THE EFFECT OF DIMETHIPIN ON
WHEAT MATURITY

By

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Bachelor of Science

Cameron University

Lawton, Oklahoma

1980

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 1983

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ACKNOWLEDGMENTS

The author wishes to express his appreciation to his major adviser Dr. Tom Peeper for his assistance, training, and patience throughout the course of the study. Appreciation is extended to the members of the graduate committee, Dr. H. A. L. Greer, Dr. Eddie Basler, and Dr. Roy Johnston for their help and advice.

I would like to dedicate this thesis to my parents whose suffering, perseverance, dedication, and encouragement serve to guide me.

I would like to offer a special thanks to my wife Susan for her understanding and encouragement which made this accomplishment possible.

Appreciation is extended to the Department of Agronomy at Oklahoma State University for the use of the facilities, equipment, and land which made the research possible. Appreciation is also extended to Melanie Bayles for her assistance in typing this thesis.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

Artificially accelerating the maturity of wheat (a list of all common and scientific names of plants is found in Table I) could prove advantageous to wheat producers since earlier initiation of harvest would reduce the potential for weather related crop losses. In addition, earlier harvesting would provide additional time flexibility for the subsequent planting of short season double crops.

Over 2.8 million hectares of hard red winter wheat were planted in Oklahoma during 1978, and approximately 2.0 million hectares or 71.4 percent of that planted was harvested (10). Standing mature wheat is very sensitive to adverse weather. In Oklahoma an average of 25 severe hailstorms occur per year with 31% of these storms occurring during May and 23% during June (14) when the wheat is most vulnerable (35). The earlier wheat is harvested, the less chance there is for crop loss due to weather.

Several problems remain when double-cropped soybeans and sorghum follow wheat, despite the progress in developing early maturing varieties of wheat. Inadequate rainfall prior to small grain harvest, can result in depleted soil moisture by harvest, poor double crop stands and hence,

TABLE I

COMMON AND SCIENTIFIC NAMES OF PLANTS

Common Name	Scientific Name
barley	*Hordeum vulgare* (L.)
barnyardgrass	*Echinochoa crus-galli* (L). Beauv.
bean	*Phaseolus* spp.
cheat	*Bromus secalinus* (L.)
common lambsquarter	*Chenopodium album* (L.)
cotton	*Gossypium* spp.
cox orange apple	*Malus* spp.
foxtail millet	*Setaria italica* (L.) Beauv.
giant foxtail	*Setaria faberi* (Herrm)
grapes	*Vitis* spp.
jointed goatgrass	*Aegilops cylindrica* Host
ladysthumbs	*Polygonum persicaria* (L.)
large crabgrass	*Digitaria sanguinalis* (L.) Scop.
lemon	*Citrus limon* (L.) Burm.
morningglory	*Ipomoea* spp.
mungbean	*Phaseolus aureus* (L.) Roxb.
pea	*Lathyrus* spp.
potato	*Solanum tuberosum* (L.)
prickly sida	*Sida spinosa* (L.)
redroot pigweed	*Amaranthus retroflexus* (L.)
rescuegrass	*Bromus willdenowii* Kunth
rice	*Oryza sativa* (L.)
sorghum-sudan	*Sorghum* spp.
soybean	*Glycine max* (Merr.)
sunflower	*Helianthus* spp.
velvetleaf	*Abutilon theophrasti* Medic.
wheat	*Triticum aestivum* (L.)
wild buckwheat	*Polygonum convolvulus* (L.)
wild oat	*Avena fatua* (L.)
witchweed	*Striga lutea* (Lour.)

decreased yields (37). In central and southern Texas, there is an annual race to complete grain sorghum planting after wheat harvest to minimize the risk of yield decreases from summer heat, drought, and damage caused by sorghum midge (*Contarinia sorghicola* Coquillett) (44).

Most Kentucky farmers produce three crops in two years by planting corn first, followed by wheat or barley, and finally planting soybeans immediately into the small grain stubble. A one or two week delay in the small grain harvest frequently results in a reduction in the stand and a decline in yield of the double crop (1, 28, 29). Thus, accelerating wheat maturity could prove valuable in double cropping systems.

Application of dimethipin (2,3-dihydro-5,6-dimethyl-1,4-dithium-1,1,4,4-tetroxide) has been reported to reduce caryopsis moisture in rice and permit harvesting of that crop five to seven days earlier than normal (47). Thus, the objectives of this research were to determine the effect of dimethipin upon the maturation of wheat and to determine whether dimethipin applications affected wheat yield, caryopsis weight or caryposis protein content. In addition the effect of dimethipin on selected rotational crops was investigated.

CHAPTER II

LITERATURE REVIEW

Natural and synthetic chemicals which effect the growth of plants have undergone investigation for many years. Wittwer (48) summarized the history of growth regulators from the 1930's to the 1970's and noted that since the 1930's when growth regulators were first identified as important for plant growth, the challenge has been to identify the beneficial uses. The herbicidal effects of 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) announced by Hammer and Turkey in 1944 resulted in great progress in the commercial use of growth regulators by aiding the delineation of auxin pathways.

During the 1950's and 1960's, a number of synthetic growth regulators were developed for horticultural crops. These include malic hydrazide (1,2-dihydro-3,6 pyrid azinedione), chlormequat (2-chloroethyltrimethyl ammonium chloride), SADH (succinic acid, 2,2-dimethyl hydrazide), and TIBA (2,3,5-triiodobenzoic acid) (9). In recent years, research with halogen-substituted benzoic acid (18); 1,1-dichloro-2-phenoxy-ethanes; , -dichlorotolunes; and 1,1-dichloro-2-phenyl ethanes have elucidated their plant growth regulating activity on horticultural crops, but these chemicals have not been found to be beneficial in accelerating the maturity of wheat.

