

March, 1953

To the Graduate Council:

I am submitting herewith a thesis written by James Elbert Byrd entitled "Weed Control In Sweet Potatoes With N-1 Naphthyl Phthalamie Acid." I recommend that it be accepted for 9 quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Horticulture.

E. S. Putt
Major Professor

We have read this thesis
and recommend its acceptance:

Homer D. Luning

I. N. Skold

Loyal E. Shanks

Accepted for the Council:

E. R. Watson
Dean of the Graduate School

WEED CONTROL IN SWEET POTATOES WITH N-1 NAPHTHYL
PHTHALAMIC ACID

A THESIS

Submitted to
The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by

James Elbert Byrd

March, 1953

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to: Prof. H. D. Swingle, Department of Horticulture, for his able direction and guidance on this study and in the preparation of this thesis; Dr. B. S. Pickett, Department of Horticulture, for aiding in the initial stage of this study and in reviewing this thesis; and the Agricultural Library Staff for their kind assistance in securing reference material.

J.E.B.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
II. REVIEW OF LITERATURE	3
III. EXPERIMENTAL PROCEDURE	12
IV. EXPERIMENTAL RESULTS AND DISCUSSION	16
V. SUMMARY	32
BIBLIOGRAPHY	34

LIST OF TABLES

TABLE	PAGE
I. Types of Weeds and Grasses Present	
In Experimental Area	17
II. Number of Broadleaf Weed and Grass	
Seedlings per 3 Square Feet 15 Days	
After Treatment With N-1 Naphthyl	
Phthalamic Acid	18
III. Number of Broadleaf Weed and Grass	
Seedlings per 3 Square Feet 30 Days	
After Treatment With N-1 Naphthyl	
Phthalamic Acid	20
IV. Loss of Plants During The First 15	
Days After Treatment With N-1 Naphthyl	
Phthalamic Acid	21
V. Total Pounds of Sweet Potatoes Produced	
From Plots Treated With N-1	
Naphthyl Phthalamic Acid	23
VI. Pounds of Marketable Sweet Potatoes	
Produced From Plants Treated With	
N-1 Naphthyl Phthalamic Acid	24
VII. Pounds of Number 1 Grade Sweet Potatoes	
Produced From Plots Treated With N-1	
Naphthyl Phthalamic Acid	26

TABLE

PAGE

VIII.	Pounds of Number 2 Grade Sweet Potatoes Produced From Plots Treated With Various Amounts of N-1 Naphthyl Phthalamic Acid	28
IX.	Pounds of Cull Sweet Potatoes Produced From Plots Treated With N-1 Naphthyl Phthalamic Acid	29
X.	Yields Per Plot of Cracked Sweet Potatoes Following Treatment of N-1 Naphthyl Phthalamic Acid	30

CHAPTER I

INTRODUCTION

Since the cultivation of crops by man, weeds have been a problem. Every year farmers and gardeners are confronted with the eradication or control of these pests with a considerable cost for labor. Weeds reduce yields and quality, which in turn results in less profitable enterprises. Cultivation is the principal method of controlling weeds, but with the rising costs of labor the problem is increasingly serious. This has encouraged a search for methods of controlling weeds other than the usual cultural practices.

In the vegetable field, 2,4-D has been used effectively on sweet corn and asparagus (1,11), but it seldom eliminates the need for all cultivation. Oils like Stoddard Solvent have been used successfully in weeding carrots (11,19,23). A chemical which has been used in controlling weeds in onions is potassium cyanate (6,8,19). No chemical has provided entirely satisfactory weed control for our vegetables. This includes the sweet potato which has gone almost completely uninvestigated as far as chemical weed controls are concerned.

The sweet potato is the second most important vegetable crop in the nation. In Tennessee and in the South, it ranks first. The labor required per acre to grow sweet potatoes

ranks high when compared to many of our leading crops. It is important, therefore, that a practical and satisfactory method be found for the control of weeds for this crop.

One of the chemicals showing some possible merit is N-1 Naphthyl Phthalamio Acid. These experiments were set up to determine whether N-1 Naphthyl Phthalamio Acid was practical for weed control in sweet potato production.

CHAPTER II

REVIEW OF LITERATURE

One of the first chemicals used to control weeds in sweet potatoes was Sodium 2,4-Dichlorophenoxyethyl Sulfate, sold under the trade name of Crag Herbicide I. Wellman (24) reported that the experimental results were promising on sweet potatoes at lay-by time. The dosage varied from two to four pounds per acre, depending on the soil type. Lower rates were used on the lighter sandy soils.

