EMERGENCE OF VELVETLEAF, *Abutilon theophrasti* AND OF WILD CANE, *Sorghum bicolor*, FROM DIFFERENT SEED DEPTHS AND SITE OF UPTAKE OF VARIOUS CHEMICALS

by

JERRY LEE CONDRAY

B. S., Kansas State University, 1966

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

Approved by:

Oliver G. Russ
Major Professor

TABLE OF CONTENTS

INTRODUCTION

The successful control of weeds with preemergent herbicides has been a complex task with variables such as soil type and moisture. Soil adsorption, dilution of the herbicide in the soil, and movement by rainfall are factors which are in part responsible for the varied results of soil incorporation of the preemergent herbicide. The incorporation of chemicals in some cases has proven effective in improving results in the field by reducing volatilization and photodecomposition. The site of uptake may have an effect on herbicidal properties.

The emphasis in this research was on the characteristics of the species to be controlled rather than on what the chemical was adapted to do in certain environmental conditions. Environmental conditions were important but so were the physiological characteristics of the seedling. The primary considerations involving the use of soil-incorporated herbicides in this investigation were the potential of the weed seed to emerge from different soil depths, the ability of the seed to remain viable in the soil, and the location of chemical absorption (root vs shoot) by the seedling. This approach required the investigation of the chemical-seedling interaction.

The objective of this study was to determine the potential for emergence of velvetleaf,[1] Abutilon theophrasti Medic.,

---

[1]Abutilon theophrasti Medic. will be referred to hereafter as velvetleaf.

and of wild cane,[2] Sorghum bicolor (L.) Moench, and the site of uptake of various chemicals for these two species.

The two weed species studied are problems in crops such as corn, soybeans, and sorghum. Chemicals included in the study were simazine,[3] EPTC,[4] trifluralin,[5] and vernolate.[6]

---

[2] Sorghum bicolor (L.) Moench will be referred to hereafter as wild cane.

[3] Simazine is the common name for 2-chloro-4,6-bis (ethylamino)-s-triazine. Hereafter in this paper it will be referred to as simazine.

[4] Ethyl N,N-dipropylthiocarbamate will be referred to as EPTC throughout this paper.

[5] α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine is the chemical name for trifluralin, the common name used in this paper.

[6] Vernolate is the common name for S-propyl dipropylthiocarbamate and it is the form used throughout this paper.

REVIEW OF LITERATURE

Burnside (1965), in an extensive study of the seed and phenological properties of wild cane, found variability in germination, dormancy, ability to float, viability over a period of time, and ease of shattering the seeds. He conducted a depth-of-planting experiment and found that depths to six inches had little effect on emergence of seedlings. His work pointed out clearly the diverse variability in the seed characteristics of the weed species.

In a greenhouse study with sorghum, Martin, Taylor, and Leukel (1935) found effects of depth to be rather small compared to soil temperature. The percentage and rapidity of germination in sorghums was reduced by soil temperatures below 25° C and slightly reduced by deep planting (two and a half inches). Seedling development was retarded by low temperatures but not by deep planting. Murphy and Arny (1939) used five different soils and compared greenhouse and field studies to show differences in emergence. The deeper the seed, the denser and cooler the soil, the longer it took for the grasses to emerge, but legumes emerged much more readily under similar conditions. Greenhouse conditions were more conducive to deeper planting than field locations. There was a positive correlation between large seed size and ability to emerge from deep seed position. Dawson and Bruns (1962) pointed out differences in results on depth studies they made in the greenhouse and in the field. Their study established a relationship between seed weight and depth of planting with successful emergence. Wiese and Davis (1967) presented evidence that emergence was determined by several factors including depth of seed, soil temperature, soil type and moisture conditions. Their results from planting weed seed at six depths indicated optimum diurnal temperature range interaction with soil moisture and type to present a complex picture of seedling emergence factors.

The relationship of soil adsorption of EPTC to oats injury in various soil types was studied by Ashton and Sheets (1959). They found that EPTC was adsorbed to a much greater extent by air-dry soil than by soil near field capacity and that adsorption was inversely related to biological effectiveness. Conditions favorable for herbicidal action were most favorable for loss of the herbicide. Hauser (1965) used EPTC to study depths of placement in the soil. He pointed out the need for determining the most effective placement using soil applied herbicides. Gray and Weierich (1965) investigated various factors affecting vapor loss of EPTC from soils. Their results show soil moisture as the most important factor. Depth of incorporation ranked second in importance. They also found differences with varying soil textures. Temperature and moisture interacted differently under different soil types. A study of photochemical decomposition of trifluralin by Wright and Warren (1965) suggested that applications in soil reduced losses over various synthetic surfaces under varying light conditions. They pointed out soil adsorption, moisture, leaching, and pH as important factors affecting biological activity of trifluralin.