Dimethipin

Dimethipin, an experimental growth regulator developed by the Uniroyal Chemical Division of Uniroyal, Inc., is known by the registered trade name Harvade and by the experimental compound numbers UBI N252 and UBI 1285. Dimethipin has been formulated as a 600 gm/l flowable. It is classified chemically as a substituted dithiin tetroxide. An oil based surfactant is typically added to dimethipin spray mixes to enhance its activity for it reportedly lacks the ability to penetrate the cuticle (3, 5, 6, 29, 31, 40).

Dimethipin has been successfully used as a cotton defoliant by promoting leaf abscission by inducing cellulase activity in the superior abscission zone (3, 4, 6, 16). In cotton it has been reported to reduce the rate of regrowth and the percent of boll openings without reducing lint or cottonseed quality. Dimethipin also reportedly reduces seed moisture of sunflowers which permits earlier harvesting (2).

Potato desiccation was more effective when dimethipin at 0.56, 1.12, or 2.24 kg/ha was applied twice with an interval between applications of 5 and 15 days than when only a single application was made. The use of two applications produced excellent vine and leaf dessication with very little vine regrowth (6, 7, 29, 30, 31). Siecyka (40) observed a slower and poorer rate of potato foliage kill, which was attributed to a rain of 1.09 cm two hours after application.

In California research, dimethipin was applied to rice at rates of 0.56, 1.12, and 1.68 kg/ha 10 to 15 days prior to the estimated harvest date. The caryopsis moisture was reportedly reduced so that harvesting operations could take place five to seven days earlier without adversely affecting the yield, caryopsis or milling quality (2, 47). Applications of 1.12 and 1.68 kg/ha to rice 20 days prior to the estimated harvest date did not allow the plant to mature propoerly thus reducing yield, caryopsis quality or milling quality. However, Easten (11) investigated the use of dimethipin on Labelle rice (a long grain cultivar) in Texas and concluded that applications of 0.14 and 0.56 kg/ha to rice produced no effect on caryopsis moisture.

Application of dimethipin to lemon trees at rates of 0.28 and 0.56 kg/ha decreased the amount of pull force needed to detach the fruit (13). However, up to 70-80% of the total fruit ring area was severely damaged by the treatments.

Application of dimethipin to apple trees at concentrations of 250 to 1000 ppm immediately after picking induced complete defoliation within 30 days (2). Knight (23) reported similar results when dimethipin was applied to orange trees.

Philip (34) noted that dimethipin caused defoliation of cotton and dessication of potato vines, but not kidney beans. He also observed that applications of dimethipin inhibited the normal appearance of cellulase enzymes that accompany the abcission process in plants (34).

Hoagland (17) reported the inhibition of root and hypocotyl elongation when wheat plants were transferred in the dark to a dimethipin solution for 24 and 48 hours, but only root elongation was affected after 24 hours if the transfer occurred in the light. In the presence of light, dimethipin significantly decreased phenylalanine ammonia-lysase (PAL) activity. In treated plants anthocyanin, chlorophyll, benzoyarginine-p-nitroanitide (BAPA) and proline-p-nitroanitide (PPNA) were reduced in the hypocotyl 48 to 96 hours after treatment, whereas leucine-p-nitroanitide (LPNA) activity was increased.

Effect of Growth Regulators on Wheat Maturity

The germination of wheat occurs when the radical or first seminal root pushes forth from the seed causing swelling in the nodal region. The coleoptile which encloses the first leaves grows upward (25). The adventitious root system is composed of whorls of roots which arise from the crown. When the crown is composed of a variable number of successive nodes and internodes (26) from which tillers arise (15, 35), Zadoks (50) refers to this as tillering. The elongation of the culm is known as stem elongation. The booting stage begins when the flag leaf ligule is barely visible and ends when the boot is swollen but the awns are not visible.

According to Large (24), wheat ripening is stage 11, which can be further divided into three substages: I. milky ripe (the caryopsis has fluid milk), II. mealy ripe (caryopsis is soft, but contains dry contents), III. fully ripe (caryopsis is difficult to divide with a nail). Zadoks (50) further divided the ripening stages into early milk, medium milk and late milk. Late milk is defined as the stage when the caryopsis is increasing in solids that are visible when crushed between the fingers. More mature stages are defined as soft dough (finger nail impression on the caryopsis is not held), and hard dough (finger nail impression on the caryopsis is held).

As wheat approaches physiological maturity and starts to dry the loss of moisture from the caryopsis is rapid (1). Thus, a rapid increase in caryopsis dry weight occurs during the postanthesis period (33).

The percent moisture of a caryopsis is highly variable during a given day and is dependent upon relative humidity (32). The rate of water absorption increases during periods of high relative humidity due to capillary forces within the caryopsis (28). The effect of repeated wetting and drying of the wheat caryopsis is a decrease in test weight and a decrease in protein content (42).

Ries (38) reported an increase in total protein content of the seeds and caryopses per plant when peas and oats were treated with simazine (2-chloro-4,6-bis-ethylamino-s-triazine). No change in seed protein content occurred when simazine was applied to dry edible beans. Vergara (45) reported an increase in the protein content of rice when treated with simazine.

Application of ethephon to wheat at the late joint stage reduced the height of the plant without reducing yield (27). Treating wheat with ethephon and ametryne (2-ethyl-amino-4-(isopropylamino)-6-(methylthio)-s-triyine) increased wheat flour protein, but reduced the caryopsis yield (18, 45).

The weight of 1000 kernels (TKW) and yield are heritable traits (8, 12, 19, 36, 39, 41) and are increased or decreased by environmental conditions (46, 49). Analysis of samples from Oklahoma Foundation Seed Stocks in 1980 indicated that average TKW of Vona and TAM W 101 wheat were 22 and 36 g, respectively, and the test weights were 73.5 and 79.1 kg/hl,. respectively. In 1981, the Oklahoma Foundation Seed Stock average TKW of Vona, Triumph 64, and TAM W 101 wheat were 25, 36, and 38 g, respectively, and the test weights were 74.9, 81.1, and 75.6 kg/hl, respectively (20, 21).