In another early experiment carried on by Arle, Leonard, and Harris (2), activated carbon was used to reduce 2,4-D injury to sweet potato plants at planting time. The activated carbon protected the sweet potato plants completely against injury at the rates of 1.3 pounds per acre of 2,4-D. The higher rates of 2,4-D resulted in a loss of some plants. The yields from this experiment were: check, 319 bushels; 1000 ppm., 324 bushels; 2000 ppm., 298 bushels; 3000 ppm., 246 bushels; 4000 ppm., 234 bushels. Porto Rico Sweet Potato plants were moistened with water and the roots dusted thoroughly with activated carbon. A stick was used to force the roots into the 2,4-D treated soil soon after treatments.

Diesel fuel plus Sinox General, Dinitro, and 2,4-D applied as pre-emergence sprays gave good weed control in

sweet potatoes planted as small whole potatoes. According to Poole and Hernandez (15), Dinitro at the rates of six pounds per acre gave the best results. Diesel fuel plus Sinox General showed the highest yield per acre, out-yielding the hoed plots, but was second on weed control. There was no noticeable effect on the plants from this treatment or the Dinitro. There was some injury due to 2,4-D on plots treated with this material.

In a second experiment (15), Dinitro and CMU, 3-(p-chlorophenyl)-1,1-Dimethylurea, was used as a pre-planting spray in which all plants were vine cuttings. Dinitro, at the rates of four pounds per acre, gave the best results with 97.7 per cent weed control in the hand-planted plots. There was only 52.8 per cent control on machine planted plots. CMU at the rates of one-half pound per acre gave 47.7 per cent control of weeds in the hand planted plots and 24 per cent control in the machine planted plots.

Dinitro and CMU used as a post-planting spray at the rates of eight pounds per acre gave 44 per cent control of weeds. CMU at the rates of one pound per acre gave 28 per cent weed control.

Warren (21) found that Chloro IPC (Isopropyl N 3-chloro phenyl carbamate) at four pounds per acre reduced the total crabgrass numbers by over 50 per cent and at eight pounds per

acre by over 80 per cent. Stunting of the sweet potatoes varied from moderate to extremely severe, and the yields were significantly reduced in most treatments.

However, Warren (19,20) indicates that a new chemical, N-1 Naphthyl Phthalamic Acid, not yet on the market, has given best results of the chemicals tested in several states. It controls crabgrass and several broadleaved weeds.

Tests were conducted by Warren (13,20) on sweet potatoes using one, two, and four pounds of Phthalamic Acid per acre. He found this material would give over 50 per cent control of crabgrass when applied to sweet potatoes in wet soil. Dry soil treatments were less effective. He also found that sweet potato yields were reduced by this chemical.

Warren (21) used Phthalamic Acid on muskmelons at the rates of one, two, and four pounds per acre. He obtained 45 to 75 per cent reduction in crabgrass. Control increased with the rate of application. The muskmelons were delayed in maturing, but the total yield was not affected.

In Dutton's (5) resume presented to the North Central Weed Control Conference, he states that some experiments with N-1 Naphthyl Phthalamic Acid resulted in good weed control in sweet potatoes, with no reduction in yields, when a selective application of four pounds per acre was used. In the same report he states that others obtained only fair

weed control and lower yield when two to four pounds per acre was used.

Fair to good weed control in onions was obtained with Phthalamic Acid according to Dutton (5). The crop was not affected by this chemical.

Meador and Hemphill (13) used Naphthyl Phthalamic Acid in preliminary experiments with sweet potatoes. Treatments applied two weeks after the sweet potatoes were set gave 80 per cent control of broadleaved weeds and 70 per cent of grasses. Severe formative effects were apparent until harvest. Yields were slightly less than those obtained from the check plots.

Phthalamic Acid was used on cucumbers at the rate of four pounds per acre by Meador and Hemphill (13). Four weeks after treatment this material gave 28.2 per cent control of grasses and 64.8 per cent control of broadleaved weeds.

In other experiments by Meador and Hemphill (13), watermelons were treated with Phthalamic Acid at the rate of four pounds per acre. This chemical gave 79.5 per cent control of broadleaved weeds and 62.7 per cent control of grasses four weeks after treatment.

From similar studies with cucumber, muskmelon, watermelon, and squash, treated at the rates of one, two, four, six, and eight pounds per acre, Sweet and Ries (17) obtained favorable results. Naphthyl Phthalamic Acid at two pounds

per acre was effective in controlling weeds, whether used as a pre-emergence or a post-emergence application. Crop injury from pre-emergence sprays at this rate was negligible. The squash was injured by higher rates, but the other crops tolerated as high as six pounds per acre whether applied as a pre-emergence or a post-emergence spray.