Davis, Funderburk, and Sansing (1959) verified the uptake of simazine through the root and not the shoot by using a radioactive isotope of carbon. They studied corn, cotton, and cucumber and found consistent uptake through the root only, except when the simazine contacted an area with a broken cuticle. The simazine was translocated throughout the plant when taken up by the roots. Parker (1966) used sorghum seed in petri dishes to conduct a bioassay on site-of-uptake. Among the chemicals he used, EPTC was taken up through the shoot and trifluralin through the root. As a criteria for judgement he compared concentrations which caused similar stunting of root and shoot. The experiment was concluded at three days. Nishimoto, Appleby, and Furtick (1967) studied chemical site-of-uptake by placement of chemical in soil at field capacity and sealing the container with a plastic bag. This prevented evaporation and the need for watering. Since there was no need for watering during the experiment, the chemical was not moved by leaching. Concerning root and shoot uptake in the soil, Hartley (1964) states that in general, less volatile, less soluble herbicides have the root as the most important path of entry. He attests to the fact that entrance through the

MATERIALS AND METHODS

Experiments reported on in this paper were conducted during 1967 in Kansas State University greenhouse facilities. The soil used in the studies was a silty clay loam of unnamed soil type. Randomized complete block design was used throughout the study.

The first experiment was a test of the germination and emergence of both wild cane and velvetleaf from different depths in the soil. Germination of the weed seed during a short period of time and at a high percentage was desirable to reduce variation in the experiment. The velvetleaf seed was immersed in 95°C water for one minute as a method of improving seed germination.[7] Dry seed of both species was then treated with tetrachloro-p-benzoquinone (seed protectant). Germination results were taken in sand culture with pint freezer containers over the open petri dishes to reduce evaporation and provide room for growth. The germination test was made in the greenhouse where subsequent parts of the experiment were conducted. The average diurnal variation was from a minimum of 21.1°C to a maximum of 36.6°C. Wood boxes one foot square and one foot deep were constructed for the study of emergence. There were three replications of one, two, four, six, and eight inch planting depths. One hundred seeds of each species were planted in rows in each box.

---

[7] This was a modification of a method used by G. P. Steinbauer and Buford Grigsby, 1959. Methods of obtaining field and laboratory germination of seeds of bindweed, lady's thumb and velvetleaf. Weeds 7:41-46.

Since there was a considerable quantity of seed which did not produce seedlings, the viability of the remaining seed of the two species at the different depths was tested. The zone of soil (containing the seed) from four inches above the planting depth to four inches below was removed. This volume of soil was then mixed thoroughly and placed in trays three inches deep. The number of seedlings of each species emerging was noted and when germination ceased, the soil was remixed and watered again. Results were taken twice and the number of seeds to produce seedlings was compared among planting depths.

The second experiment was to study the site of uptake of simazine, EPTC, trifluralin, and vernolate on the two weed species included. A one inch layer of soil on a plastic sheet was treated at a rate of 30 gal/acre of spray mixture and moistened to near field capacity. The chemicals were applied at the following rates: three lb. A.I.[8]/acre of EPTC; one lb. A.I./acre of trifluralin; three lb. A.I./acre of vernolate; and four lb. A.I./acre of simazine. Seed of both species was planted two inches deep at a rate of 25 seeds per container. A planting disc was used in planting both the velvetleaf and wild cane seed. By incorporating the chemicals in the soil before adding it to the gallon containers and adding one inch at a time, untreated soil could be added in layers to get the different layers of

---

[8]A.I. refers to active ingredient of the chemical.

chemically treated soil above and below the seed level. The five treatments differed in the placement of the treated band in relation to the depth of the seed in the soil. The check had no treated soil in the container. The other four treatments were: a band of treated soil one inch deep one inch above the seed, a band of treated soil one inch deep one inch below the seed, bands of treated soil one inch deep both one inch above and one inch below the seed, and a band of treated soil from one inch above the seed to one inch below the seed. These five treatments were replicated three times with each combination of the two weed species and the four chemicals. The untreated soil in the containers was brought to near field capacity as the containers were filled. In the studies involving simazine and EPTC, the gallon cans were sealed with a plastic freezer bag using rubber bands to seal the "miniature greenhouses." This technique was used by Nishimoto et al. (1967). In the treatments involving trifluralin and vernolate, a wood frame covered with plastic was used to enclose the experiment. A white cloth was placed over the top of the plastic hood to reduce the heat. Both methods reduced evaporation and eliminated the need for watering. Movement of the chemical from the treated bands in the soil was minimal since there was no watering during the growth period. Weed seedlings were observed for herbicidal injury.