CHAPTER III

METHODS AND MATERIALS

Dimethipin Effects on Wheat Maturity

Five field experiments were conducted to investigate the influence of dimethipin applications on the decline of wheat caryopsis moisture over time. The locations during 1981 and 1982 and designations are: near Stillwater, Oklahoma (Stillwater 81 and Stillwater 82); Lake Carl Blackwell Research Area, Payne County, Oklahoma (Blackwell 81 and Blackwell 82); and Agronomy Research Station, Perkins, Oklahoma (Perkins 81). Experiments Stillwater 81, Stillwater 82, and Blackwell 82 were seeded with a single disc drill with a row spacing of 20.3 cm. Blackwell 81 and Perkins 81 were seeded with a hoe-type drill with a row spacing of 25.4 cm. Crop production details and treatment dates are in Table II. Soil information for each experiment is in Table III.

Dimethipin, with the addition of the surfactant, UBI 1262 (polyoxyethylene-20-oleylether), at 1% v/v, was applied over the crop canopy at 0, 0.56 and 1.12 kg/ha in all experiments with a compressed air bicycle sprayer. The boom was equipped with four 11005 nozzles spaced at 50.8 cm, and

TABLE II

WHEAT VARIETIES, SEEDING DATES AND RATES, TREATMENT AND HARVEST DATES FOR THE FIVE DIMETHIPIN FIELD EXPERIMENTS

Designation	Variety	Seeding Date	Seeding Rate	Treatment Dates: Late Milk	Treatment Dates: Soft Dough	Treatment Dates: Firm Dough	Harvest Date
			(kg/ha)				
Stillwater 81	Triumph 64	11/10/80	84.0	5/06/81	5/18/81	5/26/81	6/09/81
Blackwell 81	TAM W 101	11/03/80	72.8	5/06/81	5/15/81	5/26/81	6/10/81
Perkins 81	Vona	12/03/80	72.8	5/06/81	5/12/81	5/15/81	5/28/81
Stillwater 82	Vona	11/25/81	84.0	5/20/82	5/29/82	6/07/82	6/21/82
Blackwell 82	Vona	11/03/81	72.8	5/21/82	5/28/82	6/07/82	6/28/82

TABLE III

CHARACTERISTICS OF THE SOIL AT EACH EXPERIMENTAL SITE AND SOIL USED IN GREENHOUSE

Designation	Soil Series	Soil Classification	Organic Matter	Particle Size Distribution Sand	Silt	Clay	pH
			- - - - - - -	- - (%) - -	- - - -	- - -	
Stillwater 81	Port	Cumulic Hapustoll	0.6	35.5	39.0	25.5	7.6
Blackwell 81	Port	Cumulic Hapustoll	0.8	13.8	55.5	31.5	6.4
Perkins 81	Teller	Udic Arguistoll	0.9	55.0	29.5	15.5	6.2
Stillwater 82	Port	Cumulic Hapustoll	0.6	33.0	45.0	23.0	7.6
Blackwell 82	Port	Cumulic Hapustoll	0.7	37.5	40.0	22.5	5.8
Greenhouse 1 thru 4	Teller	Udic Arguistoll	0.7	47.5	32.5	20.0	6.1
Greenhouse 5	Kirkland	Udic Arguistoll	1.2	45.0	23.5	31.5	6.5

calibrated to apply a total volume of 280 l/ha at a pressure of 1.55 kg/cm^2. Water was used as the carrier for all treatments. In each experiment all dimethipin treatments were applied at the late milk, soft dough, and firm dough stages of wheat growth.

Caryopsis moisture was determined at the time of treatment and at three to four day intervals after treatment by randomly hand harvesting ten spikes from each plot. The spikes were placed in plastic bags to reduce moisture loss while being transported to the laboratory. At the laboratory three caryopses were removed from each spike, one from the top, middle and bottom of the head. The lemma and palea were removed from each seed. The 30 caryopses were weighted and then oven dried at 55 C for 24 hours. After drying they were reweighed to determine the amount of moisture lost.

At harvest ripeness, yields were determined by harvesting a 1.5 x 7.6 m area from each plot with a small plot combine. The percent caryopsis moisture at harvest at Stillwater 81, Blackwell 81, and Perkins 81 was determined by oven drying a sample of the combine harvested caryopses at 55 C for 72 hours. Caryopsis moisture at harvest was determined in the field with a Dole Model 400 portable grain moisture meter for Stillwater 82 and Blackwell 82. Test weight was determined with a standard test weight device. TKW was determined with the aid of an automatic counter and an electronic balance. Caryopsis protein content was determined using the dye binding method (43).

The experiments were designed as 3 x 3 factorials with dimethipin rates and application dates as the factors. Each treatment was replicated 6 times. Prior to sampling of the soft dough growth stage treatments, caryopsis moisture data from the milk stage treatments were analyzed using a randomized complete block analysis. Prior to sampling of dimethipin effects from firm dough treatments, data from the milk and soft dough stages were analyzed using a 2 x 3 factorial analysis. The bicycle sprayer was pushed through the 0.0 dimethipin plots to eliminate any sprayer traffic effects.

Visual ratings of crop injury and weed control were based on a 0-100 scale, with 0 equal to no effect and 100 equal to complete plant kill. Crop vigor was also rated on the 0-100 scale with 100 equal to no effect and 0 equal to complete plant kill. All experimental data was analyzed statistically. Treatment means were compared using LSD's at the 0.05 level of significance.

On June 9, 1981 the wheat stubble at Stillwater 81 was moldboard plowed and disked. On June 10, 1981 Forest soybeans were planted at 67.2 kg/ha using a single disk drill with 40.6 cm row spacing. Soybean injury was evaluated visually on July 13, 1981.