According to Feldman and Smith (7), N-1 Naphthyl Phthalamic Acid is a selective herbicide and should be applied as a pre-emergence soil spray rather than as a contact herbicide. In their experiments they found that practical control was obtained for a variety of both monocotyledonous and dicotyledonous weeds for periods longer than one month at the rates of five, ten, and fifteen pounds per acre. The effectiveness of weed control increased with the rate of application. Cotton, soybeans, flax, pumpkin, corn, and snapbeans were not injured by pre-emergence applications at the rates of five pounds per acre, and with the exception of pumpkin, these crops appeared to tolerate ten pounds per acre. As a post-emergence spray (pre-emergence to weeds) five pounds per acre was quite safe on snapbeans and cotton and only slightly injurious to squash. Cotton appeared to be the most resistant of the crops in that rates as high as ten pounds per acre were tolerated without apparent ill effect. Contact sprays have no effect on young or established weeds.

A number of field tests were made at the Naugatuck Chemical Agricultural Experiment Station (13) with such crops as cotton, soybeans, flax, pumpkin, squash, corn, and beans. Phthalamic Acid gave an average of 92 per cent weed control in all crops, and with the exception of squash no phytotoxicity was evident. The existing weeds made little growth in all treated plots. All treatments were applied as pre-emergence sprays using 150 gallons of liquid per acre immediately after seeds were sown. Treatments were applied as twelve inch bands on the row at a rate of five pounds per acre of soil surface actually treated or as a total area spray in which the entire soil surface was treated at the same rate.

N-1 Naphthyl Phthalamic Acid has also been used on plants other than vegetable crops. Miller and Erskine (13) tested it on certain ornamental trees to prevent fruit formation. Horse Chestnut trees treated when the fruits were three-eighths inches in diameter eliminated fruits without injury to the foliage. Purple crab apple treated in the pre-pink stage at the rates of 5.4 ounces per 100 gallons of water plus Dowax at a ratio of 1:20 prevented fruiting without foliage injury.

Sugar beets are sensitive to Phthalamic Acid. Nelson (13,22) reported destruction of both weeds and sugar beets in pre-emergence applications at the rates of two and eight pounds per acre. At eight pounds per acre in 40 gallons

of water, White and Willard (13) got stunted beets by the two leaf stage. Eight weeks later there was little recovery.

Similar tests with beets were carried on by Sweet, Ries, and Patterson (18) at three different stations. In all cases two and six pounds of Phthalamic Acid per acre gave adequate weed control but injured the beets.

Hoffman and Smith (9,14,22) treated Bonny Best tomato plants with N-1 Naphthyl Phthalamic Acid and found at 0.1 ppm. the acid caused a leaf roll; at 1.31 ppm., epinasty; and at 20 ppm., stem swelling (greenhouse data). In the field test fruit set was completely inhibited at 20 to 2000 ppm. The vine weight was almost normal at 20 ppm., (the lowest concentration tested), but epinastic and morphological effects were severe.

Phthalamic Acid at the rates of ten pounds per acre gave some control of weeds in corn and soybeans in a screen test conducted at the University of Tennessee by Howell (10). Injury was noted in the soybeans, but there was no serious damage to the corn. Lower rates of this chemical were not effective as a weed control measure.

Hanson and Freeman (13) in comparative experiments found that at the rates of three and six pounds per acre N-1 Naphthyl Phthalamic Acid was less effective in weed control than 2,4-D at 1.5 pounds per acre. The principal weeds controlled were crabgrass and redroot pigweed.

Marshall (12) in a screening test found that Phthalamic Acid gave poor control of both broadleaves and quack grass when used alone or in combination with 2,4-D on corn.

This acid when used on lawns was ineffective to crabgrass in advanced growth stages according to research studies by De France and Simmons (3,16). It discolored and severely restricted the bentgrass turf. However, they found that chick weed was controlled by two applications of spray.

Dunham (4) reported work from the University of Wisconsin with Phthalamic Acid resulted in no control of foxtail. The applications were used as a post-emergence spray. No record was made regarding the effect on the crop.

Warren (22) reported the most appropriate rate of application of N-1 Naphthyl Phthlamic Acid, to obtain maximum weed control and minimum crop damage, was between two and four pounds per acre, although in some situations eight pounds seemed justified.

Warren (19,20,21,22) found this chemical is more active in the soil than on the foliage. It has given good control of germinating crabgrass and some broadleaved weeds in transplanted muskmelons and sweet potatoes on sandy soil. On muck soil weed control has been poor. The rates ran as high as sixteen pounds per acre.

According to the manufacturers of this chemical (Naugatuck Chemical Division) N-1 Naphthyl Phthalamic Acid

is a monobasic acid with a molecular weight of 291 and a melting point of 185 degrees C. It is a crystalline solid, almost insoluble in water, but slightly soluble in acetone, benzene, and ethyl alcohol. The sodium and potassium salts of the acid are very soluble. It is not stable in solutions above pH 9.5 nor at temperatures in excess of 200 degrees C. It is nonexplosive and is not corrosive to spray equipment.