EXPERIMENTAL RESULTS

Germination studies in a sand culture indicated that the wild cane seed used (a mixture from different locations in Kansas) was 95.6% viable. Similar tests of the velvetleaf seed indicated germination of 95.2%. The depth of planting study was started on February 14, 1967, and final count taken March fourth. Both species showed a delayed time of emergence with deeper planting depths. No velvetleaf emerged from the six or eight inch planting depths. Table 1 indicates a decreasing emergence of velvetleaf seedlings with increased depth of planting. There was a significant difference in emergence from the different depths as shown by the F test. Calculated F values and the table F values were obtained from Fryer's procedures and tables.[9]

Table 1. Number of velvetleaf seedlings to emerge from different soil depths.

Depth of planting	Replication 1	2	3	Mean
1"	89	91	88	89.3
2"	85	90	91	88.6
4"	2	18	13	11.0
6"	0	0	0	0
8"	0	0	0	0

Table F = 3.84 Calculated F = 1974.4*§

§ Asterisk denotes significant differences between treatment means at the .05 level. n.s. denotes no significant differences between treatment means.

---

[9]Fryer, H. C. 1966. Concepts and methods of experimental statistics. Allyn and Bacon, Inc., Boston.

One-inch and eight-inch planting depths for wild cane showed four days difference in time of emergence. Data for wild cane in Table 2 show that there is no significant difference in number of seedlings to emerge from various planting depths. Emergence was only slightly better than a third of the germination percentage in sand culture.

Table 2. Number of wild cane seedlings to emerge from different soil depths.

Depth of planting	Replication 1	2	3	Mean
1"	51	30	26	35.6
2"	35	32	38	35.0
4"	34	33	31	32.6
6"	27	31	39	32.3
8"	45	30	33	36.0

Table F = 3.84 Calculated F = 0.15 n.s.

The volume of soil from four inches above the seed to four inches below the seed depth was then removed from the boxes, mixed and placed in greenhouse flats. The soil in the flats was watered for three weeks and the seedlings counted and averaged within treatments. The soil was again mixed thoroughly and watered. At the end of two weeks, the seedling count was made and averaged within the depth-of-planting treatments. At the end of both greenhouse flat tests, germination had stopped. Only one velvetleaf seed germinated after the soil was removed from the boxes. There was no significant difference between treatments for the average number of wild cane seedlings produced throughout the experiment. The totals in the last line of Table 3 are not included in the analysis of variance but are included as a comparison between the treatments. Results of the site of chemical uptake are presented in Tables 4 through 7. The data presented are on the basis of the appearance of the plants. The plants were considered affected by the chemical when they were in a very stunted condition at the end of the experiment. Where no number is presented, the plants were injured or failed to emerge.

The velvetleaf treatments in Table 4 had no significant difference between means of the treatments and the check because of the unusually small number of plants in the control. Observations on the site of uptake follow Table 4.

Table 3. Average number of wild cane seedlings to become established.

	Treatment				
	1"	2"	4"	6"	8"
Depth study	35.6	35.0	32.6	32.3	36.0
1st tray study	25.0	34.6	36.3	36.3	28.6
2nd tray study	12.3	17.3	11.6	10.3	14.3
Total	72.9	86.9	80.5	78.9	78.9

Table F = 3.84 Calculated F = 0.59 n.s.

EXPLANATION OF PLATE I

Wild cane and velvetleaf seedlings in depth of planting study. Time of emergence was later for deeper seed depths.

PLATE I

EXPLANATION OF PLATE II

Wild cane seedlings at the conclusion of the experiment. Labels indicate depth of planting in inches.

PLATE II

Table 4.§ Number of velvetleaf and wild cane seedlings showing no injury from placement of simazine.

Treatments	Velvetleaf Replications			Wild cane Replications		
	1	2	3	1	2	3
C	2	15	2	14	18	17
A	1	1	0	14	21	22
B	0	0	1	9	5	4
AB	0	0	0	3	3	4
I	0	0	0	0	0	1

Table F = 3.84 Calculated F = 1.96 n.s.
Calculated F = 29.14*

§ In tables 4-7 C represents check (no chemical), A = chemical above the seed, B = chemical below the seed, AB = the chemical bands both above and below the seed, I = the seed planted in a two inch band of treated soil.

Simazine studies were planted March 23 and EPTC studies on March 24, 1967. Simazine was absorbed through both the shoot and root in the velvetleaf seedlings. The A, AB, B, and I treatments showed no injury until a week after planting. Simazine was absorbed only through the root in wild cane seedlings. The seedlings from the I treatment had leaf tips burned. Some seedlings ceased growth at a three inch height when the roots contacted the chemical in the band below the seed. All simazine treatments caused the velvetleaf seedlings to show herbicide injury one week after planting.

