SOLANUM CAROLINENSE AND *SORGHUM HALEPENSE* CONTROL IN PEANUTS (*ARACHIS HYPOGAEA* L.)

By

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SOLANUM CAROLINENSE AND SORGHUM HALEPENSE

CONTROL IN PEANUTS (ARACHIS

HYPOGAEA L.)

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CHAPTER I

INTRODUCTION

Herbicides have been used for many years for control of annual weeds in peanuts, and their use has become an established practice. However, as some weeds were controlled, other species emerged as problems. These ecological shifts often involve either a change to herbicide-resistant annual broadleaved weeds or to deep-rooted perennial species.

Johnsongrass (Sorghum halepense L.), a perennial, has become a serious problem in the southern United States in peanuts and many other cultivated crops. Johnsongrass has become a problem because it has two means of plant propagation. It not only can reproduce by seed but also can reproduce a new plant at each node of the underground rhizomes. After johnsongrass plants are six weeks old they may already be producing rhizomes, and after one summer this seedling will have a very extensive rhizome system. Cultural control of johnsongrass is difficult and the problem with chemical control is to get the herbicide into the rhizomes and keep it there long enough to kill them. Thus, field experiments were conducted to develop improved control procedures for johnsongrass.

Another perennial weed that is becoming a greater problem in peanuts is horsenettle (Solanum carolinense L.) This species has survived years of cultural control practices and herbicide treatments and occurs in isolated areas of large tracts of land. Horsenettle has also become a serious problem because of two methods of propagation. Horsenettle seed has been shown to have 68 percent viability. It also has a large tap root that is capable of propagation when sectioned. This means that normal disking procedures may spread this serious pest on cropland.

Horsenettle is also a problem because of competition with the peanut crop and because it can cause the grade of harvested peanuts to be reduced, because the fruit of horsenettle cannot be separated from the peanuts and the fruit balls cause spoilage of stored peanuts.

As with johnsongrass, the problem is to find herbicides that will kill the tops and also translocate into the taproot and kill it. Field experiments were conducted to correlate herbicide activity to horsenettle population reduction, fruit suppression, complete control, and the susceptibility of peanuts.

CHAPTER II

LITERATURE REVIEW

Peanuts

Peanuts are a high-value cash crop in Oklahoma. They are valued for the high protein and oil. They are a member of the Papilionaceae family (55). In Oklahoma 118,000 acres were planted in peanuts in 1971 and 90 percent were treated with herbicides to control weeds (6). The plants produce best with high soil fertility and 42 to 54 inches of water (either by rainfall or irrigation) on a light sandy loam soil (55).

When peanuts are harvested, samples are taken to determine the grade classification. Then they are sold according to their quality. The grading of peanuts is based on many things, but one visible form of grade reduction is caused by the presence of foreign material. This material may be composed of rock, sand, vinestalks, or other substances (55). A common contaminant in Oklahoma is the fruit of the horsenettle plant.

To obtain maximum peanut production in Oklahoma, weed competition must be prevented. Commonly applied herbicides include trifluralin (all chemical herbicide names are listed in Table I), alachlor, benefin, dinoseb, vernolate, and several of these herbicides in combination (21). These herbicides control most annual grasses and broadleaved weeds, but

TABLE I

COMMON AND CHEMICAL NAMES OF HERBICIDES

Common Name	Chemical Name
Alachlor	2-chloro-2',6'diethyl-N-(methoxymethyl) acetanilide
Amitrole	3-amino-s-triazole
Asulam	methyl sulfanilylcarbamate
Benefin	N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine
Bromacil	5-bromo-3-sec-butyl-6-methyluracil
Butralin	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine
Dalapon	2,2-dichloropropionic acid
Dicamba	3,6-dichloro-o-anisic acid
Dinitramine	N^4,N^4-diethyl-α,α,α-trifluoro-3,5-dinitro-toluene-2,4-diamine
Dinoseb	2-sec-butyl-4,6-dinitrophenol
DMPA	O-(2,4-dichlorophenyl) O-methyl isopropyl-phosphoramidothioate
DPX 1840	3,3a-dihydro-2-(p-methoxyphenyl)-8H-pyrazolo-(5,1-a) Isoindol-8-one
EPTC	S-ethyl dipropylthiocarbamate
Glyphosate	N-(phosphonomethyl)glycine
Methazole	2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione
MBR 4400	Chemical name not available
MSMA	monosodium methanearsonate
Napropamide	2-(α-napthoxy)-N,N-diethylpropionamide
Naptalam	N-1-naphthylphthalamic acid

TABLE I (CONTINUED)

Common Name	Chemical Name
Nitralin	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropyl-aniline
Oryzalin	3,5-dinitro-N^4,N^4-dipropylsulfanilamide
Paraquat	1,1'-dimethyl-4,4'-bipyridinium ion
Picloram	4-amino-3,5,6-trichloropicolinic acid
Profluralin	N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine
San 6706	Chemical name not available
Silvex	2-(2,4,5-trichlorophenoxy)propionic acid, propylene glycol (C_3H_6O to $C_9H_{18}O_3$)butyl ether esters
Terbacil	3-tert-butyl-5-chloro-6-methyluracil
Trifluralin	α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
2,4-D amine	(2,4-dichlorophenoxy)acetic acid, diethylamine salt
2,4-DB ester	4-(2,4-dichlorophenoxy)butyric acid, butoxy-ethanol ester
2,4,5-T	(2,4,5-trichlorophenoxy)acetic acid
Vernolate	S-propyl dipropylthiocarbamate

most perennial species, such as johnsongrass and horsenettle, are not affected.

Johnsongrass

Johnsongrass is a perennial grass found in open areas, fields, and waste places. It can be cultivated for forage, but it is a troublesome weed in most crops. It is a native of the Mediterranean region and is found throughout approximately the southern half of the United States (52). It was introduced into the United States in the early nineteenth century (36). Holm (27) stated that johnsongrass had become one of the world's most troublesome weeds. McWhorter (34) reported that the reason it is such a problem is that it produces seed as most other plants do, but it also can reproduce from buds on an extensive rhizome system. Oyer, Grier and Rogers (43) stated that seedling johnsongrass produces rhizomes within a few weeks. McWhorter (34) showed the greatest rhizome production to occur after seed head formation. Anderson, Appleby and Weseloh (2) found a growth of 5,200 internode lengths of rhizome growth in 4.5 months. Apical dominance of the rhizome buds, as demonstrated by Beasley (9), gives the plant great spreading power. McWhorter (37) showed that rhizomes dehydrated 65 percent still germinated after 16 days. Hull (29) reported emergence of rhizomes from a depth of 60 cm. He also stated that the optimum temperature for growth of rhizomes is 30^{o} C. Rhizome bud germination was suppressed at 15^{o} C. Rhizomes failed to exhibit cold hardiness at any time in the life cycle. McWhorter (35) showed a 45 percent reduction of soybean yields due to johnsongrass. Millhollon (39) found similar reductions in sugarcane.

Several researchers have worked on chemical control of johnsongrass.

Woerstermeyer and Cooper (54) found that rhizomes re-invaded after one year's treatment with chlorate herbicides. Millhollon (39) stated that organic arsenic herbicides and dalapon gave good control for one year. With addition of bromacil, seedling grass was killed. McWhorter (37) stated that a summer fallow program with trifluralin incorporated inhibits rhizome growth in the incorporated layer. Hicks (25) stated that dalapon is a short residual johnsongrass herbicide for one-year control. Dalapon at 7.4 lb/A caused 85 to 95 percent control of rhizome johnsongrass (26). Hull (28) stated that rhizome buds fail to accumulate dalapon. Hamilton (22) found that the major disadvantage of dalapon and organics is that repeated application is needed. Parochetti (44) showed that dalapon with trifluralin resulted in 79 percent control after three years. Gonzales (20) showed that bromacil at 8 lb/A provided 90 percent control of rhizome johnsongrass. Standifer and Thomas (47) showed that trifluralin kills seedling johnsongrass if incorporated properly. Millhollon (40) found that trifluralin applied at 1½ and 3 lb/A induced 54 to 84 percent control, respectively, of 6-inch rhizome joints planted in the incorporated layer. Jones and Edmondson (30) found that a double rate of trifluralin disked in for two years resulted in good control of rhizome johnsongrass.

A new herbicide that looks promising for johnsongrass control is glyphosate. Several investigators (8, 11, 46) found that 2- to 40-inch johnsongrass treated with 2 lb/A of glyphosate gave better control than dalapon or MSMA and at 3 lb/A gave excellent results. Fell, Helpert and Merkle (17) showed that glyphosate applied to the soil and planted to <u>Sorghum</u> <u>bicolor</u> the next year did not show any crop injury. Apparently glyphosate has no soil activity. Upchurch, Baird and Bigeman (49) showed that glyphosate had greater phytotoxicity at higher temperatures. Dowland and Tweedy (15) reported that all rates of glyphosate applied gave good top kill. They found more control of rhizome johnsongrass at maturity. Baird and Upchurch (8) reported that early tillage of glyphosate-treated johnsongrass gave less control. They (7) also reported that better control of glyphosate-treated johnsongrass was obtained if tillage was held off 4 to 7 weeks after treatment. Overton, Mullins and Jeffery (42) showed that cotton and soybeans showed some tolerance to glyphosate at taller stages. Worsham (56) reported that glyphosate looked good on johnsongrass in no-till corn. Dertwig, Andrews, Duncan and Frost (14) reported increased activity of glyphosate on johnsongrass in the fall. They attributed this increased activity of glyphosate to greater rhizome commitment, larger canopy reception, more active transport to reproductive and storage organs and prevented recovery during the winter months.

Horsenettle

Horsenettle is a perennial broadleaved species found throughout much of Oklahoma and the southern and eastern United States. The plant grows to be eight to eighteen inches tall, has small spines protruding from the stems and veins of the alternating leaves, and is more commonly found growing in a sandy soil. The fruits are yellow in color and are approximately 0.5 to 1.5 inches in diameter (3), being similar in size and weight to an unshelled peanut.

The horsenettle plant is classified as belonging to the Solanaceae family (17). Two species are commonly found in Oklahoma. They vary slightly from each other in growth characteristics. Solanum carolinense

L. is the most widely known. It has the minute stellate or star shaped hairs which cover the plant, sessile or appressed against the stem and leaves. Solanum torreyi Gray varies primarily in the attachment of the stellate hairs. Small stipules raise the hairs slightly off the stem and leaves. Both species may have either violet-to-bluish or white flowers and are similar in size and other characteristics (2). Horsenettle has two methods of propagation, the seed and taproot sections. Furrer (19) found that the fruit of the horsenettle contains an average of 86 seeds. Of these seed, 2 to 12 percent are capable of sprouting the following spring. Subsequent studies found seed viability as high as 67 percent, which indicates seed may be a prime factor of dissemination (3).

Another means of plant propagation has been the sectioning of the taproot from an established plant. Furrer (19) found that sections of root planted three feet deep in the soil developed into new plants. Root sections less than one inch long by 0.187 inches in diameter were capable of plant propagation. Depth of the sections in the soil did not prevent emergence unless root sections were planted twelve inches or deeper. Normal cultivation procedures do not control the horsenettle but instead spread it (3). Plowing and disking, which dissect the taproot and spread these sections, may account for the gradual increase in size of the infestation.