Another new chemical N-1 Naphthyl Phthalimide, developed by Hoffman and Smith (9) along with Phthalamio Acid, has shown promise as a practical weed control for sweet potatoes and vine crops. According to Dutton (5) it is apparently safer on melons and sweet potatoes than the acid and gives as good or better weed control.

Warren (22) made comparative tests with N-1 Naphthyl Phthalimide and N-1 Naphthyl Phthalamio Acid and found the "imide" relatively inactive on the foliage of the plants. However, in the soil it gave results similar to the acid except that the herbicidal activity of the "imide" was sometimes delayed slightly and appeared to last longer. The apparent lack of direct foliage injury from the "imide" proved to be a definite advantage in spraying transplanted crops. This was especially true for sweet potatoes where the acid caused injury while the "imide" did not.

CHAPTER III

EXPERIMENTAL PROCEDURE

This experiment included a study of the field growth and production of one crop of Porto Rico Sweet Potatoes, where N-1 Naphthyl Phthalamic Acid was used as a pre-emergence spray to control the weeds. It began with the setting of plants in the spring and continued through harvesting and grading.

The material used in this work was N-1 Naphthyl Phthalamic Acid, code number 2-6Q8 formulation 2, obtained from the Naugatuck Chemical Division in the form of a wettable powder containing 90 per cent active ingredients.

The plots were on a Wolftever, silty clay loam soil, which is a fertile, second bottom land, well-drained and suited to sweet potato production. The previous year lespe-deza was grown on the plots, and it was fall plowed. Prior to ridging 800 pounds per acre of a 5-10-10 analysis fertilizer was broadcast and disked in the upper four inches. The rows were marked, and 400 pounds per acre of the same was applied in the rows, and the ridges were bedded on this. Ridges were made ten days before plant setting.

The experimental area was divided into twenty plots, each having an area of 200 square feet. Each plot consisted of two adjoining rows, four feet apart and 25 feet long.

There were four randomized plots for each treatment with a five foot alley between replications. The alleys minimized the effect of drift of material as well as facilitated harvesting. Guard rows bordered each side of the field.

Plants were grown in the Experiment Station beds, pulled, and taken directly to the field. They were set in the ridge one foot apart on May 13th. Moisture was low at this time, and many of these plants failed to survive. Those that lived were slow to recover. The dead plants were reset on May 26th. A light rain aided these newly set plants to recover quickly, and there was little noticeable difference between the two settings when the treatments were applied.

Each plot was hoed and clean-cultivated on June 4th, and treatments were applied on June 5th. At the time of application all plants had recovered from the shock of transplanting and were standing. Phthalamic Acid was applied at the rates of one, two, four, and six pounds per acre of the active ingredient. It was applied as a spray at the rate of 100 gallons per acre over the entire row and middle. No attempt was made to keep the material off the sweet potato plants. A plain water spray was applied to the check rows.

The temperature at the time of application was 93 degrees F., and the soil moisture was very low. A very light rain fell the first night after spraying, and the

temperature dropped considerably; however, it returned to 91 degrees F. the following day and remained hot and dry for the next four days. A 0.44 inch rain was recorded on June 9th. More rains came on June 10th, 12th, and 15th. The next twenty days were hot and dry.

Weather conditions throughout the growing season, for the most part, were hot and dry and unfavorable for best sweet potato growth. Soil moisture was low at the beginning of the season as the result of light spring rains and remained low during most of the growing season. The total rainfall for the period of this experiment was 14.13 inches.

Weed counts were taken, using a one foot square frame, at fifteen and thirty day intervals following the treatment. Counts were taken from three different places in each plot. Individual plot records were made of all plants that died during the first fifteen days after treatment. The different kinds of weeds and grasses present in the experimental area were recorded also. Frequent comparisons were made of the number of weeds and amount of spray injury present between plots.

On July 11th, which was 36 days after treatment, all plots were clean-cultivated with a hoe. No other cultivation was necessary, and the plots were free of weeds at harvest time.

The potatoes were harvested October 2nd. with a mechanical Irish potato digger and placed in bushel baskets.

Each basket was labeled in the field and then taken to the storage house, where they were graded and weighed prior to curing. The grades used were based on United States Standard grades with the addition of a grade for cracked potatoes.

The data were analysed by the analysis of variance method. Separate analyses were run on each of the following: total yields, marketable yields, number one yields, number two yields, and cracked potato yields.

CHAPTER IV

EXPERIMENTAL RESULTS AND DISCUSSION

In studying the effects of N-1 Naphthyl Phthalamic Acid on weeds and grasses, a list of the different species present in the entire experimental area was recorded as indicated in Table I. The more common of these species were crabgrass, morning glory, nutgrass, and poor John. Only a few plants of Johnson grass, lamb's quarter and smartweed were present.