In the treatments containing EPTC, only one velvetleaf seedling emerged from any container having treated soil. The chemical was evidently absorbed through both the shoot and the root of the seedling. Wild cane seedlings in EPTC-treated soil also showed injury. The chemical was absorbed through the shoot and the root. The seedlings grew about 3/4 inch above the soil surface. The leaves of these "shoots" never unfolded. In the B treatment (a band of treated soil one inch below the seed) the seedlings looked normal until the roots contacted the chemical. Growth of these seedlings ceased at about three inches above the soil surface. The simazine and EPTC studies were concluded on April sixth.

Table 5. Number of velvetleaf and wild cane seedlings showing no injury from placement of EPTC.

Treatments	Velvetleaf Replications			Wild cane Replications		
	1	2	3	1	2	3
C	X[§]	10	12	16	19	16
A	0	0	0	0	0	0
B	0	1	0	0	0	0
AB	0	0	0	0	0	0
I	0	0	0	0	0	0

Table F = 4.12 Calculated F = 131.28*
Table F = 3.84 Calculated F = 289*

§ Analysis of covariance was used as a means of supplying missing datum.

EXPLANATION OF PLATE III

Simazine study with velvetleaf. Treatments were: (121) chemical in band below seed, (122) seed in center of band of chemical, (123) the band of chemical was above the seed, (124) the seed had both--bands above and below the seed, (125) check--no chemical.

PLATE III

EXPLANATION OF PLATE IV

Simazine study with wild cane showed escape of seedlings in one treatment. Containers were labeled as follows: 211 had a band of chemical above the seed. 212 had the seed in the center of the two inch band. 213 had no chemical treatment. 214 had a band of chemical below the seed. 215 had bands of chemical both above and below the seed.

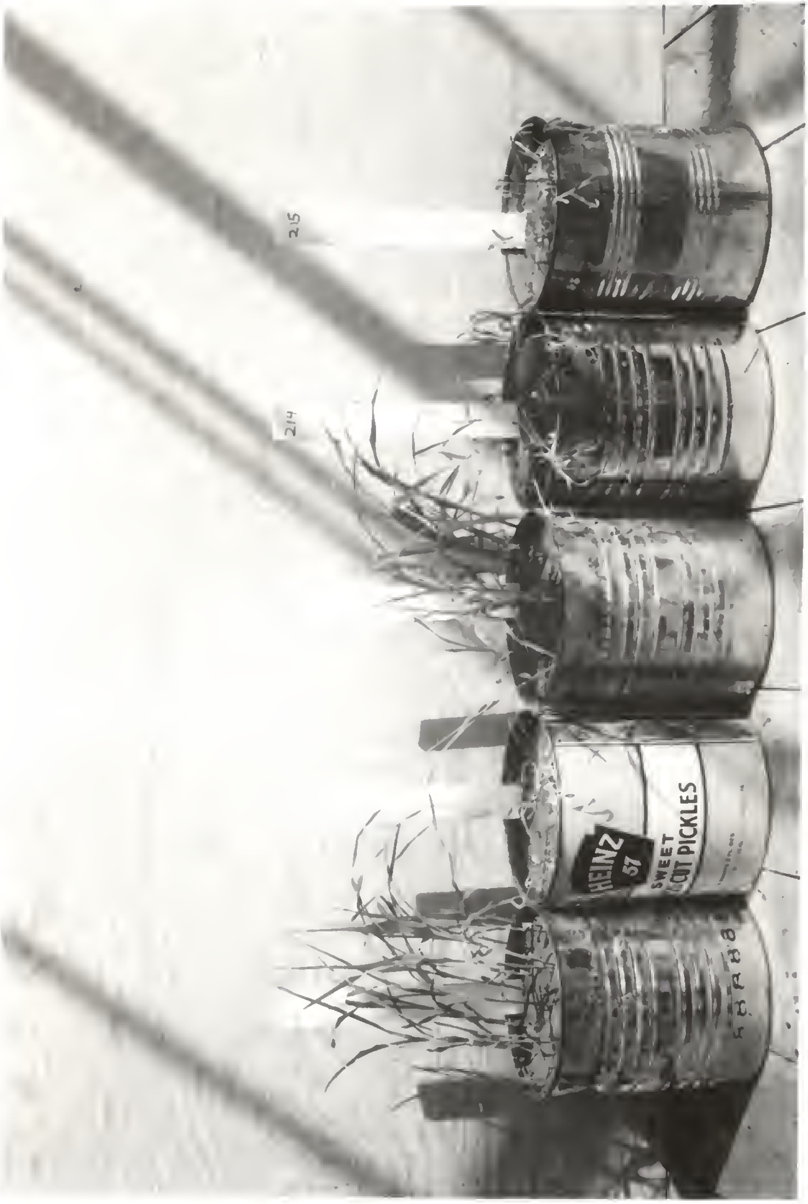

PLATE IV

EXPLANATION OF PLATE V

EPTC study with velvetleaf. Container 331 had a band of chemical below the seed. 332 had chemical both above and below the seed. 333 had the chemical band above the seed. 334 was the check. 335 had the seed planted in the chemical band.

