oz.	G	F
A-77.......	8/25	Dalapon	16 oz.	G	G
A-78.......	8/25	Dalapon	20 oz.	G	G
A-79.......	8/25	Dalapon	24 oz.	G	E
A-80.......	8/25	Dalapon	36 oz.	E	G
A-81.......	8/25	Cx. P.	1 oz.	P	P
A-82.......	8/25	Cx. P.	4 oz.	F	F
A-83.......	8/25	Cx. P.	8 oz.	F	F
A-84.......	8/25	Cx. P.	12 oz.	F	P
A-85.......	8/25	Cx. P.	16 oz.	G	P
A-86.......	8/25	Cx. P.	20 oz.	G	P
A-87.......	8/25	Cx. P.	24 oz.	G	F
A-88.......	8/25	Cx. P.	32 oz.	G	F
A-89.......	8/25	Cx. L.	1 gal.	E	P
A-90.......	9/27	Kuron	1 oz.	P	P
A-91.......	9/27	Kuron	2 oz.	F	F
A-92.......	9/27	Kuron	4 oz.	F	F
A-93.......	9/27	Kuron	6 oz.	F	F
A-94.......	9/27	Kuron	8 oz.	G	F
A-95.......	9/27	Kuron	16 oz.	G	P
A-96.......	9/27	Dalapon	10 oz.		
		TCA	8 oz.	F	F
A-97.......	9/27	Dalapon	8 oz.		
		TCA	6 oz.	G	G
A-98.......	9/27	Dalapon	6 oz.		
		TCA	4 oz.	G	E
A-99.......	9/27	Dalapon	1 oz.		
		Kuron	1 oz.	F	P
A-100......	9/27	Dalapon	2 oz.		
		Kuron	1 oz.	P	P
A-101......	9/27	Dalapon	8 oz.		
		Kuron	1 oz.	P	P
A-102......	9/27	Dalapon	1 oz.		
		Kuron	2 oz.	F	P
A-103......	9/27	Dalapon	2 oz.		
		Kuron	2 oz.	F	P
A-104......	9/27	Dalapon	8 oz.		
		Kuron	2 oz.	F	E
A-105......	9/27	Dalapon	1 oz.		
		Kuron	4 oz.	F	P
A-106......	9/27	Dalapon	2 oz.		
		Kuron	4 oz.	F	F-G
A-107......	9/27	Dalapon	8 oz.		
		Kuron	4 oz.	F	G

* See Footnote **, Table XX.
† See Footnote *, Table II.

TABLE XXV

REGROWTH RESULTS OF DRY GROUND PLATS TREATED IN 1953

Plat No.	Date Treated	Herbicide*	Concentration Per Gallon of Water	1953 Apparent Results†	1954 Apparent Results†	1955 Apparent Results†
A-1......	9/24	2, 4, 5-7	2 oz.	E	E	G-E
A-2......	9/24	BK #22	2 oz.	E	F	P
A-3......	9/24	Ammate	12 oz.	E	G	F
A-4......	9/24	PBC	12 oz.	E	P	P
A-5......	9/24	TCA	12 oz.	E	E	E
A-6......	9/24	2, 4-D	2 oz.	E	F	P
A-7......	9/24	CMU p'der	12 oz.	G	E	E
A-8......	9/24	CMU pellets	12 oz.	P	G	P

* See Footnote **, Table XX.
† See Footnote *, Table II.

WATERFOWL MANAGEMENT ON MULTIPLE-USE RESERVOIRS IN TENNESSEE

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Tennessee Game and Fish Commission

COLOR SLIDES

1. *Dam and Lake.* In Tennessee during the past 25 years, a great boom in the creation of reservoirs for flood control, power, and navigation has resulted in the impoundment of over 600,000 acres of water. T. V. A. and the Corps of Engineers have been the major contributors to this situation.

2. *Watauga Lake With Drawdown Shown.* In the eastern part of the State storage reservoirs are present from which water is drawn to maintain navigable levels, to produce power in the lower mainstem reservoirs and to provide flood storage. In these storage reservoirs, fluctuation of water levels is often violent, sometimes utilizing much of the water in the reservoir.

3. *Kentucky Lake Near Paris Landing.* Mainstem reservoirs are generally shallower, broader, and less subject to extreme fluctuation than the storage lakes. This photo shows a scene on Kentucky Lake where waters extend for 184 miles through two states, Kentucky and Tennessee, and contains 156,000 acres of water at normal pool elevation. It is on these mainstem reservoirs with less violent fluctuation that waterfowl habitat development is undertaken with large scale projects.

4. *Buttonbush on Mud Flats.* One of the problems involved in providing better habitat on power reservoirs is that of utilizing mud flats, etc., which are exposed by late summer or early fall drawdown. Obnoxious plants soon take over this marginal land and have to be controlled by:

5. *Tractor Plowing Mud Flats.* Plowing up the willow and buttonbush which creep into the area of operation, or—

6. *Axe Used on Buttonbush.* Using axes and bush cutters to remove the larger growths and prepare the land for agricultural manipulation.

7. *Rye Grass on Mud Flats.* After preparation of the land and often only by seeding of recently exposed mud flats, planting of green materials such as rye grass is accomplished. These plantings commence in late August and continue until October 15.

8. *Japanese Millet on Mud Flats.* Past experiments with Japanese millet indicate that if planted on mud flats in mid-August, excellent results may be obtained by producing both seed and green material for early migrants.

9. *New Hope Mud Flats and Upland Fields.* Where land is suitable, upland fields adjacent to the lake are leased from T. V. A. or the Corps of Engineers