Wide variations of weed and grass control occurred during the first fifteen days after treatment. Table II indicates the best weed control reduced weeds 64 per cent. This was in plots treated with four pounds per acre of Phthalamic Acid. The grass was reduced 76 per cent in plots treated with six pounds per acre. All other treatments failed to give more than 50 per cent control of weeds or grasses, and a few plots showed no control for either crabgrass or weeds.

The best control of grass was obtained in replicate four at rates of two and six pounds per acre, whereas the best control of weeds was in replicate three at the rates of four and six pounds per acre. This was probably due in part to moisture conditions. The topography was such that a portion of replicates one and two had a tendency to retain moisture for a slightly longer period.

TABLE I

TYPES OF WEEDS AND GRASSES PRESENT
IN THE EXPERIMENTAL AREA

Lambs' Quarter (*Chenopodium album*)

Prickly or False Mallow (*Sida spinosa*)

Milk Weed (*Asclepias syriaca*)

Johnson Grass (*Sorghum halepense*)

Rag Weed (*Ambrosia trifida*)

Crabgrass (*Digitaria* spp.)

Nutgrass (*Cyperus* spp.)

Morning Glory (*Ipomoea* spp.)

Poor John (*Diodia teres*)

Trumpet Flower (*Campsis radicans*)

Horsenettle (*Solanum carolinense*)

Smartweed (*Polygonum* spp.)

TABLE II

NUMBER OF BROADLEAF WEED AND GRASS SEEDLINGS PER 3 SQUARE FEET 15 DAYS AFTER
TREATMENT WITH N-1 NAPHTHYL PHTHALAMIC ACID

Number Weeds						Number Grasses				
Rates Per Acre						Rates Per Acre				
Replicates	Check	1 lb.	2 lb.	4 lb.	6 lb.	Check	1 lb.	2 lb.	4 lb.	6 lb.
1	18	26	29	10	16	3	9	32	5	2
2	42	26	9	10	9	11	9	1	3	1
3	13	10	11	6	2	3	3	3	2	3
4	19	10	8	7	17	9	8	0	3	0
Total	92	72	57	33	44	26	29	36	13	6
Average	23	18	14.25	8.25	11	6.5	7.25	9	3.25	1.5
Per Cent Of Check		78.26	61.95	35.87	47.82		111.53	148.46	50.00	23.07

Although some weed and grass control was evident, it was concluded from field observations that control of both weeds and grasses was unsatisfactory during this period. In plots where weed control was obtained, the number of remaining weeds was sufficient to cause considerable damage to the sweet potatoes.

Thirty days after treatment little change had occurred in the weed and grass population. Residual effects were present in the soil, and a slight increase in weed control was evident in certain plots according to Table III. This increase in control may be attributed in part to climatic conditions. No rain fell during the latter fifteen-day period, soil moisture was low, and the temperature was rather high.

Plant losses during the first fifteen days following treatment were very small. In all plots only 18 plants were lost, and five of these were in the check plots as indicated in Table IV.

Toxic effects on the sweet potatoes were slow to appear. Leaf injury was evident in some areas by the fourth day, and it was very noticeable by the tenth day. All treated plots were injured by the spray, which was also true in Warren's (13) experiment with sweet potatoes. Meader and Hemphill (13) reported severe formative effects were apparent in sweet potatoes until harvest. The degree of injury

TABLE III

NUMBER OF BROADLEAF WEED AND GRASS SEEDLINGS PER 3 SQUARE FEET 30 DAYS AFTER
TREATMENT WITH N-1 NAPHTHYL PHTHALAMIC ACID

Number Weeds						Number Grasses					
Rates Per Acre						Rates Per Acre					
Replicates		Check	1 lb.	2 lb.	4 lb.	6 lb.	Check	1 lb.	2 lb.	4 lb.	6 lb.
1	23	17	20	9	11	9	15	13	7	5	5
2	38	21	6	6	11	7	12	5	5	2	2
3	16	10	9	5	7	11	8	1	1	1	1
4	17	8	14	4	6	3	7	2	5	5	2
Total		94	56	49	24	35	30	42	21	18	10
Average		23.5	14	12.25	6	8.75	7.5	10.5	5.25	4.5	2.5
Per Cent Of Check			59.57	52.12	25.53	37.23		140.00	70.00	60.00	33.33

TABLE IV

LOSS OF PLANTS DURING THE FIRST 15 DAYS AFTER TREATMENT
WITH N-1 NAPHTHYL PHTHALAMIC ACID

Replicates	Check	Treatments Per Acre			
		1 lbs.	2 lbs.	4 lbs.	6 lbs.
1	0	2	0	0	1
2	4	3	0	1	0
3	1	0	0	2	0
4	0	0	0	2	2
TOTAL		5	0	5	3

varied with the treatments, with rates of four and six pounds per acre showing the greatest injury.