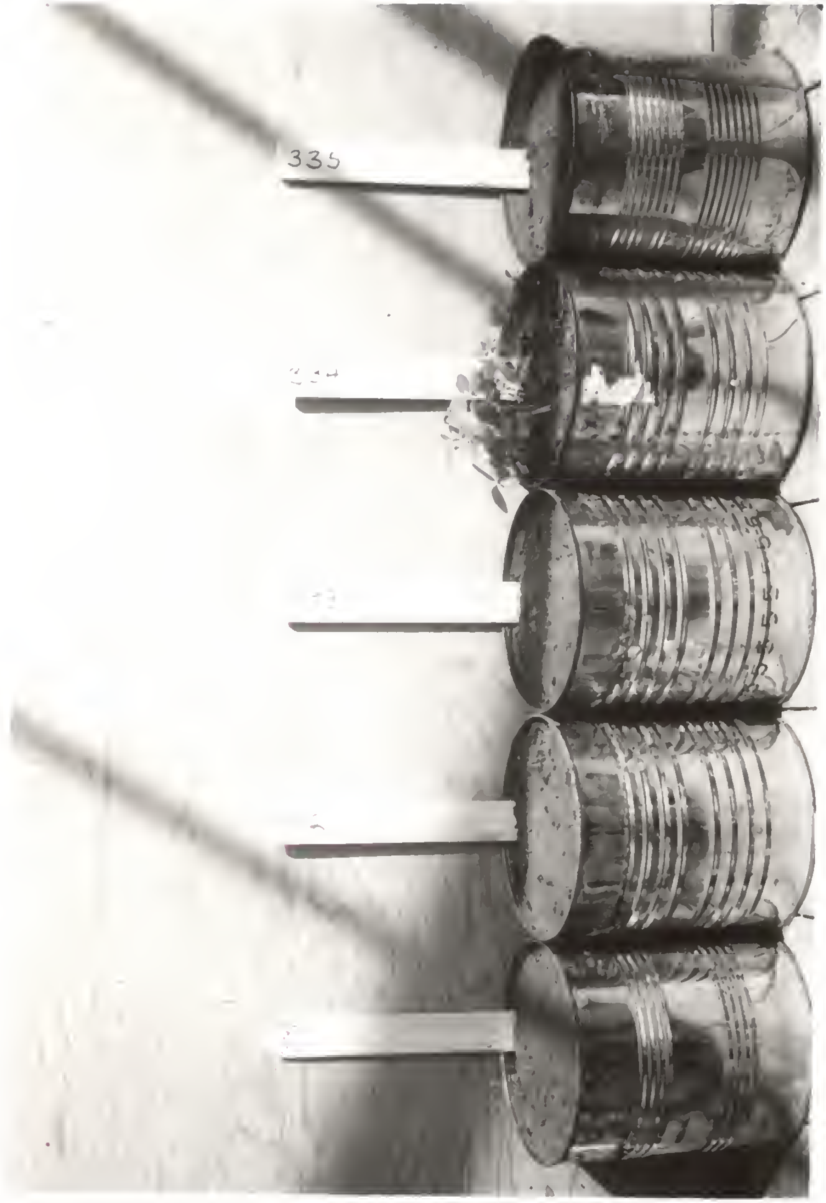

PLATE V

EXPLANATION OF PLATE VI

EPTC study with wild cane shows effects of site of uptake. Container 431 had the seed planted in a chemical band. 432 had the band of chemical below the seed. 433 had the chemical band above the seed. Container 434 had both a chemical band above and below the seed. 435 was the check. Seedlings of container 432 were not damaged as much as with the other chemical placements.