Visual rating of the weed cover at Perkins 81 was made on July 6, 1981. Glyphosate at 2.24 kg/ha acid equivalent was then applied to control weeds present. On July 10, 1981 10 rows each of OK12 mungbeans, AOK8 sorghum by sudan hybrid (sorghum-sudan), and foxtail millet were planted at 77 kg/ha, 77 kg/ha and 2 kg/ha, respectively, with a no-till drill in 25.4 cm rows in three replications of the experiment. On August 4 and 21, 1981, sorghum-sudan and mungbean injury was visually evaluated. The foxtail millet did not emerge. On August 21, 1981 the forage yields of sorghum-sudan and mungbeans were determined by harvesting a 2 x 1 m area from each plot with a flail type forage harvester. The total plot yield was weighed and a sample dried to determine dry matter production.

Greenhouse and Controlled Environment Experiments

Three experiments (experiments G1, G2 and G3) were conducted to determine the effect of preemergence dimethipin applications on several monocotyledonous and dicotyledonous species. In addition, greenhouse experiments were conducted to determine the effect of postemergence dimethipin applications on wheat (experiment G4) and wild buckwheat (experiment G5). The experimental design used for experiments G1, G2, G3, and G5 was a completely randomized design with four replications. Experiment G4 had eight replications.

Dimethipin was applied with a compressed air bicycle sprayer. The boom was equipped with four 11005 nozzle tips spaced at 50.8 cm and calibrated to apply a total volume of 280 l/ha at 1.55 kg/cm^2. Water was used as the carrier for all treatments. The surfactant UBI 1262 was applied with all treatments at 1% v/v.

In experiment G1, dimethipin at 0.0, 0.28, 0.56 and 1.12 kg/ha was applied preemergence to AOK8 sorghum-sudan, OK12 mungbeans, Forest soybeans, and foxtail millet planted in 473 ml pots filled with 250 grams of Teller loam soil (Table III). Eight seeds of either sorghum-sudan, soybeans, or mungbeans were planted in each pot. Foxtail millet was seeded at approximately 25 seeds per pot and was not thinned. The pots were initially bottom saturated, then top watered as necessary. The pots were maintained under constant florescence and incandescence lighting in a growth room at a temperature of approximately 32.2 C for 13 days. At that time fresh foliage weight and percent emergence was determined.

In experiment G2, dimethipin at 0.00, 0.14, 0.28, 0.56 and 1.12 kg/ha was applied preemergence to TAM W 101 wheat, AOK8 sorghum-sudan, Forest soybeans, and foxtail millet planted in 473 ml pots containing 250 grams of soil (same as G1). Eight seeds of TAM W 101 wheat, sorghum-sudan, soybeans and mungbeans were planted in each pot and were thinned to the four most vigorous plants per pot 10 days after planting. Foxtail millet was seeded at approximately 25 seeds per pot and was not thinned. Pots were initially bottom saturated, then top watered as necessary. The pots were maintained in the greenhouse without artificial light. The temperature ranged from 23.8 C daytime to 7.2 C during the night for 29 days. After that time fresh foliage weight was determined.

In experiment G3 dimethipin at 0.00, 0.14, 0.28, 0.56 and 1.12 kg/ha was applied preemergence to barley, TAM W 101 wheat, pigweed, barnyardgrass, cheat, prickly sida, wild buckwheat, crabgrass, rescuegrass, wild oats, morningglory, jointed goatgrass, and sunflower planted in 946 ml pots containing 500 grams of soil. Each pot was seeded with 20 seeds of barnyardgrass and cheat, 15 seeds of prickly sida, 10 seeds each of rescuegrass, wild oats, velvetleaf, barley, morningglory, and jointed goatgrass, and eight seeds of sunflower and wheat. Pots were bottom saturated initially, then top watered as necessary. The pots were maintained in the greenhouse without supplemental lighting. Temperature ranged from 23.8 C daytime to 7.2 C during the night. After 31 days percent emergence and fresh foliage weight was determined.

In experiment G4, dimethipin at 0.00, 0.14, 0.28, 0.56 and 1.12 kg/ha was applied to TAM W 101 wheat at the four to five leaf stage of growth. The wheat was seeded in 946 ml pots containing 500 grams of soil. Pots were bottom saturated initially, then top watered as necessary. The pots, each with one plant, were maintained in the greenhouse without supplemental lighting. Temperature ranged from 23.8

C daytime to 7.2 C during the night. After 41 days fresh foliage weight was determined.

In experiment G5, dimethipin at 0.00, 0.14, 0.25 and 0.56 kg/ha was applied to wild buckwheat which was approximately 60 cm tall. The wild buckwheat plants were transplanted from the field at the two true leaf growth stage into 1100 ml pots, one plant per pot. The pots were filled with Kirkland clay loam soil (Table II). The pots were watered as necessary to prevent drying, and were maintained in the greenhouse under the same conditions as described for G4 above. After 35 days fresh weight was determined.

CHAPTER IV

RESULTS AND DISCUSSION

Effect of Dimethipin on Wheat Maturity

In experiment Stillwater 81, none of the dimethipin applications affected the moisture content of wheat over the 35 day period from late milk to maturity (Table IV). However, averaged over application dates, both rates of dimethipin reduced wheat yield and TKW (Table V). Neither test weight nor protein content of the wheat were affected by the decrease in yield or TKW. Dimethipin at 0.56 and 1.12 kg/ha reduced the stand and growth of soybeans planted after the wheat was harvested (Table IV).