According to Table V all treatments indicated an increase in yields over the check plots. The highest total yields of all treatments was 274.75 pounds harvested from plots sprayed at the rates of two pounds per acre. The smallest yields of all treatments was 243.50 pounds produced by the check plots. Some of the reduction in yields from the check plots can be attributed to the loss of five plants soon after the spray was applied. The plots treated at the rates of two pounds per acre had a perfect stand. It is doubtful if the total difference of approximately 31 pounds should be attributed to the loss of only five plants.

The greatest difference in average yields between treatments, however, was only eight pounds. Plots treated with Phthalamic Acid at the rate of four pounds per acre ranked second in yield and gave the best control of broad-leaf weeds. It was found that six pounds per acre caused severe toxic conditions of the plants, and the yields were the lowest of the treated plots. When the data were analysed, no significant differences were found between treated and untreated plots.

A study of the average marketable plot yields in Table VI indicates that treatments of two pounds per acre produced more pounds than any other treatment used.

TABLE V

TOTAL POUNDS OF SWEET POTATOES PRODUCED FROM PLOTS
TREATED WITH N-1 NAPHTHYL PHTHALAMIC ACID

Replicates	Treatments					Total
	Check	1 lb.	2 lb.	4 lb.	6 lb.	
1	73.25	64.00	61.50	83.25	84.00	366.00
2	62.75	53.75	71.50	67.25	51.25	306.50
3	49.25	77.25	72.00	56.25	59.75	314.50
4	58.25	70.00	69.75	64.25	64.00	326.25
Total	243.50	265.00	274.75	271.00	259.00	1313.25
Average	60.87	66.25	68.68	67.75	64.75	328.31
L.S.D.	No Significant Difference					

TABLE VI

POUNDS OF MARKETABLE SWEET POTATOES PRODUCED FROM PLANTS
TREATED WITH N-1 NAPHTHYL PETHALANIC ACID

Number 1, 2, Jumbos						
Treatments						
Replicate	Check	1 lb.	2 lb.	4 lb.	6 lb.	Total
1	53.25	42.00	50.00	52.50	66.25	264.00
2	49.00	36.75	58.00	55.25	35.25	234.25
3	40.25	64.00	58.00	41.50	53.25	257.00
4	39.25	51.25	63.00	42.00	49.50	245.00
Total	181.75	194.00	229.00	191.25	204.25	1000.25
Average	45.43	48.50	57.25	47.81	51.06	
L.S.D.	No Significant Difference					

Marketable potatoes included number one, number two, and jumbo size. Applications of six pounds per acre was second, and one pound per acre, third in marketable yields. The greatest difference in average yields between treatments was approximately twelve pounds. In each treatment the average marketable yields were higher for the treated plots than for the check plots. However, when the data were analysed by the analysis of variance method no significant difference was found between the treated and check plots.

According to Table VII each treatment showed an increase in number one grade sweet potatoes over the check plots with rates of two and six pounds per acre producing the highest yields. According to Table IV rates of two pounds per acre maintained a perfect stand of sweet potatoes, whereas three plants were missing in treatments of six pounds per acre. All other treatments had five plants missing. The lowest yields of number ones were obtained from the check plots which also produced the smallest total crop and marketable potatoes as indicated in Tables I and II respectively. Replicate one produced the highest yield of number one sweet potatoes, and replicate two produced the lowest yield. Tables I and II indicate similar results of these two replicates regarding marketable and total yields. No significant difference was shown when the data were statistically analysed.

TABLE VII

POUNDS OF NUMBER 1 GRADE SWEET POTATOES PRODUCED FROM
PLOTS TREATED WITH N-1 NAPHTHYL PHTHALAMIC ACID

Treatments						
Replicate	Check	1 lb.	2 lb.	4 lb.	6 lb.	Total
1	47.25	35.25	36.75	51.75	57.25	228.25
2	37.00	28.75	46.00	43.50	31.00	186.25
3	33.25	55.00	50.25	32.00	40.00	210.50
4	28.25	39.75	47.75	33.25	42.25	191.25
Total	145.75	158.75	180.75	160.50	170.50	816.25
Average	36.43	39.68	45.18	40.12	42.62	204.06
L.S.D.	No Significant Difference					

The yields per treatment of number two sweet potatoes follow similar trends as in the yields of number one sweet potatoes. Rates of two pounds per acre continued to lead in production, but no significant difference in yields was noted between the treatments as shown in Table VIII. The highest yielding replicate was number four.

Fewer culls were produced in the plots receiving treatments of six pounds per acre. The highest yields of culls were produced in the check plots and those sprayed at the rates of two pounds per acre. Individual plot yields as recorded in Table IX, varied from 4.75 pounds to 11.25 pounds, while little difference was noted in average yields between treatments.