Several herbicides have given season-long control of horsenettle. Bradbury (10) found summer applications of several phenoxy and benzoic compounds capable of top kill or fruiting suppression, but not of residual control. He also reported that 32 lb/A of phenoxy compound controlled 100 percent of the horsenettle the following year. Frieser

(18) reported that 2,4,5-T at 3 lb/A caused good top kill. Albert (1) found that 2,4-D and 2,4,5-T were very effective for control of horsenettle for one season, but that regrowth occurred the following year. Trapaidze (48) reported that dicamba at 18 lb/A resulted in excellent foliage kill and root kill to a depth of one-sixteenth of an inch. Reis (45) showed partial control of horsenettle in horticultural crops with bromacil and terbacil. de Hertogh, Hooks and Klingman (13) reported EPTC at 1 lb/A repeated three times and DMPA gave some control of horsenettle.

Application and tillage may also affect response to herbicides. Horsenettle roots reach their lowest starch content about 30 days after emergence (3), and translocation to the roots appears greatest from this time on. Augustein (5) showed that dicamba translocates more readily to roots than does 2,4-D. However, this was a small amount considering the amount applied. Matthiesen and Santelmann (33) found that dicamba, picloram, 2,4-D and 2,4-DB provided good control of horsenettle. Several different investigators (4, 32, 50) reported that 2,4-DB is inherently nonphytotoxic and requires conversion to 2,4-D via beta-oxidation for expression of its herbicidal properties. Glyphosate also has potential for horsenettle control.

Heikes (23) showed that glyphosate applied at 2 lb/A gave good control of Canada thistle (Cirsium arvense), a perennial broadleaved weed. Lee (31) stated that glyphosate is translocated from aboveground parts to the roots. He also showed that glyphosate translocated best in perennial broadleaved weeds when the sink site shifted to the root system shortly after flowering. Cooly and Smith (12) showed that glyphosate applied on silverleaf nightshade (Solanum eleagnifolium) gave better control in the later stages of growth. They also found that glyphosate applied at 3 lb/A resulted in 100 percent control after seven months. Early clipping reduced the control obtained. Warner (51) has done some work with the straight and V-shaped sweep blades in control of perennial weeds and found that the V-shaped blade gave good results.

CHAPTER III

MATERIALS AND METHODS

Experiments were conducted in 1972 and 1973 in various areas in Oklahoma to evaluate herbicides for selective control of horsenettle and johnsongrass in peanuts. The johnsongrass experiments were conducted at the Agronomy research stations, both in Stillwater and west of Lake Carl Blackwell. The horsenettle experiments were conducted at the Perkins Agronomy Experiment Station, the Caddo County Peanut Research Station, 10.5 miles north of Cromwell, and three miles north of Shawnee, Oklahoma.

All field treatments were applied to heavy stands of native horsenettle or johnsongrass. An experimental-plot tractor-mounted boom-sprayer was utilized to apply treatments unless otherwise noted. In the field experiments 30 gallons per acre (gpa) of water carrier was used except where noted. A completely randomized block experimental design was utilized. The visual injury ratings are taken on a scale of 0-100 with 0 representing no injury, grading to 100, which represents complete top kill. The herbicides used in the various studies are listed with the respective studies and all chemical names are listed in Table I. All studies are on well established horsenettle or johnsongrass unless otherwise noted. Detailed spraying information for both the johnsongrass studies and the horsenettle studies is given in Tables XV and XVI, respectively (see Appendix, pages 55-64).

Johnsongrass Control Studies

Preplant Incorporated Treatments

Treatments were applied to this experiment (Experiment A1) either in the fall, the spring, or at both times, for three years from the fall of 1970 through 1973, except that treatments were not applied in the fall of 1972 because of very wet weather. The experimental area was freshly disked prior to fall and spring treatments and was free of organic trash. Incorporation was with a tandem disk set to cut approximately two inches deep and was done within one hour of herbicide application. This area was plowed six inches deep each fall after the excessive plant material was removed. No additional tillage was allowed during the growing season. Environmental and field data of all johnsongrass field experiments are shown in Table XV (see Appendix, pages 55-60).

Control in Five Crops

An experiment was conducted at Stillwater in 1972 and 1973 (Experiment A2) to evaluate various herbicides (Table II) for control of johnsongrass and to determine their selectivity toward five crops (sorghum, peanuts, mungbeans, soybeans, and cotton). Preplant incorporated treatments were disked into the soil two inches deep within one hour after treatment. The crops were then planted and the one preemergence treatment applied to the soil surface. The postemergence treatments were applied to johnsongrass in 1972 when it was in the heading stage. These postemergence treatments were sprayed in 40 gallons of water per acre (gpa). These treatments were sprayed over the crop in 1972 and the crop was replanted without any re-treatment in 1973.

Comparison of Asulam and Glyphosate

Two experiments were conducted in 1972 and 1973 at Stillwater and at Lake Blackwell to evaluate glyphosate and asulam for johnsongrass control. These experiments were combined into Experiment A3. Treatments were applied postemergence to actively growing johnsongrass at the 18-inch, boot, and head stages. Most of these treatments were hand applied in one gallon of water per 100 square feet. The only exception was one treatment of glyphosate at 1/3 lb a.i. per five gallons of water sprayed until the plants were wet.

Fall Glyphosate Treatments

Three experiments were conducted at Stillwater and Lake Blackwell to evaluate glyphosate and asulam and their effect on established johnsongrass as a fall treatment. These three experiments were combined into Experiment A4. Treatment with the Mon 1139 formulation of glyphosate was applied to one experiment in Stillwater in 1971. All experiments after this time used the Mon 2139 formulation of glyphosate with surfactant already in it. The johnsongrass was at early heading, 26- to 36-inch stage of growth, having been mowed earlier. This experiment was repeated in 1972 with a hand sprayer and one gallon of water per 100 sq. ft. The other two experiments were treated in the fall of 1972 and were not re-treated. The glyphosate treatments were applied in one gallon of water per 100 sq. ft. and some spot treatments were applied as a.i. per 5 gallons of water, sprayed until the plants were wet.

Height vs Month of Treatment

This experiment (Experiment A5) was conducted in 1973 at Lake Carl Blackwell to evaluate glyphosate and its effect on johnsongrass at three different stages--18-inch, 36-inch, and 48-inch. These three heights were applied in each of three months--June, July, and August--all with three rates of glyphosate. The June plots were spring growth. The July and August plots were mowed and allowed to regrow to the proper stage. Trifluralin at 3/4 lb/A was incorporated two inches deep over the whole experiment to control seedling johnsongrass.

Preplant Control with Glyphosate

An experiment (Experiment A6) was conducted to evaluate glyphosate for johnsongrass control prior to planting cotton and soybeans. Glyphosate was applied to johnsongrass at five stages of growth--6, 12, 18, 24, and 36 inches. Each plot was then subdivided into two smaller subplots. One subplot was disked four days after treatment. The other subplot was disked and prepared for planting eight days after treatment. Then cotton and soybeans were planted into each subdivided plot. This allowed evaluation of johnsongrass control at different stages and at two disking dates, as well as evaluation of any injury to the crops planted into the plots. The 24- and 36-inch stage plots were treated with 3/4 lb/A of trifluralin disked in two inches deep prior to planting. The 6-, 12-, and 18-inch plots were not treated with trifluralin. Glyphosate was applied at 3 and 4 lb/A at the three smaller heights and at 2, 3, and 4 lb/A on the 24- and 36-inch heights.

Glyphosate Spot Treatment

Another experiment (Experiment A7) was conducted to evaluate glyphosate spot treatments on johnsongrass at two growth stages. Johnsongrass plots were mowed and the johnsongrass allowed to regrow to the proper stage for treatment (36 inches, boot stage and 48 inches, heading stage). Trifluralin was applied to this experiment in the winter of 1973 at 3/4 lb/A and disked approximately 2 inches deep prior to 1974 evaluations.

Bromacil-Glyphosate Combinations

An experiment (Experiment A8) was conducted at Lake Blackwell to evaluate treatments for industrial johnsongrass control. Glyphosate was applied for quick top kill and the bromacil was used for residual control. These two herbicides were applied in four ways: both were added together in a tank mix; bromacil was applied, and then glyphosate was applied one hour later; bromacil was applied and then glyphosate was added two weeks later; or glyphosate was applied and then bromacil was added two weeks later. Two rates of bromacil (15 and 20 lb/A) were combined with 2 and 3 lb/A of glyphosate for four possible combinations. These treatments were applied at two growth stages, to 24- or 48-inch johnsongrass. Each stage was mowed and allowed to regrow to the proper stage before treatment.

Horsenettle Control Studies

Preliminary Treatments of Horsenettle

A two-year experiment (Experiment B1) was conducted to evaluate complete control or population reduction of horsenettle with various herbicides. Nineteen days after treatment in 1972, half of each plot was disked. This same treatment was applied again in 1973. Each year the horsenettle was treated in the postbloom stage. The boom sprayer was mounted on pipes on the back of the experimental plot sprayer tractor to adjust to proper height. This experiment was on fallow ground in a heavy stand of horsenettle.

Secondary Treatments of Horsenettle

Another experiment (Experiment B2) was conducted near Cromwell to evaluate various herbicides and their effect on horsenettle in the bloom stage. This was a two-year experiment, with each plot treated once in 1972 and once in 1973.

Glyphosate at Different Times

Two experiments were conducted to evaluate glyphosate and its effect on horsenettle at different stages of growth and in different months. These two experiments were combined into Experiment B3. In the first experiment, horsenettle at the fruiting stage was treated with 2 and 4 lb/A of glyphosate in June and July. These plots were not re-treated. In the second experiment the horsenettle was treated at one of three stages of growth--prebloom, bloom, or fruit set. Glyphosate was applied at 2, 3, and 4 lb/A in July, August and September. All treatments were mowed and allowed to regrow to the proper stage before treatment.

Control at Different Growth Stages

An experiment (Experiment B4) was conducted at Shawnee to evaluate three herbicides and their effect on horsenettle at five different growth stages--sprouting (0-6 inches), prebloom (6-12 inches), bloom (12-18 inches), postbloom (18-24 inches), and fruit set (18-24 inches). The plots were disked in June and allowed to regrow to the proper stage before treatment.

Control in Peanuts

An experiment (Experiment B5) was conducted at Ft. Cobb to evaluate herbicides for horsenettle control and crop response in peanuts. This experiment was divided into two parts, groundcrack and postemergence treatments. The groundcrack treatments were applied when the peanuts were just emerging through the ground and the horsenettle was 2 to 3 inches tall. The postemergence treatments were applied after the peanuts were ten inches tall and fourteen inches in diameter and the horsenettle were at the bloom stage. This experiment was conducted in peanuts heavily infested with horsenettle. This experiment was set up so that each plot consisted of two rows of peanuts per bed and four beds per plot. One half of each plot was used for groundcrack treatments and the other half for postemergence treatments.