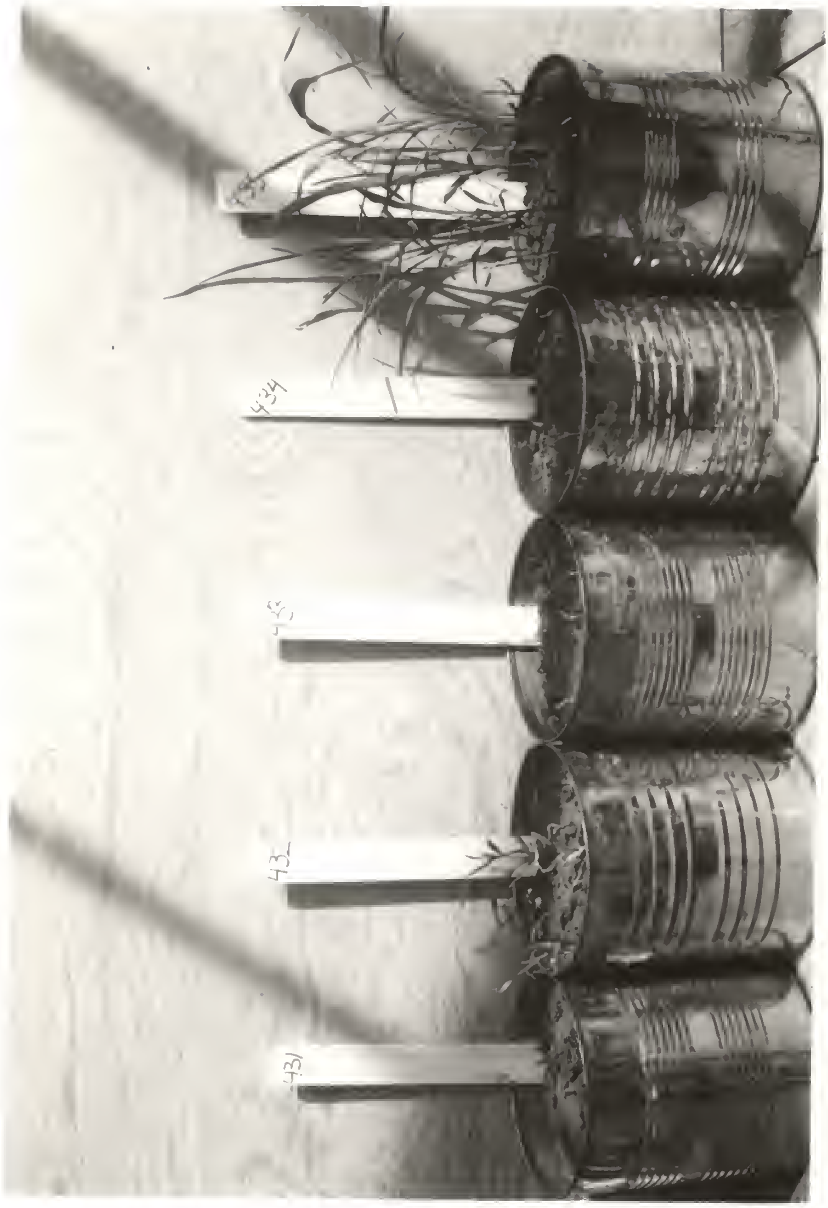

PLATE VI

Vernolate and trifluralin studies were initiated on April 13 and 14, respectively. Vernolate was absorbed not only through the shoot but also through the root in both velvetleaf and wild cane. In the wild cane study the chemical below (B) treatment plants were severely stunted. Other treatments caused death and drying up of the seedlings. Trifluralin did not affect velvetleaf but controlled wild cane when placed with or above the seed. No seedlings emerged when the seed was planted in the band of treated soil. The chemical was taken up through the shoot only and not the root system. Treatments with chemical above the seed resulted in injured seedlings which failed to grow over a half inch above the soil surface. Vernolate and trifluralin results were taken on April 30.

Table 6. Number of velvetleaf and wild cane seedlings showing no injury from placement of vernolate.

Treatment	Velvetleaf Replication			Wild cane Replication		
	1	2	3	1	2	3
C	1	16	22	18	23	20
A	0	0	0	0	0	0
B	1	0	3	0	0	0
AB	0	0	0	0	0	0
I	0	0	0	0	0	0

Table F = 3.84   Calculated F = 4.20*
Calculated F = 196.8*

Table 7. Number of velvetleaf and wild cane seedlings showing no injury from placement of trifluralin.

Treatment	Velvetleaf Replication			Wild cane Replication		
	1	2	3	1	2	3
C	5	20	19	22	21	23
A	3	15	20	0	0	0
B	8	11	21	19	22	22
AB	5	21	19	0	0	0
I	3	9	12	0	0	0

Table F = 3.84 Calculated F = 2.52 n.s.
Calculated F = 520*

DISCUSSION

Previous research, as cited in the laterature review, has shown that results of depth-of-planting studies are dependent on many factors other than the characteristics of the species. Since this was a greenhouse study, the environmental factors were more stable than under field conditions. Diurnal temperature ranges, moisture conditions and soil type may be much different from those in the field; therefore, one should use caution in applying the data obtained from greenhouse research to some field situations.

The germination and emergence of wild cane and velvetleaf were studied using seed of wild cane gathered at different locations in the eastern half of Kansas and velvetleaf seed gathered on the agronomy farm northwest of the Kansas State University campus. The soil used was a silty clay loam. The emergence, according to literature, would have been faster in a lighter textured soil. The average diurnal temperature ranged from 21.1°C to 36.6°C. The soil was watered about every third day, depending on evaporation.