Table X indicates there were wide variations between plots in the number of pounds of cracked sweet potatoes produced. The most favorable applications in this instance were two and six pounds per acre. The two pound spray solution produced 15.50 pounds while four pounds gave 42.50 pounds of these potatoes.

In spite of the fact that some control of weeds and grasses was evident, the conclusion is that N-1 Naphthyl Phthalamic Acid as a weed control has proven unsatisfactory in this experiment. Field observations have shown that the number of remaining weeds in each treatment were sufficiently large to cause considerable damage to the sweet potatoes.

TABLE VIII

POUNDS OF NUMBER 2 GRADE SWEET POTATOES PRODUCED
FROM PLOTS TREATED WITH VARIOUS AMOUNTS
OF N-1 NAPHTHYL PHTHALAMIC ACID

Treatments						
Replicates	Check	1 lb.	2 lb.	4 lb.	6 lb.	Totals
1	6.00	6.75	13.25	9.75	6.75	42.50
2	12.00	8.00	12.00	11.75	4.25	48.00
3	7.00	9.00	7.75	9.50	13.25	46.50
4	11.00	11.50	15.25	8.25	6.75	52.75
Total	36.00	35.25	48.25	39.25	31.00	189.75
Average	9.00	8.81	12.06	9.81	7.75	47.43
L.S.D.	No Significant Difference					

TABLE IX

POUNDS OF CULL SWEET POTATOES PRODUCED FROM PLOTS
TREATED WITH N-1 NAPHTHYL PHTHALAMIC ACID

Replicates	Treatments					Totals
	Check	1 lb.	2 lb.	4 lb.	6 lb.	
1	7.75	7.50	8.25	8.75	8.75	41.00
2	7.75	6.25	10.75	6.25	7.00	38.00
3	9.00	6.50	8.00	5.50	4.75	33.75
4	7.75	11.25	6.75	8.25	5.00	39.00
Total	32.25	31.50	33.75	28.75	25.50	151.75
Average	8.06	7.87	8.43	7.18	6.37	37.93

TABLE X

YIELDS PER PLOT OF CRACKED SWEET POTATOES FOLLOWING
TREATMENT OF N-1 NAPHTHYL PHTHALAMIC ACID

Replicates	Treatments					Total
	Check	1 lb.	2 lb.	4 lb.	6 lb.	
1	12.25	14.50	3.25	13.00	9.00	52.00
2	6.00	10.75	2.75	5.75	9.00	34.25
3		6.75	6.00	9.25	1.75	23.75
4	11.25	7.50	3.50	14.50	10.00	46.75
Total	29.50	39.50	15.50	42.50	29.75	156.75
Average	7.37	9.87	3.87	10.62	7.43	39.18
L.S.D.	No Significant Difference					

Burning of the sweet potato leaves, and stunting of plant growth was evident for several days from the use of Phthalamic acid. The sweet potato plants completely recovered from the early toxic effects of the spray, and no significant difference was noted in the yields.

Considering the cost of material, equipment, and labor, with the amount of weed control obtained in this experiment, the results do not encourage the recommendation of this chemical to the farmer as a partial solution to the weed problem in sweet potatoes.

CHAPTER V

SUMMARY

Since World War II, chemical weed control has expanded into a wide field of research. Many chemicals have been tested on numerous crops, but weed control with sweet potatoes has been slow. Some of the newer chemicals have shown promise in this crop. Therefore, the purpose of this experiment was to determine if N-1 Naphthyl Phthalamic Acid would be effective in controlling weeds in sweet potatoes.

The acid, code number 2-6Q8 formulation 2, was used as a pre-emergence spray to the weeds at the rates of one, two, four, and six pounds per acre. Treatments were applied after the sweet potato plants had completely recovered from the shock of transplanting. The soil was dry, and the temperature was 93 degrees F. Weather conditions throughout this experiment for the most part, were hot and dry and unfavorable for best sweet potato growth. Soil moisture was low at the beginning of the season as the result of light spring rains and remained low during most of the growing season.

Weed and grass control was very unsatisfactory in many of the plots. At the end of fifteen days after treatment, rates of four and six pounds per acre gave 64 per cent control of weeds and 76 per cent control of grasses, respectively, which were the maximum results obtained.

Toxic effects on the plants were noticeable after the fourth day, and the degree of injury varied with the treatments. Four and six pounds per acre treatments showed the greatest injury.

Treatments with this chemical did not significantly affect the yield of this crop, although sprayed plots showed a slight increase in yields over all check plots. Solutions of two pounds per acre produced the highest total yield and also ranked highest for marketable yields. The check plots produced more culls than any of the treatments.

The data on total yields, marketable yields, number one yields, number two yields, and cracks were statistically analysed and no significant difference was found.