At Blackwell 81, dimethipin at 0.56 kg/ha applied to wheat in the late milk stage of growth on May 6 had no effect on caryopsis moisture for eight days after application (Table VI). However, from May 15 through May 29, caryopsis moisture was decreased by this treatment four of the five times it was determined. By June 2, as the caryopses approached maturity, the differences noted earlier disappeared. It is not clear why the lower rate of dimethipin applied at the late milk stage reduced moisture, but dimethipin at the high rate (1.12 kg/ha) applied on May

TABLE IV

EFFECT OF DIMETHIPIN APPLICATIONS AT THREE GROWTH STAGES ON WHEAT CARYOPSIS MOISTURE AND SOYBEAN INJURY (STILLWATER 81)

Dimeth-ipin Rate	Growth[A] Stage	Caryopsis Moisture												Soybean Injury
		May										June		July
		6	9	11	14	15	19	22	26	27	29	2	9	13
(kg/ha)		(%)												
0.56	Late milk	(61.7)[B]	58.1	54.6	50.2	45.1	34.3	45.3		27.0	18.81	9.6	10.1	4
1.12	"	(62.2)	59.1	53.9	49.3	45.5	34.6	44.2		28.4	17.4	9.3	10.2	23
0	"	(62.5)	59.2	54.6	50.5	45.5	35.8	44.4		28.6	19.3	10.6	10.1	0
0.56	Soft Dough					(45.1)	35.9	44.7		29.3	18.81	9.3	10.1	13
1.12	"					(45.8)	36.2	44.8		29.3	18.5	9.4	9.9	32
0	"					(46.1)	37.4	42.6		28.4	20.1	9.8	9.9	0

TABLE IV (Continued)

Dimeth-ipin Rate	Growth Stage[A]	Caryopsis Moisture												Soybean Injury
		May										June		July
		6	9	11	14	15	19	22	26	27	29	2	9	13
(kg/ha)		(%)												
0.56	Firm Dough								(36.1)	31.9	18.4	9.3	9.9	20
1.12	"								(35.6)	29.6	19.2	9.9	9.5	48
0	"								(36.1)	30.2	20.2	9.8	10.1	0
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6
CV %		1.9	1.5	2.1	1.9	6.1	9.8	7.6	4.6	11.3	7.6	9.5	6.3	58

[A]Application dates were May 6, May 15 and May 26 for the late milk, soft dough and firm dough treatments, respectively.

[B]( ) = data collected at the time of applications, excluded from statistical analysis of other data collected on the same date.

TABLE V

EFFECT OF DIMETHIPIN APPLICATION RATES AVERAGED OVER APPLICATION TIMING ON WHEAT YIELD, TEST WEIGHT, CARYOPSIS WEIGHT, AND PROTEIN CONTENT (STILLWATER 81)

Dimethipin Rate	Yield	Test Weight	Caryopsis Weight	Protein
(kg/ha)	(kg/ha)	(kg/hl)	(gm/1000)	(%)
0.56	2268	60	35.0	14.3
1.12	2261	60	34.8	14.5
0.00	2649	60	35.5	14.6
LSD 0.05	225	NS	0.5	NS
CV %	14	1	2.0	5.3

6 had no effect on moisture.

None of the dimethipin treatments applied to wheat in the soft dough growth stage affected caryopsis moisture. This may be attributed to the occurrence of rainfall less than five hours after treatment.

The high rate of dimethipin applied on May 26, when the wheat was in the firm dough stage, reduced caryopsis moisture on June 10. The magnitude of the reductions, though statistically significant, would probably have had little practical significance.

Yield reductions occurred when dimethipin was applied at the late milk and firm dough growth stages. However, no difference was noted in TKW. This indicates that the treatments may have shriveled some caryopses, causing them to be lost in the harvest process. Caryopsis protein content was increased by applications of dimethipin at 0.56 kg/ha at the firm dough stage, indicating that this treatment may have slowed or stopped the caryopsis filling process (Table VI).

Analysis of crabgrass control after wheat harvest revealed no dimethipin rate by date interaction. However, averaged over application dates, plots treated with dimethipin at 0.0, 0.56 and 1.12 kg/ha contained 87, 67 and 59 percent ground cover of crabgrass, respectively (LSD 0.05 = 22.1). Thus, dimethipin at 0.56 and 1.12 kg/ha suppressed but did not eliminate crabgrass present in the wheat stubble.

TABLE VI

EFFECT OF DIMETHIPIN APPLICATIONS AT THREE GROWTH STAGES ON WHEAT CARYOPSIS MOISTURE, YIELD, TEST WEIGHT, CARYOPSIS WEIGHT, AND CARYOPSIS PROTEIN (BLACKWELL 81)

		Caryopsis Moisture															
		May										June					
Dimethipin Rate	Growth[A] Stage	6	9	11	14	15	19	22	26	27	29	2	10	Yield	Test Weight	Seed Weight	Protein
(kg/ha)		---(%)---												(kg/ha)	(kg/hl)	(gm/1000)	(%)
0.56	Late Milk	(60.3)[B]	59.1	54.9	53.4	49.4	44.7	43.0		29.9	25.5	14.9	12.2	1888	74.2	33.0	13.4
1.12	"	(60.6)	61.6	56.6	54.9	51.1	46.9	44.8		36.3	28.7	15.3	12.4	2110	74.2	32.9	13.2
0	"	(61.9)	61.5	58.1	54.9	52.1	46.8	44.8		34.3	30.2	15.4	12.6	2661	75.2	34.2	12.8
0.56	Soft Dough					(49.4)	46.2	45.2		32.9	30.2	16.5	12.5	2332	74.4	34.0	12.8
1.12	"					(51.1)	45.1	43.8		32.3	26.6	15.1	12.4	2325	74.7	33.9	13.2
0	"					(52.1)	45.9	44.0		31.3	27.3	15.1	12.5	2171	74.4	33.7	13.3

TABLE VI (Continued)

Dimethipin Rate	Growth Stage[A]	Caryopsis Moisture: May 6	May 9	May 11	May 14	May 15	May 19	May 22	May 26	May 27	May 29	June 2	June 10	Yield	Test Weight	Seed Weight	Protein
(kg/ha)		(%)												(kg/ha)	(kg/hl)	(gm/ 1000)	(%)
0.56	Firm Dough								(30.3)		25.6	14.7	12.4	2110	74.2	33.6	14.8
1.12	"								(35.1)		28.4	15.4	12.2	2090	74.9	33.5	13.6
0	"								(35.9)		29.5	15.2	12.6	2372	74.7	34.7	13.4
LSD 0.05[C]		NS	NS	NS	NS	1.7	1.5	1.5	NS	NS	4.2	1.1	0.3	250	NS	NS	0.7
CV %		2.4	1.6	3.1	2.0	2.3	2.9	2.9	11.2	13.4	12.5	6.4	1.8	10	1.6	5.0	7.3

[A]Application dates were May 6, May 15 and May 26 for the late milk, soft dough and firm dough treatments, respectively.