Subsurface Treatment

Two experiments were conducted at Cromwell and Perkins to evaluate the subsurface layering (ssl) treatments and various herbicides for control of horsenettle. These two experiments were combined into Experiment B6. The layering was done with a subsurface plow consisting of three blades, two larger ones (36 inches) on the outside and a small one (24 inches) in the center. The sweep is pulled through the soil to apply a uniform layer of herbicide six to eight inches below the soil surface. In the first experiment in 1972, the herbicide was applied with one flood type nozzle under each blade. Another experiment was conducted in 1973 at Perkins to evaluate the technique when compared with postemergence treatments. This experiment was applied in the fall. The sweep in this experiment had two fan nozzles under each blade to apply a more uniform layer of herbicide. This experiment was applied to a field of native horsenettle which had been disked during the summer. There was the bladed treatment, a bladed check, and an untreated check. The blade was pulled six to eight inches deep through the soil when the horsenettle was at the bloom stage.

CHAPTER IV

RESULTS AND DISCUSSION

Johnsongrass Control Studies

Preplant Incorporated Treatments

This experiment consisted mainly of dinitroanaline preplant incorporated herbicides. There were no differences among the herbicides one year after treatment. In the third year of treatment early season johnsongrass control was obtained with trifluralin, nitralin, oryzalin and butralin (Table II). These herbicides were giving 70 to 80 percent control of rhizome johnsongrass, but only trifluralin still provided any effective control by midseason. MBR 4400, San 6706, methazole and MSMA did not give satisfactory control. Ratings continued to drop gradually 395 days after treatment when cultivation was discontinued.

Control in Five Crops

In this study crops were planted after the preplant treatments. After one year's treatment, trifluralin, profluralin, nitralin and dinitramine gave 50 percent or better johnsongrass control where double the recommended rate of each was used (Table III). At the end of the growing season trifluralin provided 50 percent control and profluralin 70 percent. In this same year of treatment several postemergence

TABLE II

CONTROL OF JOHNSONGRASS WITH PREPLANT INCORPORATED TREATMENTS

		Control at Various Days After Treatment[2]				
Herbicide	Time of Treatment[1]	Rate (lb/A)	30 (%)	70 (%)	125 (%)	395 (%)
Trifluralin	Fall	½	60	10	20	20
	Fall	1	60	20	30	40
	Fall	2	80	60	60	20
	Fall & Spring	½ & ½	60	10	20	30
	Fall & Spring	1 & 1	80	40	50	40
	Fall & Spring	2 & 2	90	80	80	50
	Spring	½	70	40	40	20
	Spring	1	80	40	50	40
	Spring	½	60	30	50	30
Nitralin	Fall	½	50	30	20	20
	Fall	1	80	30	30	20
	Fall	2	60	30	30	10
	Fall & Spring	½ & ½	60	20	30	20
	Fall & Spring	1 & 1	70	40	40	30
	Fall & Spring	2 & 2	80	50	50	40
	Spring	½	50	20	30	30
	Spring	1	70	40	30	20
	Spring	2	70	40	40	30
Oryzalin	Fall	2	80	30	20	20
	Fall & Spring	2 & 2	80	30	30	20
	Spring	2	70	10	10	20
MBR-4400	Fall	4	50	20	30	10
	Spring	4	60	20	20	10
San-6706	Spring	2	60	30	30	20
	Spring	4	60	20	20	20
	Fall & Spring	2 & 2	60	20	30	20
	Fall & Spring	4 & 4	70	40	40	30
Methazole	Fall	4	60	20	20	20
	Fall & Spring	4 & 2	60	20	30	30
	Spring	4	50	10	20	30
Butralin	Fall	6	80	60	60	40
	Fall	8	70	60	70	40
	Fall & Spring	6 & 3	70	40	50	20
	Fall & Spring	8 & 4	50	30	50	20
	Spring	6	70	30	30	20
	Spring	8	60	30	30	20
MSMA	Spring	2	50	10	10	30
	Fall & Spring	3 & 2	60	20	10	30
Check	-	-	0	0	0	0

[1]Treatments applied from Fall 1970 to Spring 1973 with the exception that Fall 1972 treatments could not be applied due to excessive rainfall.

[2]Days after 1973 Spring treatment.

TABLE III

COMPARISON OF PREPLANT AND POSTEMERGENCE HERBICIDES FOR JOHNSONGRASS CONTROL

Herbicide Trt.	Rate lb/A	J-grass[3]	J-grass[3]	Sorghum	J-grass[3]	Sorghum	J-grass[3]
Preplant Incorporated		40[1]	76[1]	76[1]	131[1]	131[1]	401[1]
Devrinol	4	40	30	100	40	100	50
	6	50	40	100	40	100	60
Trifluralin	1	30	50	100	30	100	40
	2	50	30	100	40	100	60
Profluralin	2	30	30	100	30	100	60
	4	70	60	100	60	100	70
Butralin	3	30	30	100	30	100	50
	4	30	30	100	30	100	40
Nitralin	2	20	30	100	40	100	40
Dinitramine	1/2	50	40	100	30	100	40
	1	50	60	100	40	100	60
Check	-	0	0	0	0	0	0
Pre-emergence		40[1]	76[1]	76[1]	131[1]	131[1]	401[1]
MBR 8251	4	40	40	0	40	0	60
Check	--	0	0	0	0	0	0
Postemergence		365[2]	401[2]	401[2]	456[2]	456[2]	726[2]
Glyphosate	1 1/3	100	90	0	80	0	80
	2 2/3	100	90	0	90	0	80
	4	100	90	0	100	0	80
MSMA	2	70	50	0	50	0	60
Dalapon	3.7	60	40	0	40	0	50
	5.5	80	50	0	50	0	50
Asulux	3	50	30	0	40	0	60
Check	-	0	0	0	0	0	0

No injury to peanuts, soybeans or cotton.

[1]Days after 1973 treatment.

[2]Days after July 15, 1972, treatment.

[3]J-grass means johnsongrass.

herbicides were used over the crops. Glyphosate was applied on mature johnsongrass at 1 1/3, 2 2/3 and 4 lb/A and resulted in 100 percent control. It also killed the mungbeans, cotton and soybeans. MSMA was applied at 2 lb/A and caused 90 percent control in August. All crops except cotton were killed. Dalapon was applied at 3.7 and 5.5 lb/A and provided 60 and 70 percent control, respectively. The crops were not injured. After a second year of application of the dinitroanalines, trifluralin showed 50 percent control, profluralin produced 70 percent control and dinitramine induced 50 percent control of johnsongrass early in the growing season. The only crop injured by the dinitroanalines was sorghum, which was killed in the seedling stage. Late in the growing season only the double the recommended rate of profluralin provided 60 percent control. In the second year of treatment the postemergence treatments were not re-applied but the crops were planted. Glyphosate, 726 days after treatment, showed 80 percent control of johnsongrass at the three rates applied. There was no crop injury to the four crops planted, peanuts, cotton, sorghum and soybeans. MSMA, dalapon and asulam gave 50 to 60 percent control 726 days after treatment. No crop injury was noted with these herbicide treatments.

Comparison of Asulam and Glyphosate

Glyphosate was applied at 1 1/3, 2 2/3, and 4 lb/A on 18-inch johnsongrass. The low rate did not give any control 760 days after treatment (Table IV). The other rates resulted in 70 and 80 percent, respectively. Asulam applied at 1 1/2 and 3 lb/A did not give satisfactory results. Glyphosate was applied as a spot treatment at .25, .12, and .06 lb/5 gallons of water on johnsongrass in the head stage.

TABLE IV

COMPARISON OF GLYPHOSATE AND ASULAM POSTEMERGENCE ON JOHNSONGRASS

Herbicide	Rate (lb/A)	J. Gr. Stage	Visual Ratings 400 Days[1] J. Gr.[2]	490 Days[1] J. Gr.[2]	760 Days[1] J. Gr.[2]
Glyphosate	1.33	18"	0	0	0
	2.67	18"	70	70	80
	4.0	18"	80	80	90
Asulam + Surfactant	1.5 + ½%	18"	20	30	60
	3 + ½%	18"	30	30	70
Check	--	--	0	0	0
Glyphosate	0.25/5 gal.	Head	100	100	100
	0.12/5 gal.	Head	100	100	100
	0.06/5 gal.	Head	100	100	90
Asulam + Surfactant	4 + ½%	Head	50	50	60
		Expanded Study			
			51 Days[1]	107 Days[1]	377 Days[1]
Glyphosate	2	18"	60	50	60
	4	18"	90	80	90
	1/3/5 gal.	18"	90	90	90
Asulam + Surfactant	3 + ½%	18"	40	50	70
Glyphosate	2	Boot	80	80	80
	4	Boot	90	90	90
	1/3/5 gal.	Boot	80	90	90
Asulam + Surfactant	3 + ½%	Boot	40	40	70
Glyphosate	2	Head	90	90	80
	4	Head	90	90	80
	1/3/5 gal.	Head	100	100	90
Asulam + Surfactant	3 + ½%	Head	40	40	70

[1]Days after last treatment.

[2]J. gr. = johnsongrass.

All of these treatments caused 90 to 100 percent control 760 days after treatment. All of these rates appear to be too high for spot treatments. Asulam applied at 4 lb/A on johnsongrass in the head stage resulted in only 60 percent control 760 days after treatment. In another experiment glyphosate at 2 and 4 lb/A and 1/3 lb/5 gal. of water and asulam at 3 lb/A was applied to 18-inch johnsongrass (boot and head stage). At the 18-inch treatment glyphosate at 2 and 4 lb/A provided 60 and 90 percent control, respectively, 377 days after treatment. Asulam at 3 lb/A showed best control of 70 percent at the 18-inch stage. Glyphosate at 1/3 lb/5 gal. of water as a spot treatment was more concentrated than needed even at the 18-inch stage of growth.

Fall Glyphosate Treatments

Glyphosate applied at 1 1/3, 2 2/3 and 4 lb/A in the fall in three different experiments showed 70 to 90 percent control of rhizome johnsongrass 598 days after treatment (Table V). In two of these experiments glyphosate was applied at .33, .16, and .8 lb/5 gal. of water as spot treatments and resulted in 90 to 100 percent control for 598 days after treatment. Asulam again showed unsatisfactory results.

Height vs Month of Treatment

Glyphosate was applied at 2, 3, and 4 lb/A on 18-, 36-, and 48-inch johnsongrass in June, July and August. The 18-inch johnsongrass treatments in June, July and August caused 80 to 90 percent control (Table VI). The 36-inch johnsongrass treatments provided 90 to 100 percent control, and treatment on 48-inch johnsongrass induced 100 percent control. This slight increase in control was due to an increase in the

TABLE V

EFFECT OF FALL APPLIED GLYPHOSATE ON JOHNSONGRASS CONTROL AT THREE LOCATIONS

			Ratings		
		Rate	Days After Treatment		
Location	Herbicide	(lb/A)	243	318	598
Stillwater	Glyphosate	1.33	80	70	70
		2.67	90	80	80
		4.0	100	90	90
		0.33/5 gal.	100	90	90
		0.16/5 gal.	100	90	100
		0.8/5 gal.	100	90	90
Lake Carl Blackwell	Glyphosate	1.33	80	70	80
		2.67	80	80	80
		4.0	90	90	90
		0.33/5 gal.	90	90	90
		0.16/5 gal.	90	90	100
Stillwater[1]	Glyphosate	2	80	80	90
		4	90	90	90
	Asulam + Surfactant	1.5 + 0.5%	30	30	40
		3.0 + 0.5%	40	40	50
	Check	--	00	00	00

[1]These days refer to days after 2nd treatment; the 1st treatment was applied in 1972.