Velvetleaf emergence was affected by seed depth. The planting of velvetleaf seed at different depths resulted in average emergences of 89.3% at one inch, 88.6% at the two inch planting depth, and 11.0% at the four inch depth. The one and two inch depths approached the sand culture germination test with velvetleaf seed germinating 95.2%. Wild cane seed with a germination percentage of 95.6 gave emergence ranging from an average of 32.3% to 36.0% at the different planting depths. There was no significant difference in the number of seedlings from planting the seed at one, two, four, six, or eight inch depths.

Since there was a significant amount of seed which failed to produce seedlings, the viability of the remaining seed was questioned. The soil containing the seed was removed from the boxes, thoroughly mixed, and placed in greenhouse flats. The soil was then watered and when emergence ceased, a count was taken and the process repeated. Only one velvetleaf seedling emerged from the three inch deep flats. This small amount of germination for the number of seed present was an indication that the velvetleaf seed which did not produce seedlings had lost its viability during the depth-of-planting study. The number of wild cane seedlings to emerge in the flats the first time was nearly as many as emerged from the boxes. In sand culture, germination of wild cane was 95.6% while the emergence of seedlings from the depth-of-planting study for some reason was only about a third of that amount. The first tray study germinated another third of the seed. The second tray study resulted in about a sixth of the seed originally planted germinating. There was no significant difference between original planting depths in the number of seeds to produce seedlings at that point. The wild cane seed remained viable at all depths in the soil. This pattern of emergence suggests that further research is necessary.

The results of the site-of-uptake part of the experiment must be observed with the fact in mind that with both species tested, the seedlings were under two weeks of age. The development of a secondary root system could have an effect on the site of uptake of a soil incorporated herbicide.

Simazine was absorbed by velvetleaf through both the root and shoot. The check containers had an abnormally small and variable number of seedlings. No chemical was taken up through the shoot of the wild cane seedlings; however, treatments with chemical below the seed showed evidence of chemical uptake. One can conclude that seed below the depth of incorporation would produce seedlings unaffected by the simazine. The conclusion would not be valid if leaching had occurred to an appreciable extent.

EPTC was absorbed through shoot and root in both velvetleaf and wild cane. Only one velvetleaf seedling emerged from any of the treatments containing incorporated chemical. This lack of emergence was an indication of the effect of EPTC on the germination of velvetleaf. The wild cane seedlings were also affected; however, the chemical below the seed gave delayed action of the herbicide.

Vernolate was absorbed through the shoot and also the root in both velvetleaf and wild cane. Vernolate in the band of soil below the seed caused the wild cane seedlings to be stunted at a three inch height.

Trifluralin resulted in no injury to velvetleaf seedlings. If there was a specific site-of-uptake, the chemical had no toxic effect. In this study it is assumed that there was no site-of-uptake because visual observations revealed no differences. Wild cane gave results indicating that there was no trifluralin uptake through the roots; however it was taken up through the shoot. The treatment with treated soil below the seed resulted in no injury. This was evidence that trifluralin applied near the surface would control wild cane seedlings at seed depths below the level of incorporation.

SUMMARY

From experimental results it can be concluded that depth in the soil of velvetleaf seed has a significant effect on the number of seedlings to emerge. This experiment indicated that the viability of the seed which did not germinate from 4, 6, and 8 inch planting depths was reduced.

Depth of wild cane seed in the soil does not significantly affect the number of seedlings to emerge. This experiment indicated that the viability of the seed was not reduced with different depths of planting.

Simazine was taken up through the shoot and also through the root in velvetleaf seedlings up to two weeks of age. Wild cane seedlings up to this age (with only a primary root system) take simazine up through the root and not the shoot.

Both wild cane and velvetleaf seedlings absorbed EPTC and vernolate through the shoot and also the root.

Velvetleaf seedlings had no distinguishable site of uptake for trifluralin. The chemical was not toxic enough to induce injury on velvetleaf seedlings. Wild cane seedlings absorbed trifluralin through the shoot and not the roots.

ACKNOWLEDGMENT

The author would like to express his sincere appreciation and thanks to his major advisor, Mr. Oliver G. Russ, for his guidance in selecting a research topic, suggestions in conducting the research, and for his critical reading and correction of this thesis.

LITERATURE CITED

Ashton, F. M., and T. J. Sheets. 1959. The relationship of soil adsorption of EPTC to oats injury in various soil types. Weeds 7:88-90.

Burnside, O. C. 1965. Seed and phenological studies with shattercane. University of Nebraska College of Agriculture. The Agricultural Experiment Station Research Bulletin 220.

Davis, D. E., H. H. Funderburk, Jr., and N. G. Sansing. 1959. The absorption and translocation of C^{14}-labeled simazine by corn, cotton and cucumber. Weeds 7:300-309.