[B]( ) = data collected at the time of applications, excluded from statistical analysis of other data collected on the same date.

[C]LSD 0.05 for date by rate interaction.

None of the dimethipin treatments at Perkins 81 affected the caryopsis moisture content over the 15 day period from late milk to maturity. Dimethipin had no significant effect on caryopsis yield, test weight, weed weight or protein content of the wheat (Table VII). However, the rapid decrease in moisture over the treatment period may be attributed to the drought conditions during the latter part of the growing season of the wheat, which severely reduced yield. The low caryopsis weight is another result of the drought conditions. Averaged across application dates, dimethipin at 0.56 and 1.12 kg/ha reduced the percent ground cover of weeds present 38 days after wheat harvest. Sorghum-sudan sown 42 days after harvest did not appear to be visually injured by any dimethipin applications. However, there was an increase in plant vigor that may have been associated with partial control of the weedy ground cover (Table VIII). The increased vigor resulted in higher sorghum-sudan yields when dimethipin was applied at the soft dough stage or at 0.56 kg/ha at the firm dough growth stage of wheat (Table IX). When averaged across application dates, dimethipin at 0.56 and 1.12 kg/ha injured mungbeans by reducing emergence (Table VIII). Mungbean growth was extremely variable, thus differences in yield due to dimethipin treatments were not detectable (Table IX).

In experiment Stillwater 82, the only detectable effect of dimethipin on grain moisture was on June 7. On that

TABLE VII

EFFECT OF DIMETHIPIN APPLICATIONS AT THREE GROWTH STAGES ON WHEAT CARYOPSIS MOISTURE, YIELD, TEST WEIGHT, CARYOPSIS WEIGHT, AND CARYOPSIS PROTEIN (PERKINS 81)

		Caryopis Moisture									
		May									
Dimethipin Rate	Growth[A] Stage	6	9	12	15	19	21	Yield	Test Weight	Seed Weight	Pro-tein
(kg/ha)		- - - - - - - - - -			(%)	- - - - - - - - -		(kg/ha)	(kg/hl)	(gm/1000)	(%)
0.56	Late Milk	(46.6)[B]	45.9	42.4	31.9	14.3	13.0	517	73.4	21.3	19.6
1.12	"	(47.3)	46.0	42.5	31.3	13.8	12.6	638	73.4	21.1	18.5
0	"	(47.9)	45.7	41.0	34.1	17.8	13.8	538	73.2	21.2	19.8
0.56	Soft Dough			(42.4)	31.6	16.8	13.3	551	73.2	21.6	20.3
1.12	"			(42.5)	37.1	16.4	15.0	538	72.6	22.0	19.9
0	"			(42.7)	34.4	15.9	14.5	585	73.2	21.6	21.4

TABLE VII (Continued)

Dimethipin Rate	Growth Stage[A]	Caryopis Moisture May 6	9	12	15	19	21	Yield	Test Weight	Seed Weight	Protein
(kg/ha)		- - - - -	- - - - -	- - -	(%)	- - - - -	- - - - -	(kg/ha)	(kg/hl)	(gm/1000)	(%)
0.56	Firm Dough				(32.3)	17.5	14.2	558	73.7	21.1	20.6
1.12	"				(33.7)	16.9	14.7	470	72.9	21.2	20.6
0	"				(34.1)	19.1	13.7	511	73.9	21.3	20.5
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %		6.1	2.5	3.3	12.6	22.0	19.1	36.3	1	4.3	6.6

[A]Application dates were May 6, May 12 and May 15 for the late milk, soft dough and firm dough treatments, respectively.

[B]( ) = data collected at the time of application, excluded from the statistical analysis of other data collected on the same date.

TABLE VIII

THE EFFECT OF DIMETHIPIN APPLICATIONS TO WHEAT ON VISUAL WEED CONTROL AND VISUAL ROTATIONAL CROP INJURY (PERKINS 81)

Rate	Weed Control[A]	Sorghum-Sudan Vigor		Mungbean Injury	
	July 6	Aug 4	Aug 21	Aug 4	Aug 21
(kg/ha)	(% grd. cov.)	------(%)-------		------(%)-------	
0.56	73	85	87	50	71
1.12	31	82	84	73	90
0.00	97	53	76	24	32
LSD 0.05	29	19	NS	38	36
CV (%)	64	69	65	77	55

[A]% grd. cov. = % ground cover

TABLE IX

THE EFFECT OF DIMETHIPIN APPLICATIONS TO WHEAT ON FRESH FOLIAGE WEIGHT OF SORGHUM-SUDAN, AND MUNGBEANS SEEDED AFTER WHEAT HARVEST (PERKINS 81)

Rate	Growth Stage[A]	Sorghum-Sudan	Mungbean
(kg/ha)		(kg/ha)	(kg/ha)
0.56	Late milk	10581	685
1.12	"	11153	480
0.00	"	9598	548
0.56	Soft dough	13433	1136
1.12	"	15408	612
0.00	"	10250	1507
0.56	Firm dough	13457	617
1.12	"	11209	222
0.00	"	8945	979
LSD 0.05		3415	NS
CV %		17	92

[A]Application dates were May 6, May 12 and May 15 for the late milk, soft dough and firm dough treatments, respectively.

date, averaged over the first two application dates, wheat treated with the high rate of dimethipin (1.12 kg/ha) had 25.5% moisture, whereas the lower rate and check contained 30.2 and 32.6 percent moisture, respectively (LSD 0.05 = 2.9). The rapid decrease in caryopsis moisture from 32 percent on June 18 to 10 percent on June 21 may be attributed to a four day average wind of 13.8 K and an average high temperature of 29.4 C. Dimethipin at 0.56 kg/ha applied at the late milk stage reduced the test weight of wheat. Dimethipin had no significant effect on yield, test weight or protein content of wheat (Table X).