TABLE VI

EFFECTS OF GLYPHOSATE APPLIED TO JOHNSONGRASS AT DIFFERENT HEIGHTS AND DATES

J.gr. Tmt. Ht.	Date Trted.	Rate lb/A	Visual Ratings							
			Da.[1]	J.gr.[2]	Da.[1]	J.gr.[2]	Da.[1]	J.gr.[2]	Da.[1]	J.gr.[2]
18"	6/14/73	2	65	70	99	70	141	80	411	90
18"		3	65	70	99	80	141	80	411	100
18"		4	65	80	99	80	141	90	411	100
36"	6/21/73	2	58	90	92	90	134	90	504	100
36"		3	58	90	92	90	134	90	504	100
36"		4	58	100	92	100	134	100	504	100
48"	6/28/73	2	51	100	85	100	127	90	397	100
48"		3	51	100	85	100	127	100	397	100
48"		4	51	100	85	100	127	100	397	100
18"	7/5/73	2	44	70	78	70	120	80	390	90
18"		3	44	70	78	70	120	80	390	100
18"		4	44	80	78	80	120	90	390	100
36"	7/19/73	2	30	90	64	90	106	100	376	100
36"		3	30	90	64	100	106	90	376	100
36"		4	30	100	64	100	106	100	376	100
48"	7/26/73	2	23	100	57	100	99	100	369	100
48"		3	23	100	57	100	99	100	369	100
48"		4	23	100	57	100	99	100	369	100
18"	8/2/73	2	--	--	50	80	92	70	362	100
18"		3	--	--	50	80	92	80	362	100
18"		4	--	--	50	80	92	90	362	100
36"	8/23/73	2	--	--	36	90	80	90	350	100
36"		3	--	--	36	90	80	90	350	100
36"		4	--	--	36	100	80	90	350	100
48"	8/30/73	2	--	--	29	100	71	90	341	100
48"		3	--	--	29	100	71	100	341	100
48"		4	--	--	29	100	71	100	341	100

[1]Days after treatment.

[2]J. gr. means johnsongrass.

amount of foliage.

Preplant Control with Glyphosate

Glyphosate was applied at 2, 3, and 4 lb/A on 6-, 12-, 18-, 24-, and 36-inch johnsongrass, and then disked 4 or 8 days after treatment. Glyphosate applied on 6-inch johnsongrass at 3 and 4 lb/A resulted in 50 percent control with both disking intervals 114 days after treatment (Table VII). Eighteen-inch johnsongrass also showed little difference between disking intervals after treatment. Glyphosate applied to 24-inch johnsongrass provided 100 percent control regardless of the disking interval 86 days after treatment. The same was true of the 36-inch treatments. The smaller stages of johnsongrass showed a greater difference in rate and disk intervals than did the taller stages.

Glyphosate Spot Treatments

Spot treatments of 2, 1, .5, and .125 oz. of glyphosate per gallon of water spray were applied until runoff to try to find the most effective rate for control. These treatments were applied to 36-inch (boot) and 48-inch (head) johnsongrass. Glyphosate applied at 2, 1, and .5 oz. per gallon of water provided 100 percent control of 36-inch johnsongrass 347 days after treatment (Table VIII). It appears that the effective rate of the spot spray treatments is between .5 oz/gal. and .25 oz/gal. of water spray.

Bromacil-Glyphosate Combination

Bromacil plus glyphosate as a tank mix provided 90 to 100 percent control of 24-inch johnsongrass 102 days after treatment (Table IX).

TABLE VII

EFFECTS OF GLYPHOSATE ON JOHNSONGRASS AT DIFFERENT STAGES OF GROWTH

J. gr.[1] Tmt. Height	Disc. Interv.	Rate lb/A	Visual Ratings							
			Day[1]	J.gr.[2]	Day[1]	J.gr.[2]	Day[1]	J.gr.[2]	Day[1]	J.gr.[2]
6"	4 day	3	58	50	72	40	114	40	394	50
6"	4 day	4	58	60	72	40	114	50	394	50
6"	8 day	3	58	70	72	40	114	40	394	50
6"	8 day	4	58	60	72	60	114	60	394	50
12"	4 day	3	51	50	65	50	109	50	379	70
12"	4 day	4	51	50	65	40	109	50	379	60
12"	8 day	3	51	60	65	70	109	70	379	70
12"	8 day	4	51	70	65	60	109	60	379	70
18"	4 day	3	44	80	58	80	100	80	370	90
18"	4 day	4	44	80	58	70	100	70	370	90
18"	8 day	3	44	70	58	60	100	70	370	80
18"	8 day	4	44	70	58	70	100	70	370	80
24"	4 day	2	30	-	44	100	86	100	356	100
24"	4 day	3	30	-	44	100	86	100	356	100
24"	4 day	4	30	-	44	100	86	100	356	100
24"	8 day	2	30	-	44	100	86	100	356	100
24"	8 day	3	30	-	44	100	86	100	356	100
24"	8 day	4	30	-	44	100	86	100	356	100
36"	4 day	2	23	-	37	90	79	90	349	100
36"	4 day	3	23	-	37	100	79	100	349	100
36"	4 day	4	23	-	37	100	79	100	349	100
36"	8 day	2	23	-	37	100	79	100	349	100
36"	8 day	3	23	-	37	100	79	100	349	100
36"	8 day	4	23	-	37	100	79	90	349	100

There was no visual injury to cotton and soybeans.

[1]Days after treatment.

[2]J.gr. = johnsongrass.

TABLE VIII

GLYPHOSATE AS A SPOT TREATMENT FOR JOHNSONGRASS CONTROL

Rate (oz/gal)	Visual Ratings					
	36" Johnsongrass			48" Johnsongrass		
	35[1]	77[1]	347[1]	42[1]	84[1]	354[1]
0.125	30	30	40	80	80	90
0.25	40	40	50	100	90	100
0.5	100	90	100	100	100	100
1.0	100	90	100	100	100	100
2.0	100	100	100	100	100	100

[1]Days after treatment.

TABLE IX

EFFECT OF BROMACIL-GLYPHOSATE TREATMENTS ON JOHNSONGRASS

Herbicide	Rate (lb/A)	Johnson-grass Height	Timing	Ratings 60 Days[1]	102 Days[1]	372 Days[1]
Bromacil + glyphosate	15 + 2	24"	Tank mix	100	100	100
	15 + 3	24"	"	90	90	100
	20 + 2	24"	"	100	90	100
	20 + 3	24"	"	100	100	100
Bromacil; glyphosate	15;2	24"	Glyphosate 1 hr. later	90	90	100
	15;3	24"	"	90	90	100
	20;2	24"	"	90	90	100
	20;3	24"	"	100	100	100
Bromacil; glyphosate	15;2	24"	Glyphosate 2 wk. later	90	100	100
	15;3	24"	"	90	100	100
	20;2	24"	"	90	90	100
	20;3	24"	"	100	100	100
Bromacil + glyphosate	15 + 2	48"	Tank mix	80	80	90
	15 + 3	48"	"	90	90	100
	20 + 2	48"	"	90	100	100
	20 + 3	48"	"	90	90	100
Bromacil; glyphosate	15;2	48"	Glyphosate 1 hr. later	90	90	100
	15;3	48"	"	90	90	100
	20;2	48"	"	90	90	100
	20;3	48"	"	90	90	100
Glyphosate; bromacil	2;15	48"	Bromacil 2 wk. later	100	100	100
	3;15	48"	"	100	100	100
	2;20	48"	"	100	100	100
	3;20	48"	"	100	100	100

[1]Days after treatment.

A slightly lower rating from 48-inch johnsongrass was probably caused by more foliage which intercepted the bromacil. There were few or no differences within rates of each type of application. Glyphosate applied an hour after bromacil on 24- and 48-inch johnsongrass resulted in 90 to 100 percent control. Bromacil, and then glyphosate applied two weeks later, caused 100 percent control at all rates. It appears that the best treatment is to apply glyphosate first to eliminate the johnsongrass cover, then apply bromacil to the soil.

One year after treatment there was complete control or no difference in any treatment. For industrial use the quick top kill with glyphosate and bromacil applied one week later would be the best treatment as far as quick kill and residue control are concerned.

Subsurface Layering Control

To evaluate johnsongrass control with the subsurface layering technique trifluralin and profluralin at 3 lb/A were applied in a layer 6 to 8 inches below the soil surface. After the sweep check had grown out there was no difference in the treatments. At this early stage it appears that better herbicidal layering techniques are needed.

Horsenettle Control Studies

Preliminary Treatment of Horsenettle

A preliminary screening experiment showed that there are several herbicides that could give good control of horsenettle in the postbloom stage (Table X). Silvex, 2,4,5-T ester and 2,4-D amine, applied at 1 and 2 lb/A, induced good control of horsenettle after two years of horsenettle treatment. Other herbicides used in the experiment were

TABLE X

EFFECT OF VARIOUS HERBICIDES FOR CONTROL OF HORSENETTLE
AT THE POSTBLOOM STAGE

		Visual Ratings							
	Rate	0 Days[1]		33 Days[1]		55 Days[1]		113 Days[1]	
Herbicide	lb/A	Disc	N-disc[2]	Disc	N-disc[2]	Disc	N-disc[2]	Disc	N-disc[2]
Amitrol T	1	100	90	100	90	100	80	100	80
	2	100	100	100	90	100	80	100	100
2,4,5-T	1	100	100	100	100	90	100	90	100
	2	100	100	100	100	90	100	90	100
Paraquat	½	20	40	10	50	10	40	40	80
	1	20	50	10	50	10	40	30	50
Silvex	1	70	80	100	60	90	80	100	100
	2	100	100	100	90	100	100	100	100
Dicamba	2	100	100	100	100	90	100	100	100
2,4-D amine	1 + ½% WK	90	100	100	100	90	100	100	100
	2 + ½% WK	80	100	90	90	80	100	90	100
DPX 1840	1/2	50	70	90	60	60	80	90	100
	1	90	90	100	70	70	100	80	100
Glyphosate	2	90	90	90	90	90	90	80	90
	4	90	100	100	100	90	90	90	100
Picloram	1/4	100	100	100	100	100	100	100	100
	1/2	100	100	100	100	100	100	100	100
Check	--	0	0	0	0	0	0	0	0

[1]Days after 1973 treatment. The 0 day is the result of the 1972 treatment.

[2]Non-disc.

amitrol T at 1 and 2 gallons per acre (gpa), dicamba at 2 lb/A and DPX 1840 at 1/2 and 1 lb/A. Amitrol T provided 80 to 100 percent control, respectively, 113 days after the second treatment. Dicamba resulted in complete control throughout the experiment. DPX 1840 at 1/2 and 1 lb/A did not give satisfactory control after one year but after the second year of treatment it caused 80 to 90 percent control. Other herbicides used at this horsenettle growth stage were glyphosate at 2 and 4 lb/A, paraquat at 1/2 and 1 lb/A and picloram at 1/4 and 1/2 lb/A. Glyphosate provided 80 to 100 percent control, respectively, after two years of treatment. Paraquat showed a contact effect but was not sufficient for control of horsenettle. It killed the tops but the roots resprouted after two years of treatment. Disking the plots appeared to reduce activity of the compounds for horsenettle control. It appears that cutting the horsenettle tops off decreased control, perhaps because it stops translocation to the root system at this point.