Dawson, J. H., and V. F. Bruns. 1962. Emergence of barnyardgrass, green foxtail and yellow foxtail seedlings from various soil depths. Weeds 10:136-139.

Gray, Reed A., and Andre J. Weierich. 1965. Factors affecting the vapor loss of EPTC from soils. Weeds 13:141-147.

Hartley, G. S. 1964. Herbicide behavior in the soil. pp. 111-161. In L. J. Audus, Ed. The Physiology and Biochemistry of Herbicides. Academic Press, London and New York.

Hauser, Ellis W. 1965. Preemergence activity of three thiocarbamate herbicides in relation to depth of placement in soil. Weeds 15:255-257.

Knake, Ellery L., Arnold P. Appleby, and W. R. Furtick. 1967. Soil incorporation and site of uptake for preemergence herbicides. Weeds 15:228-232.

Nishimoto, Roy K., Arnold P. Appleby, and W. R. Furtick. 1967. Site of uptake of preemergence herbicides. Weed Society of America 1967 Meeting Abstracts.

Martin, J. H., J. W. Taylor, and R. W. Leukel. 1935. Effect of soil temperature and depth of planting on the emergence and development of sorghum seedlings in the greenhouse. J. Amer. Soc. Agron. 27:660-665.

Murphy, P. R., and A. C. Arny. 1939. The emergence of grass and legume seedlings planted at different depths in five soil types. J. Amer. Soc. Agron. 31:17-28.

Parker, C. 1966. The importance of shoot entry in the action of herbicides applied to the soil. Weeds 14: 117-121.

Wiese, A. F., and R. G. Davis. 1967. Weed emergence from two soils at various moistures, temperatures, and depths. Weeds 15:118-121.

Wright, W. L., and G. F. Warren. 1965. Photochemical decomposition of trifluralin. Weeds 13:329-331.

EMERGENCE OF VELVETLEAF, *Abutilon theophrasti* AND OF WILD CANE, *Sorghum bicolor*, FROM DIFFERENT SEED DEPTHS AND SITE OF UPTAKE OF VARIOUS CHEMICALS

by

JERRY LEE CONDRAY

B. S., Kansas State University, 1966

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

The ability of wild cane and velvetleaf to emerge from one, two, four, six, and eight inches in the soil was investigated in Kansas State University greenhouse facilities. Variability in characteristics of weed seed was reported in literature reviewed. Various factors affecting emergence were cited. Velvetleaf seed was immersed in 95°C water to improve germination. Seed of both species was treated with tetrachloro-p-benzoquinone (seed protectant). Sand culture tests for germination indicated germination of 95.6% for wild cane and 95.2% for velvetleaf. An unnamed silty clay loam was used in boxes one foot deep and one foot square. Randomized complete block design was used throughout the study. All treatments were replicated three times. The F test was used to determine significant differences among treatments. Emergence of velvetleaf seedlings was significantly influenced by depth of planting; emergence of wild cane was not. The percentage emergence of velvetleaf was comparable with germination percentage at the one and two inch depths but was reduced to about ten percent at a four inch depth. No seedlings emerged from six and eight inch depths of planting. Emergence of wild cane seedlings was not significantly different with different depths of planting. Only about a third of the seed produced seedlings. The viability of the remaining seed was tested by placing the soil in greenhouse flats three inches deep, thoroughly mixing it and watering it. During the first three weeks another third of the seed germinated. The process was repeated and two weeks later, another 15% had germinated. Velvetleaf had only one seed germinate during the tray study. The tray studies indicated that the viability of the velvetleaf seed which did not produce seedlings in the depth study was destroyed and the viability of the wild cane seed was not destroyed.

The second part of the research was a site-of-uptake study with both velvetleaf and wild cane, using four chemicals. The four chemicals were ethyl N,N-dipropylthiocarbamate (EPTC), 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine), s-propyl dipropylthiocarbamate (vernolate), and α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin). The five treatments were: check (no chemical); a band of treated soil one inch deep one inch above the seed; a band of treated soil one inch deep one inch below the seed; bands of treated soil one inch deep both above and below the seed one inch; and a band of treated soil from one inch above to one inch below the seed. All seed was planted two inches deep. The soil was brought to field capacity at time of planting and the containers sealed using rubber bands with plastic bags or placed in a plastic covered frame. Reducing the evaporation eliminated the need to water and prevented leaching. The results obtained may not be applicable when the secondary root system develops since results were from plants two weeks old.

Wild cane seedlings took up simazine only through the roots. Velvetleaf seedlings took simazine up through both the roots and the shoot. EPTC was absorbed through both the root and the shoot by both velvetleaf and wild cane. Vernolate was absorbed through both the root and the shoot by both species. Velvetleaf had no distinguishable site of uptake since no injury resulted from trifluralin treatments. Wild cane seedlings absorbed trifluralin through the shoot only.