None of the dimethipin treatments at Blackwell 82 affected the moisture content of the wheat June 3 through June 28. On May 29 there was a difference in the 1.12 kg/ha rate at the late milk stage; this difference was attributed to sampling error because such increases did not reappear at any other sampling date. Dimethipin at 0.56 and 1.12 kg/ha applied at late milk decreased the TKW. Dimethipin applied at 0.56 and 1.12 kg/ha increased the protein content of wheat at the late milk stage. Dimethipin applied at 0.56 kg/ha at soft dough also increased the protein content of wheat. The yield and test weight of the wheat were not significantly affected by dimethipin. Treatments with higher protein content tended to have lower yields, although the differences were not statistically significant (Table XI).

TABLE X

EFFECT OF DIMETHIPIN APPLICATIONS AT THREE GROWTH STAGES ON WHEAT CARYOPSIS MOISTURE, YIELD, TEST WEIGHT, CARYOPSIS WEIGHT, AND CARYOPSIS PROTEIN (STILLWATER 82)

		Caryopsis Moisture								
		May		June						
Dimethipin Rate	Growth[A] Stage	20	29	7	18	21	Yield	Test Weight	Seed Weight	Pro-tein
(kg/ha)		- - - -	- - - -	-(%)-	- - - -	- - - -	(kg/ha)	(kg/hl)	(gm/ 1000)	(%)
0.56	Late Milk	(66.2)[B]	69.4	34.2	31.9	10.7	1552	62.2	24.3	14.9
1.12	"	(64.2)	67.1	30.7	32.7	10.6	1660	62.7	25.2	15.0
0	"	(66.9)	66.5	37.9	32.4	11.0	1599	70.6	25.1	13.6
0.56	Soft Dough		(67.3)	31.5	31.9	10.6	1606	66.7	26.0	13.9
1.12	"		(66.6)	29.2	31.8	11.2	1808	66.1	26.3	13.9
0	"		(67.4)	37.7	32.7	11.2	1525	68.4	26.5	13.8

TABLE X (Continued)

Dimethipin Rate	Growth[A] Stage	Caryopsis Moisture May 20	May 29	June 7	June 18	June 21	Yield	Test Weight	Seed Weight	Pro-tein
(kg/ha)		- - - - - - - -	- -(%)- -		- - - -	- - - - - - -	(kg/ha)	(kg/hl)	(gm/ 1000)	(%)
0.56	Firm Dough			(35.3)	30.7	11.0	1754	67.6	26.4	13.7
1.12	"			(37.0)	30.5	11.2	1660	65.6	26.6	13.9
0	"			(37.6)	30.4	11.4	1539	65.6	24.8	13.8
LSD 0.05[C]		NS	NS	NS[D]	NS	NS	NS	4.8	NS	NS
CV %		3.4	5.4	12.5	6.6	6.6	19	6.2	5.4	3.8

[A]Application dates were May 20, May 29 and June 7 for the late milk, soft dough and firm dough treatments, respectively.

[B]( ) = data collected at the time of applications, excluded from statistical analysis of other data collected on the same date.

[C]NS - no significant difference for main factors or interaction, except where noted.

[D]Averaged over dates, there was a significant rate effect on June 7.

TABLE XI

EFFECT OF DIMETHIPIN APPLICATIONS AT THREE GROWTH STAGES ON WHEAT CARYOPSIS MOISTURE, YIELD, TEST WEIGHT, CARYOPSIS WEIGHT, AND CARYOPSIS PROTEIN (BLACKWELL 82)

Dimethipin Rate	Growth[A] Stage	Caryopsis Moisture May 20	Caryopsis Moisture May 29	Caryopsis Moisture June 3	Caryopsis Moisture June 7	Caryopsis Moisture June 28	Yield	Test Weight	Seed Weight	Pro- tein
(kg/ha)		- - - - - - - -	- -	-(%)-	- - - -	- - -	(kg/ha)	(kg/hl)	(gm/ 1000)	(%)
0.56	Late Milk	(66.7)[B]	51.8	44.8	29.7	10.2	1578	59.8	21.4	14.8
1.12	"	(66.9)	55.7	46.9	26.4	10.4	1717	60.0	21.7	14.0
0	"	(65.9)	52.6	45.6	32.7	12.0	401	68.3	26.3	13.5
0.56	Soft Dough		(51.9)	44.8	30.6	11.4	1873	63.9	24.0	15.0
1.12	"		(52.1)	44.7	24.5	11.0	1902	63.6	23.3	13.9
0	"		(52.6)	44.9	32.6	10.9	2079	66.2	24.8	13.8

TABLE XI (Continued)

Dimethipin Rate	Growth Stage[A]	Caryopsis Moisture: May 20	May 29	June 3	June 7	June 28	Yield	Test Weight	Seed Weight	Protein
(kg/ha)		---------(%)				--------	(kg/ha)	(kg/hl)	(gm/ 1000)	(%)
0.56	Firm Dough				(33.2)	11.7	2283	67.6	25.4	13.6
1.12	"				(28.9)	11.3	2118	65.3	24.5	13.6
0	"				(26.9)	11.1	2068	64.0	23.8	13.8
LSD 0.05[C]		NS	2.4	NS	4.2	NS	NS	NS	2.3	.4
CV %		1.4	3.6	3.9	11.9	8.2	19	6.2	7.6	2.7

[A]Application dates were May 20, May 29 and June 7 for the late milk, soft dough and firm dough treatments, respectively.