Secondary Treatment of Horsenettle

DPX 1840 applied at 1/2 and 1 lb/A on horsenettle in the bloom stage gave better control of horsenettle if a surfactant was added to the solution, but it appears that it did not perform satisfactorily on horsenettle in the bloom stage (Table XI). Naptalam at 2 and 4 lb/A did not give good control even after two years of treatment. After one and two years of treatment 2,4-DB resulted in 80 to 100 percent control. Glyphosate at 3 and 4 lb/A caused 90 to 100 percent control. All treatments showed similar results after the second year.

TABLE XI

EFFECTS OF VARIOUS HERBICIDES FOR FRUIT SUPPRESSION AND POPULATION REDUCTION ON HORSENETTLE IN THE BLOOM STAGE

Herbicide	Rate lb/A	Control Ratings at Various Days 0[1]	47[1]	105[1]	375[1]
		(%)	(%)	(%)	(%)
DPX 1840	1/2	20	20	30	30
	1	30	30	40	20
DPX 1840 + Surf.[2]	½ + ½%	40	40	50	30
	1 + ½%	50	50	50	40
Check	--	0	0	0	0
Naptalam	2	60	40	60	50
	4	50	50	70	70
2,4-DB	0.4	80	90	80	90
	0.8	100	100	100	90
Check	--	0	0	0	0
Glyphosate	3	80	90	90	90
	4	90	100	100	100

[1]Days after 1973 treatment; the 0 day treatment is the effect of the 1972 treatment.

[2]Surfactant WK.

Glyphosate at Different Times

This was a preliminary study with glyphosate to observe differences that might occur due to the time of application to horsenettle in the fruiting stage. Treatments in June resulted in 80 to 90 percent control and July treatments provided 90 to 100 percent control (top two treatments in Table XII). These ratings were taken two seasons after treatment. Another experiment was conducted to re-evaluate and expand the previous experiment.

Glyphosate applied at 2, 3, and 4 lb/A in July on horsenettle in a vegetative growth stage did not control the horsenettle 368 days after treatment (remainder of Table XII). It appears that there was no control at this time because of the small amount of foliage available to intercept the herbicide. The bloom stage treatment in July resulted in 80 percent control 354 days after treatment. The treatment applied on the fruit set stage provided 90 to 100 percent control 347 days after treatment. The August vegetative stage treatment caused 20 to 50 percent control but not enough for effective control. August bloom and fruit set stages induced slightly better control than did the July treatments. It appears that glyphosate may be more active on horsenettle later in the growing season, when translocation is more predominant toward the root system.

Control at Different Growth Stages

Three herbicides were used in this study: DPX 1840 at 1 and 2 lb/A; 2,4-DB at .4 and .8 lb/A; and glyphosate at 2, 3 and 4 lb/A. DPX 1840 applied on sprouting horsenettle resulted in 10 to 20 percent control when read 113 days after treatment (Figure 1). Prebloom

TABLE XII

EFFECT OF GLYPHOSATE AT DIFFERENT TIMES OF THE YEAR AT THREE STAGES ON HORSENETTLE GROWTH

Date[1]	Rate (lb/A)	Hn. Stage	Visual Control Ratings					
			Days	Hn.[3]	Days	Hn.[3]	Days	Hn.[3]
6/28/72	2	Fruit	14[2]	60	350[2]	80	620[2]	80
	4	Fruit	14[2]	90	350[2]	90		90
7/25/72	2	Fruit	0[2]	00	350[2]	90		90
	4	Fruit	0[2]	00	350[2]	100		90
			Expanded Study					
6/27/73	2	Pre-bloom	43[2]	00	98[2]	00	368[2]	20
	3	Pre-bloom	43	00	98	00		30
	4	Pre-bloom	43	00	98	00		30
7/12/73	2	Bloom	29	80	84	70	354	80
	3	Bloom	29	80	84	80		80
	4	Bloom	29	80	84	80		80
7/26/73	2	Fruit	22	90	77	90	347	90
	3	Fruit	22	90	77	90		100
	4	Fruit	22	100	77	90		100
8/8/73	2	Pre-bloom	15	20	70	10	340	20
	3	Pre-bloom	15	20	70	20		40
	4	Pre-bloom	15	50	70	40		50
8/23/73	2	Bloom	8	50	63	60	333	80
	3	Bloom	8	40	63	70		90
	4	Bloom	8	50	63	80		90
8/30/73	2	Fruit	--	--	54	90	324	100
	3	Fruit	--	--	54	100		100
	4	Fruit	--	--	54	100		100

[1]June and July treatments were to initial growth, whereas August treatments were to regrowth from late June hoeing.

[2]Days after treatment.

[3]H.N. means horsenettle.

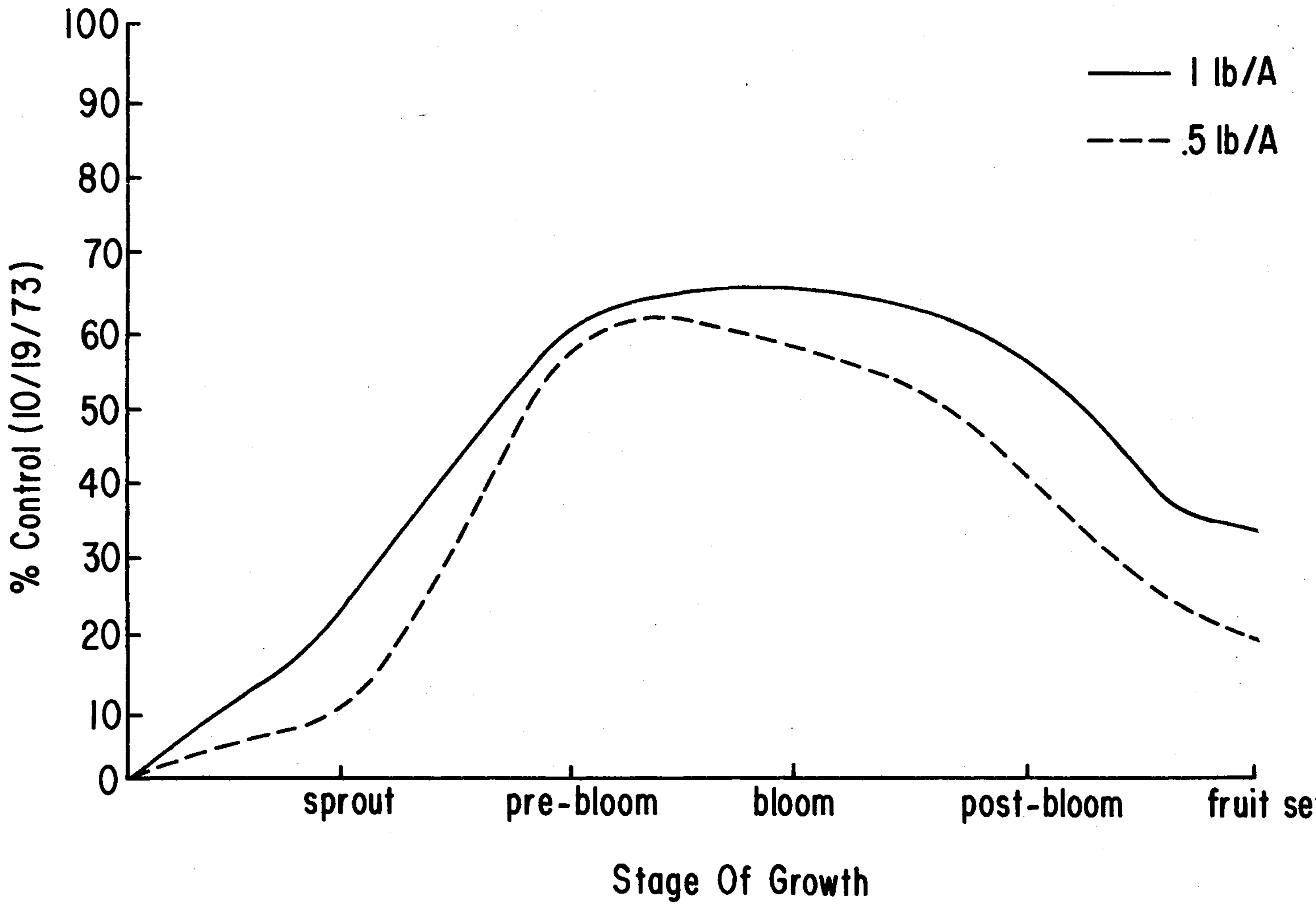

Figure 1. Effects of DPX 1840 Applied in 1973 on Horsenettle at Five Growth Stages

treatment showed 60 percent control, and there was about 60 percent control for bloom stage treatments and less for the older stages of growth. DPX 1840 caused stunting, chlorosis and leaf necrosis and, eventually, defoliation and some fruit suppression. 2,4-DB applied at .4 and .8 lb/A gave 60 percent growth inhibition of horsenettle if treated at the sprouting stage, increasing to 70 to 80 percent at the later stages up to fruit set (Figure 2). 2,4-DB caused stunting, stem curl, chlorosis, fruit suppression, and leaf necrosis and late leaf defoliation. Glyphosate applied to horsenettle when they were sprouting resulted in 10 to 20 percent control (Figure 3). Treatments applied at the prebloom stage provided 60 percent control and increased to 70 percent control for bloom stage treatments and 80 to 100 percent control for later treatments. Glyphosate produced top kill to horsenettle which did not regrow from the roots.