BIBLIOGRAPHY

LITERATURE CITED

1. Alban, M. K., and Keirns, V. E. "2,4-D as a Herbicide With Asparagus", Proceedings Fourth Annual Meeting North Central Weed Control Conference, (December, 1947), 227.
2. Arle, H. F., Leonard, O. A., and Harris, V. C. "Effect of Activated Carbon in Reducing the 2,4-D Injury to Sweet Potato Sprouts," Proceedings Fourth Annual Meeting North Central Weed Control Conference, (December, 1947), 249.
3. De France, J. A., and Simmons, J. A. "A Comparison of Chemicals For Crabgrass Control And A Study of Some Factors Related to the Control of Crabgrass With Phenyl Mercury Compounds," Proceedings of the Sixth Annual Meeting Northeastern Weed Control Conference, (January, 1952), 70.
4. Dunham, R. S. "Control of Annual Grasses," Proceedings Eighth Annual Meeting of the North Central Weed Control Conference, (December, 1951), 67.
5. Dutton, W. C. "Summary of Results With New Herbicides," Proceedings Eighth Annual Meeting of the North Central Weed Control Conference, (December, 1951), 107.
6. Ellis, M. K. "Potassium Cyanate As A Weed Control Chemical For Onions," Proceedings Fifth Annual Meeting North Central Weed Control Conference, (December, 1948), 48-51.
7. Feldman, A. W., and Smith, Allen E. "Phthalamic Acid Derivatives For Pre-emergence Weed Control," Southern Weed Conference Fifth Proceedings, (February, 1952), 12-14.
8. Hedlin, W. A. "Chemical Weed Control In Onions," Proceedings Of the American Society For Horticultural Science, Vol. 51 (1948), 501-504.
9. Hoffman, Otto L., and Smith, Allen E. "A New Group of Plant Growth Regulators," (Technical Papers), Science, Vol. 109, (June 10, 1949), 588.
- 10 Howell, David. "Reaction of Corn and Soy Bean to Certain Herbicides," University of Tennessee: Unpublished Special Problem, (June, 1952).

11. Keirns, V. E., Patterson, Vernon, and Alban, E. K. "Chemical Weed Control In Horticultural Crops," Department of Horticulture, Ohio State University, (March, 1949), 1, 2.
12. Marshall, Ernest R. "Preliminary Results With Herbicides Other Than 2,4-D For Weed and Grass Control In Field Corn," Proceedings of the Sixth Annual Meeting Northeastern Weed Control Conference, (January, 1952), 229.
13. N. P. Information Sheet No. 1. U. S. Rubber Company, Naugatuck Chemical Division, Naugatuck Connecticut, (December, 1951), 2-3, 4, 5, 6.
14. Plant Growth Regulants for Sampling by U. S. Rubber Company Phthalamic Acid and Phthalimides. Naugatuck Chemical, Division of U. S. Rubber Company, Development Department, Naugatuck, Connecticut, (Mimeographed), 2.
15. Poole, Wiley D., and Hernandez, T. P. "A Progress Report on Weed Control In Mechanized Production of Sweet Potatoes," Southern Weed Conference Fifth Proceedings, (February, 1952), 162-165.
16. Simmons, J. A., and DeFrance, J. A. "The Effectiveness of Chemicals For the Control of Mouse-ear Chickweed in Turf," Proceedings of the Sixth Annual Meeting Northeastern Weed Control Conference, (January, 1952), 78-81.
17. Sweet, R. D., and Ries, S. K. "Chemical Weeding of Curcubits," Proceedings of the Sixth Annual Meeting Northeastern Weed Control Conference, (January, 1952), 187-191.
18. Sweet, R. D., and Ries, S. K., and Patterson, M. E. "Chemical Weeding of Red Beets," Proceedings of the Sixth Annual Meeting Northeastern Weed Control Conference, (January, 1952), 111-115.
19. Warren, G. F. "Chemical Weed Control In Vegetable Crops," Purdue University, Lafayette, Indiana, (December, 1952), (Mimeographed), 1-3.
20. ———, "New Weed Killers Promise Better Control," Market Growers Journal, (February, 1952), 26-34.

21. _____, "Partial Lists of New Herbicides and New Uses For Old Ones," Lafayette, Indiana: Purdue University, (1951), (Mimeographed).
22. _____, "Weed Control in Certain Vegetable Crops With N-1 Naphthyl Phthalamic Acid," Proceedings Eighth Annual Meeting of the North Central Weed Control Conference, (December, 1951), 41.
23. _____, "Summary of 2,4,5-T (On Vegetable and Field Crops), MCP, PCP, Oils and Miscellaneous New Herbicides," Proceedings of the Fifth Annual Meeting North Central Weed Control Conference, (December, 1948), 174.
24. Wellman, R. H. "Herbicidal Properties of Sodium 2,4-Dichlorophenoxyethyl Sulfate," Proceedings Eighth Annual Meeting North Central Weed Control Conference, (December, 1951), 103.