Control in Peanuts

Several herbicides were applied over the top of growing peanuts at the groundcrack and postemergence stages (Table XIII). Glyphosate caused 20 to 40 percent injury to peanuts treated at the groundcrack stage; however, the peanuts outgrew this injury. The glyphosate controlled 60 to 70 percent of the horsenettle. When treated postemergence to the peanuts there was 80 to 90 percent control of horsenettle, but the peanuts were killed. DPX 1840 at 1/2, 1 and 2 lb/A with 1/2 percent surfactant did not hurt the peanuts treated at the groundcrack or postemergence stages, and resulted in 70 percent control of the horsenettle. Naptalam applied at 2 or 4 lb/A neither hurt the peanuts nor showed satisfactory control of the horsenettle. 2,4-DB also did not

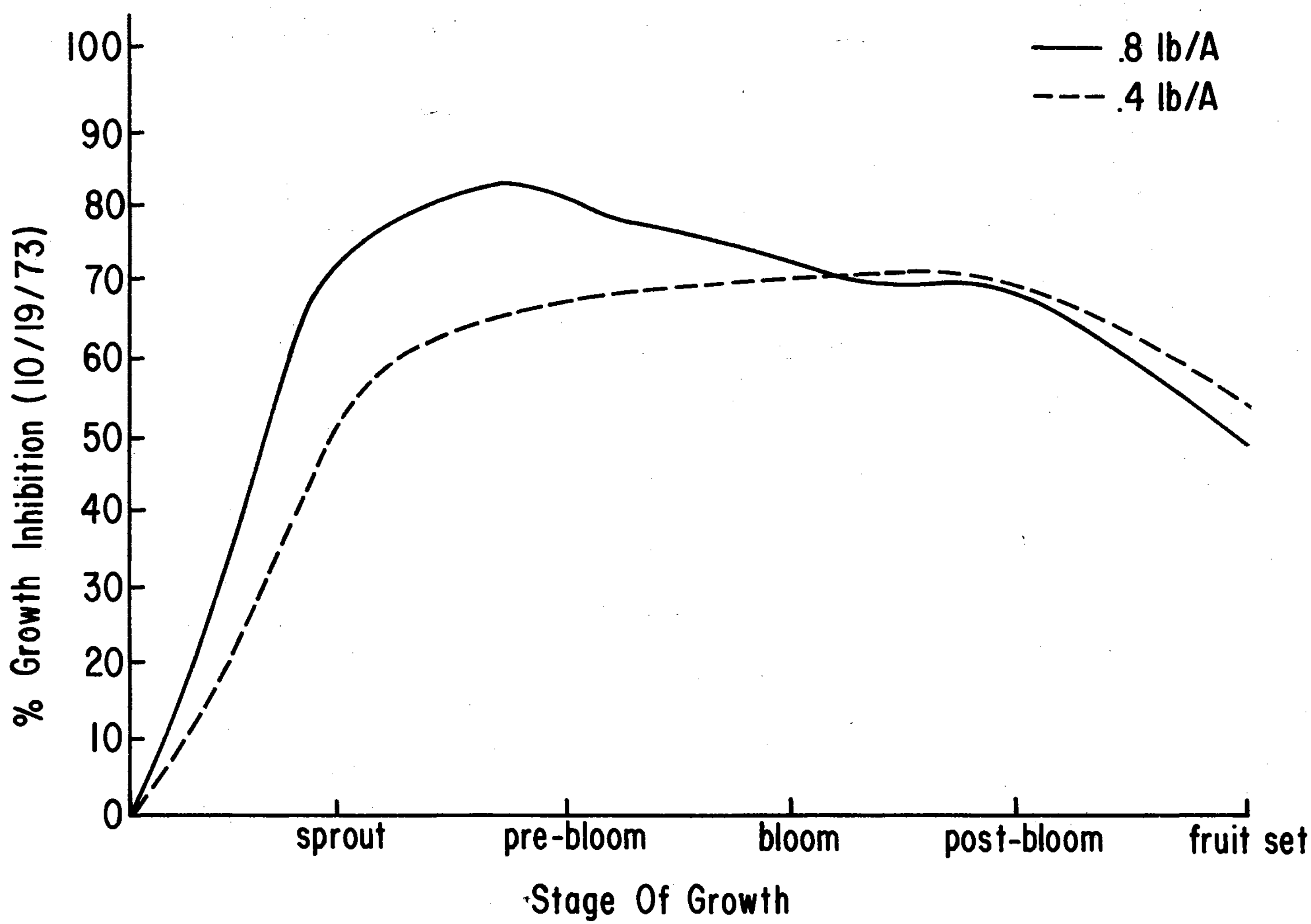

Figure 2. Effects of 2,4-DB Applied in 1973 on Horsenettle at Five Growth Stages

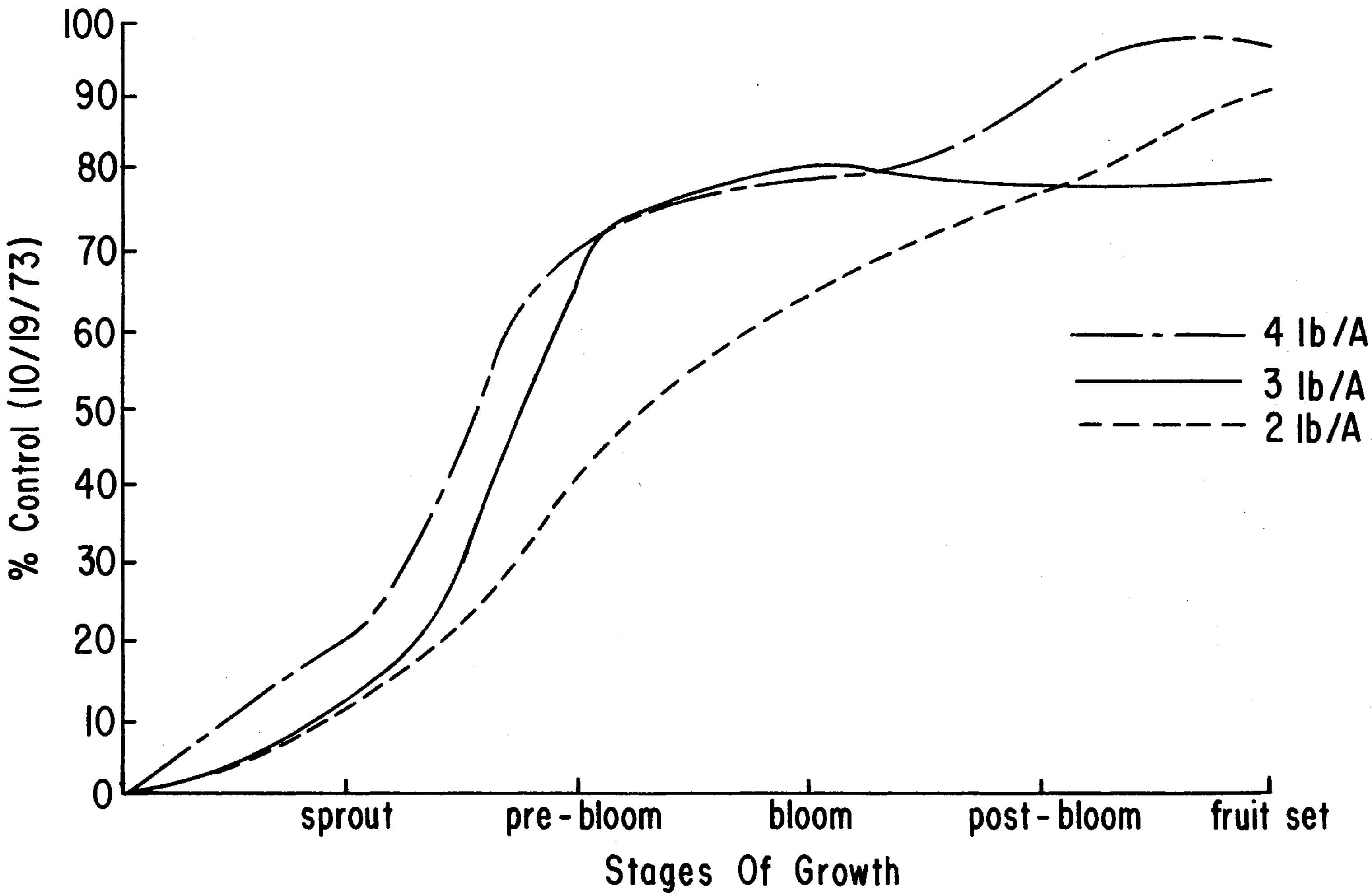

Figure 3. Effects of Glyphosate Applied in 1973 on Horsenettle at Five Growth Stages

TABLE XIII

EFFECTS OF VARIOUS HERBICIDES APPLIED TO GROUNDCRACK AND POSTEMERGENCE PEANUTS AND HORSENETTLE

Herbicide	Rate (lb/A)	Groundcrack Peanut 30[1]	Groundcrack H.N.[3] 30[1]	Groundcrack Peanut 55[1]	Groundcrack H.N.[3] 55[1]	Postemerge Peanut 55[1]	Postemerge H.N.[3] 55[1]
Glyphosate	1 1/3	20	4	0	60	100	90
	2 2/3	30	7	1	70	100	80
	4	40	6	1	60	100	90
DPX 1840	½ + ½% S[2]	10	60	20	70	0	80
	1 + ½% S	20	60	0	70	0	80
	2 + ½% S	10	60	0	50	20	70
Naptalam	2	00	40	0	40	0	30
	4	00	50	0	50	0	40
2,4-DB	.4	00	60	0	60	20	80
	.8	10	70	10	70	40	80
Dicamba	2	100	80	90	80	100	70
2,4,5-T	1	60	60	0	50	30	60
	2	70	60	30	70	40	60
Amitrole	1	40	40	0	30	0	60
	2	40	40	0	40	0	40
Check	0	0	0	0	0	0	0

[1]Days after treatment.

[2]S refers to WK surfactant.

[3]H.N. stands for horsenettle.

significantly hurt the peanuts and provided up to 80 percent control of horsenettle. Neither 2,4,5-T nor amitrole performed well in this study. Dicamba injured both the peanuts and the horsenettle severely.

Subsurface Treatments

Three dinitroanaline herbicides were used: trifluralin, profluralin, and dinitramine, at 2 lb/A. After three growing seasons, 723 days after treatment, they all produced 60 percent control (Table XIV). 2,4,5-T induced 80 percent control 723 days after treatment. Amitrole and dicamba resulted in 60 percent control 723 days after treatment.

Another subsurface layering experiment was conducted to compare subsurface layering with postemergence treatments. Three dinitroanaline herbicides were used, trifluralin, profluralin, and dinitramine. These treatments provided 60 to 80 percent control after 341 days. The postemergence treatments with 2,4,5-T and 2,4-DB caused 80 percent control 341 days after treatment. Dicamba and glyphosate resulted in 90 to 100 percent control. Postemergence treatments appeared to be superior to the subsurface sweep treatments.

Discussion

Johnsongrass control is possible with preplant incorporated, postemergence, or soil sterilant herbicides. The dinitroanaline group of compounds seem to show the best potential for control of rhizome johnsongrass of the preplant incorporated herbicides. Early season control with trifluralin, profluralin, nitralin, oryzalin and butralin was obtained. After two years of treatments at the end of the growing season, trifluralin, profluralin and dinitramine provided about 50 to

TABLE XIV

EFFECTS OF VARIOUS HERBICIDES APPLIED WITH SWEEP BLADE VS. TOPICAL TREATMENTS

Type of Trt.	Herbicide	Rate (lb/A)	Visual Ratings of Horsenettle				
			71[2]	379[2]	425[2]	453[2]	723[2]
Bladed[1]	Trifluralin[3]	2	70	60	70	60	70
"	Profluralin[3]	2	80	70	80	60	70
"	Dinitramine[3]	2	60	60	60	60	60
"	Amitrole[3]	6gpa	70	60	60	50	60
"	2,4,5-T[3]	6	90	80	70	70	80
"	Dicamba[3]	6	50	50	50	50	60
							240[2]
"	Trifluralin[4]	2	100	-	-	-	60
"	Dinitramine[4]	1	100	-	-	-	80
"	Profluralin[4]	2	100	-	-	-	70
Topical[5]	2,4,5-T[4]	2	90	-	-	-	80
"	Dicamba[4]	2	100	-	-	-	100
"	2,4-DB[4]	4	80	-	-	-	80
"	Glyphosate[4]	2	90	-	-	-	90
		3	90	-	-	-	90
		4	100	-	-	-	100
	Check	-	0	0	0	0	0

[1]Bladed 6-8" deep.

[2]Days after treatment.

[3]Cromwell location.

[4]Perkins location.

[5]Sprayed over horsenettle at 40 gpa.

60 percent control of rhizome johnsongrass without any cultivation. Others have indicated that cultivation increases the control. It appears that the other preplant herbicides do not control either seedling or rhizome johnsongrass. More studies of the dinitroanilines at the double the recommended rates with cultivation and crops need to be evaluated.

Postemergence treatments also show promise for control. Glyphosate was very effective for controlling mature johnsongrass for two years without retreatment. MSMA, dalapon, and asulam gave good control for most of one growing season, but after this time control decreased. Glyphosate killed the crops when sprayed over the top, but crops planted the following year were not injured. Glyphosate treatment at any stage provided much better control of johnsongrass than asulam treatments. The larger the johnsongrass plants, the better the control with glyphosate, especially above 24 inches. Height of the plant was more important than the date of treatment. From studies with glyphosate applied at different stages, it was apparent that not only was control best obtained after the johnsongrass reaches 24 inches or taller in height, but also 4 to 8 days are needed between times of application and disking to allow time for translocation of the herbicide to the rhizomes. Glyphosate also performed well as a spot treatment when sprayed until the johnsongrass was wet.

Another method of weed control is to use a soil sterilant along with glyphosate. Glyphosate may be used to get good top kill and allow the bromacil soil sterilant to reach the soil when applied two weeks later. Subsurface layering for control of johnsongrass using the dinitroanalines has possibilities but more study and better layering techniques are needed.

There are several herbicides that will control horsenettle in fallow areas where more than one treatment of a herbicide can be made. Picloram and dicamba showed excellent results for single treatments, while 2,4,5-T, amitrole, silvex and 2,4-D controlled horsenettle with repeated treatments. Silvex and 2,4-D treatments caused top kill but resprouting occurred. Disking treated horsenettle tended to decrease herbicidal activity. In fallowed areas, a disking operation reduced the time required for the plant to resprout. Re-treatments the next season caused top kill, but resprouting occurred again. Treatments combining herbicides with mechanical cultivation need further evaluation. The type of implement used may affect results in the fallowed areas. Since the plant is capable of propagation from root sections, a disk may be more effective than a plow or deep working sweep blade.

Control of horsenettle on fallow ground with one application of glyphosate appears to be possible. Glyphosate applied later in the growing season seems to have more herbicidal activity. Glyphosate was most effective on horsenettle in the postbloom and fruit set stages. If applied at 2 or 3 lb/A on mature horsenettle in the fall, most of the horsenettle should be controlled.

On cropland 2,4-DB and DPX 1840 appear to be the only effective herbicides that can be used on peanuts without crop injury. Single treatments of these herbicides either reduced horsenettle fruiting, population, or competition or a combination of these. Variation in the degree of injury, population change, or fruiting characteristics was observed when treatments were applied on different growth stages of the horsenettle. DPX 1840 appeared to be most effective on horsenettle at the prebloom and bloom stages. 2,4-DB was most active at the sprouting and prebloom stages.

Peanuts treated with glyphosate at the groundcrack stage showed promise for control. DPX 1840 and 2,4-DB also were effective as groundcrack treatments because they are applied while horsenettles are in their most susceptible stage to these herbicides. Also, additional re-treatments could be applied until the horsenettles pass the bloom stage without any injury to the peanuts.

Another possibility for control of horsenettle is with the subsurface layering blade. The dinitroanalines and 2,4,5-T were effective for control of horsenettle with the blade, but before any conclusions are made further evaluation of technique and these herbicides are needed.

There are several ideas for further studies which might be considered. One of these is directed type spraying on the crop with glyphosate. Double the recommended rate of dinitroanalines plus cultivation might also be a possibility. Another possibility is the improved sweep for control of rhizome johnsongrass. Ideas for horsenettle control are concerned with directed spraying and more groundcrack studies and more work on subsurface sweep blade work.

CHAPTER V

SUMMARY AND CONCLUSIONS

The influence of preplant incorporated and postemergence herbicides on johnsongrass growing in fallowed and cropped areas was studied. The double the recommended rate dinitroanalines, mainly trifluralin, profluralin and dinitramine, showed good control after two years of treatment. These dinitroanalines also show good crop tolerance except for sorghum. These herbicides applied at the double the recommended rate for at least two years plus cultivation should give satisfactory control.

Postemergence treatments look very promising. Glyphosate applied in the fall on mature johnsongrass on fallow ground with a preplant incorporated herbicide, such as trifluralin, to control annual weeds and seedling johnsongrass might be a good combination. In cropped areas glyphosate could be applied in the spring after the johnsongrass reaches 24 inches or more in height. The field could then be disked 8 days after treatment or longer. Planting of the crop may be done any time after disking. Then later in the growing season spot treatments could be used if necessary. If longer control is desired, glyphosate could be used to get quick top kill, then bromacil applied to the soil two weeks later to get longer residual control.

The influence of several herbicides on horsenettle growing in fallowed and cropped areas was studied. The most effective treatments for killing the top of the horsenettle and suppressing regrowth were picloram and glyphosate. Silvex, 2,4-D, dicamba, 2,4,5-T and amitrole were also effective for top kill, but regrowth must be re-treated for a second year. Disking tends to enhance regrowth to a slight degree. Control of horsenettle on fallow ground with one application appears to be possible with glyphosate applied late in the growing season on horsenettle in the postbloom or fruit set stages without any soil residue occurring.

On cropland 2,4-DB appears to be the most effective and economical herbicide for horsenettle control without injury to the peanut plant. 2,4-DB appears to be most effective at sprouting and prebloom stages. It is also very good for reduction of fruit numbers. Glyphosate appears promising for control of horsenettle at the peanut groundcrack stage. 2,4-DB was good both as a groundcrack and postemergence treatment until the horsenettle reached the bloom stage. It also should not injure the peanuts until they bloom.

The dinitroanalines applied as a smooth layer with a subsurface sweep blade 6 to 8 inches below the soil surface showed promise with proper application technique.

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APPENDIX

TABLE XV

ENVIRONMENTAL AND FIELD CONDITIONS AT THE TIME OF JOHNSONGRASS TREATMENTS

Experiment	A1			A2		
Date	10/19/70	4/30/71	6/18/73	5/22/72	7/15/72	6/18/73
Stages				Preplant	Postemerge	Preplant
Temperature (F)						
Air	78	94	90	84	96	88
Soil	75	80	77	82	92	83
Wind (mph)	none	none	3-5	6-8	3	4
Moisture	good	good	good	good	dry	good
Sun	bright	bright	bright	bright	bright	cloudy
Soil Texture	clay loam	clay loam	clay loam	clay loam	clay loam	clay loam
Plot Size (ft.)	10 x 20	5 x 20	5 x 20	10 x 20	10 x 20	10 x 20
Replications	4	4	4	5	5	5

TABLE XV (CONTINUED)

Experiment	A3					
Date	6/17/72	7/19/72	7/3/73	7/19/73	6/16/72	7/19/73
Stages	18"	Boot & Head	18"	Boot & Head	18"	Head
Temperature (F)						
Air	98	86	96	98	101	98
Soil	94	86	89	89	95	94
Wind (mph)	S 0-6	SE 0-5	S 5-10	S 3-5	SE 0-7	S 2-10
Moisture	dry	wet	good	good	dry	good
Sun	bright	bright	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	clay loam	clay loam	loam	loam
Plot Size (ft)	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
Replications	4	4	4	4	4	4

TABLE XV (CONTINUED)

Experiment	A4			
Date	10/13/71	10/16/72	10/14/72	10/13/72
Location	Stillwater	Stillwater	Stillwater	Lake Carl Blackwell
Temperature (F)				
Air	77	85	84	78
Soil	74	82	72	81
Wind (mph)	0	3-5	3-5	3-5
Moisture	moist	good	dry	dry
Sun	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	clay loam	loam
Plot size (ft)	10 x 15	10 x 10	10 x 10	10 x 10
Replications	3	3	3	3

TABLE XV (CONTINUED)

Experiment	A5					
Date	6/14/73	6/21/73	6/28/73	7/5/73	7/19/73	7/26/73
Stages	18"	36"	48"	18"	36"	48"
Temperature (F)						
Air	88	89	90	93	87	97
Soil	75	77	78	82	83	87
Wind (mph)	-	-	-	-	-	-
Moisture	good	good	good	good	good	good
Sun	bright	bright	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	clay loam	clay loam	clay loam	clay loam
Plot Size	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
Replications	3	3	3	3	3	3

TABLE XV (CONTINUED)

Experiment	A5 (Cont.)			A6		
Date	8/2/73	8/23/73	8/30/73	6/20/73	6/25/73	7/11/73
Stages	18"	36"	48"	6"	12"	18"
Temperature (F)						
Air	95	96	83	85	89	92
Soil	88	87	85	75	77	82
Wind (mph)	-	-	-	4	1	4
Moisture	good	good	good	good	good	good
Sun	bright	bright	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	clay loam	clay loam	clay loam	clay loam
Plot Size	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
Replications	3	3	3	3	3	3

TABLE XV (CONTINUED)

Experiment	A6 (Cont.)		A7		A8	
Date	7/25/73	8/1/73	8/2/73	8/11/73	7/12/73	7/27/73
Stage	24"	36"	36"	48"	24"	48"
Temperature (F)						
Air	88	92	92	90	92	90
Soil	85	87	88	88	87	86
Wind (mph)	5	6	3-6	2-4	S 2-3	S 5-7
Moisture	good	good	good	good	good	wet
Sun	bright	bright	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	loam	loam	clay loam	clay loam
Plot Size	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
Replications	3	3	3	3	3	3

TABLE XVI

ENVIRONMENTAL AND FIELD CONDITIONS AT THE TIME OF HORSENETTLE TREATMENTS

Experiment	B1		B2		B3	
Date	6/9/72	6/28/73	6/9/72	6/26/73	6/28/72	7/25/72
Stages					Fruit	Fruit
Temperature (F)						
Air	94	92	94	92	92	99
Soil	108	87	108	89	88	97
Wind (mph)	8-14	--	8-14	5-9	3-6	4-6
Moisture	dry	dry	dry	good	good	wet
Sun	bright	bright	bright	bright	bright	bright
Soil Texture	sand	sand	sandy	sandy	silt loam	silt loam
Plot Size (ft)	10 x 30	10 x 30	10 x 20	10 x 20	10 x 20	10 x 20
Replications	3	3	3	3	3	3

TABLE XVI (CONTINUED)

Experiment	B3 (Contd.)					
Date	6/27/73	7/12/73	7/26/73	8/8/73	8/23/73	8/30/73
Stages	Prebloom	Bloom	Fruit	Prebloom	Bloom	Fruit
Temperature (F)						
Air	88	89	92	94	93	90
Soil	82	84	88	87	85	88
Wind (mph)	3-4	5-7	6-9	3-6	3	7
Moisture	good	good	wet	good	good	good
Sun	bright	bright	cloudy	bright	bright	bright
Soil Texture	silt loam	silt loam	silt loam	silt loam	silt loam	silt loam
Plot Size (ft)	10 x 20	10 x 20	10 x 20	10 x 20	10 x 20	10 x 20
Replications	3	3	3	3	3	3

TABLE XVI (CONTINUED)

Experiment	B4				
Date	6/27/73	7/5/73	7/12/73	7/19/73	7/26/73
Stages	Sprout	Prebloom	Bloom	Postbloom	Fruit
Temperature (F)					
Air	88	92	93	89	87
Soil	82	84	85	86	83
Wind (mph)	3-5	4-7	2-5	7-10	3-6
Moisture	good	good	wet	good	good
Sun	bright	bright	cloudy	bright	bright
Soil Texture	silt loam	silt loam	silt loam	silt loam	silt loam
Plot Size (ft)	16 x 20	16 x 20	16 x 20	16 x 20	16 x 20
Replications	3	3	3	3	3

TABLE XVI (CONTINUED)

Experiment	B5		B6	
Date	7/12/72	7/27/73	6/14/72	8/31/73
Locations			Shawnee	Perkins
Temperature (F)				
Air	92	90	88	93
Soil	87	86	78	89
Wind (mph)	S 2-3	S 5-7	0-3	5-10
Moisture	good	wet	dry	good
Sun	bright	bright	bright	bright
Soil Texture	clay loam	clay loam	sand	loam
Plot Size (ft)	10 x 10	10 x 10	10 x 50	10 x 50
Replications	3	3	4	4

TABLE XVII

1972 AND 1973 RAINFALL DATA

1972 RAINFALL AT HOLDENVILLE
(INCHES)

January		February		March		April	
25	.10	3	.30	13	1.70	14	.20
29	.10	12	.60	16	.65	15	.20
				21	.70	20	.80
						21	1.30
						27	1.00
						30	.40

May		June		July		August	
1	1.46	13	.50	2	1.80	5	.10
7	.05	14	.50	3	.30	23	.18
8	.42	15	.13	4	.10	25	.90
12	.08	23	.30	13	.50	30	.30
23	.49	24	.10	30	.10		
24	.02	27	1.00				
29	.98						

September		October		November		December	
1	.70	22	2.00	1	3.00	6	.10
4	.10	27	.20	6	.70	11	.10
21	2.60	30	.10	13	1.80	15	.05
22	3.00	31	4.50	18	.30	16	.05
23	.30			20	.02	21	.10
27	.10			21	.15	30	.70

TABLE XVII (CONTINUED)

1972 RAINFALL AT SHAWNEE
(INCHES)

January		February		March		April	
2	.01	1	.03	21	.58	15	.09
4	.03	2	.03	24	.10	20	.59
17	.03	3	.07			21	1.40
28	.22	11	.07			27	1.29
		12	.52			28	.06
						30	.89

May		June		July		August	
1	.02	11	.25	3	.66	5	.07
5	.06	13	.39	4	.18	7	.04
7	.57	23	.18	13	1.04	9	.27
8	.06	24	.63	19	.06	13	.07
12	1.42	28	.01			14	.81
13	.14					15	.08
28	.18					22	.14
29	.25					25	.64
30	.35					30	.36

September		October		November		December	
1	.48	9	.10	1	2.05	6	.02
4	.07	10	.02	2	.03	12	.28
5	.12	15	.23	6	.21	15	.07
21	.15	19	.09	13	1.86	21	1.12
22	.24	21	.31	18	.52	30	.21
23	.03	22	3.07	19	.29		
26	.17	27	.09	21	.21		
27	.10	30	.25	22	.03		
		31	3.04	24	.06		
				25	.11		

TABLE XVII (CONTINUED)

1972 RAINFALL AT STILLWATER
(INCHES)

January	
2	.08

February	
2	.04
11	.02
12	.08

March	
13	.24
21	.65
24	.16

April	
15	1.02
19	.06
20	.45
26	.16
27	.36
28	.06
29	.05
30	.16

May	
1	.26
3	.06
5	.02
6	.16
7	.14
12	.55
18	.09
23	.73
28	.20
29	.03

June	
14	.11
20	.82
23	1.23
24	1.36

July	
1	.31
2	1.25
3	.50
5	.21
11	.05
12	.11
17	.03
18	.23
27	.04
29	.08

August	
5	.07
9	.09
22	.17
25	1.46
29	.08
30	.75
31	.49

September	
1	.07
2	.10
4	.05
7	.27
10	.72
12	.07
14	.05
21	.50
29	.17

October	
9	.55
21	.84
22	2.41
30	.24
31	1.44

November	
1	1.20
7	.32
13	1.20
18	.14
19	.41
21	.02
25	.31

December	
12	1.62
15	.01
30	.72

TABLE XVII (CONTINUED)

1972 RAINFALL AT FORT COBB
(INCHES)

January		February		March		April	
	0.00		0.00	24	.28	15	.93
						20	.12
						21	.05
						27	.95
						30	1.11

May		June		July		August	
1	.14	14	.96	4	.68	7	.08
7	.28			11	1.15	9	.02
10	.04			12	.08	22	.25
12	1.17			19	.97	23	.04
23	.28					25	.05
29	1.60					28	.09
						29	.02

September		October		November		December	
1	.03	22	2.92	1	1.00	30	.90
4	.31	26	.05	13	.48		
16	.30	30	.05	19	.49		
21	.15	31	1.70	22	.40		
29	.07			25	.46		
				28	.07		

TABLE XVII (CONTINUED)

1973 RAINFALL AT SHAWNEE
(INCHES)

January		February		March		April	
3	1.27	1	.79	2	.07	3	.56
9	.64	8	.78	4	.68	7	.02
18	.25	18	.10	6	1.28	8	.12
21	.34			7	.12	9	.16
26	.56			8	.15	15	.51
27	.01			9	.01	16	.97
				10	.40	19	.31
				11	.69	20	.35
				14	.12	22	.73
				24	1.14	23	.71
				25	1.74		
				28	.16		
				31	.71		

May		June		July		August	
2	.04	1	.02	1	.03	9	.46
7	.75	2	2.23	6	.02	11	.44
22	.22	3	1.22	21	.42	16	.17
23	.52	5	1.29	29	.06	30	1.24
25	1.05	14	.12	30	.11		
31	2.09	17	.25	31	.21		
		19	.07				
		20	.27				
		29	.27				
		30	2.50				

September		October		November		December	
2	.33	4	.02	5	.02	3	.33
4	.06	6	.55	8	.02	4	.04
5	.01	11	1.30	9	.01	18	.45
6	.90	12	.27	20	.14		
7	.67	13	1.12	24	.53		
8	.09	27	.74	25	2.10		
9	.38	31	.43	26	.22		
13	2.05			28	.08		
17	.24						
24	.02						
25	.05						
27	2.68						
28	.05						

TABLE XVII (CONTINUED)

1973 RAINFALL AT STILLWATER
(INCHES)

January		February		March		April	
3	1.06	1	.71	2	.06	3	.25
4	.32	2	.02	4	.38	8	.46
7	.05	7	.05	6	.76	9	.32
21	.43	8	.24	7	.03	15	.25
22	.03	18	.18	8	.31	16	1.52
26	1.21			9	.41	19	.32
27	.01			10	1.01	20	.05
28	.13			11	1.27	25	.27
				24	1.23		
				25	.72		
				26	.04		
				28	.37		
				30	.03		
				31	1.11		

May		June		July		August	
7	.78	2	.84	10	.52	9	2.10
23	.78	3	.28	11	.78	16	.06
25	.37	5	.16	21	.04		
27	.17	14	.02	23	.25		
30	.12	15	.13	25	.72		
31	.98	19	.41	26	.39		
		30	.31	29	1.62		
				30	.02		
				31	.01		

September		October		November		December	
2	.27	4	.41	20	.85	4	1.00
4	3.06	6	.03	24	2.03	5	.05
5	2.15	11	1.07	27	.13		
7	.30	13	.39	28	.05		
8	.68	27	.46				
9	.15	31	.08				
13	1.88						
17	.14						
22	.85						
25	.19						
27	2.70						
28	.04						

TABLE XVII (CONTINUED)

1973 RAINFALL AT FORT COBB
(INCHES)

January		February		March		April	
3	1.15	1	.31	1	.06	3	.37
7	.56	7	.04	2	.51	8	.58
8	.01	8	.23	4	.18	9	.02
10	.01	11	.12	6	.46	13	.24
21	.36	18	.06	8	.17	15	.02
22	.81	20	.01	9	.20	16	.59
26	.64	23	.11	10	1.55	19	.47
				13	.02	23	.01
				14	.06	24	.37
				24	.52		
				25	.96		
				26	.01		
				28	.27		
				30	1.30		
				31	.60		

May		June		July		August	
7	.19	2	.87	4	.04	9	.76
22	.68	3	.24	10	1.53	11	.11
23	1.29	14	.03	11	.32	16	.13
27	.02	17	.03	14	1.57	30	.12
31	1.77	19	.94	21	3.07		
		29	.20	22	.11		
				23	.24		
				25	.03		
				29	.21		
				30	.28		
				31	.06		

September		October		November		December	
1	.10	4	.78	7	.01	4	.49
2	.10	5	.27	8	.01		
4	.14	11	1.01	20	.17		
5	.24	13	.25	24	.10		
6	.79	27	.11	25	.65		
7	1.05			27	.04		
8	.85						
13	1.68						
17	.37						
18	.02						
25	.02						
27	2.85						

TABLE XVII (CONTINUED)

1973 RAINFALL AT HOLDENVILLE
(INCHES)

January		February		March		April	
3	1.20	1	.70	1	.20	3	.80
7	.30	7	.20	4	1.10	9	.40
18	.60	8	.70	6	.40	15	.50
21	.60	23	.20	7	.33	16	1.80
22	.10			10	.60	18	.40
26	.60			14	.39	19	.50
				15	.05	21	1.00
				24	.70	22	.60
				25	1.00	23	.20
				31	.70		

May		June		July		August	
2	.10	2	.90	11	.80	9	1.70
7	.50	3	1.90	21	.05	16	.15
23	.40	5	1.70	29	.60	29	.20
25	.26	17	.70	30	.40		
27	.90	19	.90				
31	1.82	20	1.10				

September		October		November		December	
2	.20	4	.20	8	.20	4	1.53
5	1.50	6	.50	20	1.40	5	.03
6	1.60	11	1.10	23	.70	19	.03
13	1.40	12	.30	24	1.70		
27	2.50	16	.82	25	2.25		
28	.10	27	.70	26	.90		
		31	.50				

TABLE XVII (CONTINUED)

1973 RAINFALL AT PERKINS
(INCHES)

January		February		March		April	
5	1.43	1	.13	2	.07	1	.18
7	.48	8	.29	3	.24	3	.39
21	.14	17	.46	4	.04	9	.42
26	1.06			5	1.19	15	.40
28	.19			8	.71	16	.26
31	.50			9	1.93		
				13	.07		
				23	1.43		
				24	.83		
				25	.03		
				28	.26		
				29	.02		
				30	1.01		

May		June		July		August	
6	.32	2	.20	10	.49	9	1.63
7	.47	3	.27	11	.21	30	.44
23	1.17	5	.38	22	.09		
29	.23	15	.16	25	.47		
30	.27	19	.90	29	.59		
31	1.17	20	.49				

September		October		November		December	
2	.43	4	.32	20	1.36	4	1.36
4	1.56	6	.30	24	.20	20	.09
5	.21	11	1.40	25	1.37	30	.05
6	.10	12	.63	27	.11		
7	.16	27	.16	28	.18		
8	.53						
9	.30						
13	.64						
17	.23						
22	.27						
25	.11						
27	2.53						
28	.05						

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