[B]( ) = data collected at the time of applications, excluded from statistical analysis of other data collected on the same date.

[C]LSD 0.05 for date by rate interaction.

The Effect of Preemergence Dimethipin Applications in the Greenhouse

In greenhouse experiment G1, dimethipin at 0.28 kg/ha reduced the emergence of mungbeans, soybeans, and foxtail millet. Dimethipin at 0.56 kg/ha reduced the emergence of sorghum-sudan and mungbeans. Dimethipin at 1.12 kg/ha prevented the emergence of soybeans and foxtail millet (Table XII).

Preemergence applications of dimethipin at 0.28 kg/ha reduced the foliage weight of mungbeans and foxtail millet, but had no effect on growth of sorghum-sudan. Dimethipin at 0.56 kg/ha reduced the foliage weight of sorghum-sudan, and almost killed the soybeans and foxtail millet. Mungbeans produced little growth when treated with dimethipin at 1.12 kg/ha. Sorghum-sudan appeared to be the most tolerant species to dimethipin at 1.12 kg/ha (Table XIII).

Plant growth was less vigorous in greenhouse experiment G2 than in G1. This was probably because G1 was maintained under continuous lighting and a temperature of 32.2 C, whereas G2 was maintained in the greenhouse without supplemental lighting and at temperatures that ranged from 23.8 C daytime to 7.2 C nighttime. Under G2 conditions, even the lowest dimethipin rate (0.14 kg/ha) stunted and reduced the weight of all species. Dimethipin at 0.56 kg/ha reduced the emergence of all species included, however, sorghum-sudan still exhibited more tolerance to dimethipin

TABLE XII

EMERGENCE OF SORGHUM-SUDAN, MUNGBEANS, SOYBEANS, AND FOXTAIL MILLET 14 DAYS AFTER PREEMERGENCE APPLICATION OF DIMETHIPIN (GREENHOUSE EXPERIMENT G1)

	Emergence (Percent of Total Seed Planted)			
Dimethipin Rate	Sorghum-Sudan	Mungbeans	Soybeans	Foxtail Millet
(kg/ha)	(%)			
0.00	100	100	100	42
0.28	100	67	54	17
0.56	75	59	21	5
1.12	54	17	0	0
LSD 0.05	18	32	24	4
CV %	14	33	34	13

TABLE XIII

FRESH FOLIAGE WEIGHT OF SORGHUM-SUDAN, MUNGBEANS, SOYBEANS, AND FOXTAIL MILLET 14 DAYS AFTER PREEMERGENCE APPLICATIONS OF DIMETHIPIN (GREENHOUSE EXPERIMENT G1)

	Fresh Foliage Weight			
Dimethipin Rate	Sorghum-Sudan	Mungbeans	Soybeans	Foxtail Millet
(kg/ha)	- - - - - - - - - - - - -(g/pot)- - - - - - - - -			
0.00	7.8	14.2	26.1	3.9
0.28	7.7	8.4	18.9	2.4
0.56	3.2	7.7	2.4	0.6
1.12	4.3	0.7	0.0	0.0
LSD 0.05	3.2	4.9	9.9	1.1
CV %	34.9	40.1	52.1	40.3

than the other species. At 1.12 kg/ha, dimethipin reduced growth of sorghum by sudan hybrid, soybean, foxtail millet and wheat (Table XIV).

In greenhouse experiment G3, preemergence application of dimethipin at 0.14 kg/ha did not reduce the emergence of any species included. Dimethipin at 0.28 kg/ha reduced emergence of velvetleaf, barley, sunflower, and cheat and dimethipin at 0.28 kg/ha prevented prickly sida from emerging. Dimethipin at 0.56 kg/ha prevented velvetleaf and barnyardgrass from emerging and reduced the emergence of rescuegrass. Dimethipin at 1.12 kg/ha prevented barley and morningglory from emerging. In terms of seedling emergence, wild oat, jointed goatgrass, wheat, rescuegrass, and cheat appeared to be more tolerant to dimethipin (Table XV).

At 0.14 kg/ha dimethipin reduced the fresh foliage weight of rescuegrass, wild oat, velvetleaf, barnyardgrass, sunflower, cheat, and jointed goatgrass (Table XVI). Dimethipin at 0.28 kg/ha reduced the fresh foliage weight of barley, morningglory, jointed goatgrass, and wheat. Velvetleaf, barnyardgrass, and cheat were all killed by dimethipin at 0.28 kg/ha. Morningglory exhibited interveinal necrotic spots at all rates.

The Effect of Postemergence Dimethipin Applications in the Greenhouse

In experiment G4, application of dimethipin postemergence to wheat in the greenhouse stunted the plants

TABLE XIV

FRESH FOLIAGE WEIGHT OF SORGHUM-SUDAN, MUNGBEANS, SOYBEANS, FOXTAIL MILLET, AND WHEAT 31 DAYS AFTER PREEMERGENCE APPLICATIONS OF DIMETHIPIN (GREENHOUSE EXPERIMENT G2)

	Fresh Foliage Weight			
Dimethipin Rate	Sorghum-Sudan	Soybeans	Foxtail Millet	Wheat
(kg/ha)	- - - - - - - - - - - - -(g/pot)- - - - - - - - -			
0.00	1.8	2.3	3.5	1.6
0.14	1.2	0.8	1.9	1.1
0.28	1.4	0.6	1.0	0.7
0.56	1.2	0.4	1.4	0.6
1.12	0.5	0.1	0.1	0.3
LSD 0.05	0.5	1.3	0.9	0.2
CV %	25.6	104.3	40.5	17.6

TABLE XV

EMERGENCE OF RESCUEGRASS, WILD OATS, VELVETLEAF, BARNYARDGRASS, PRICKLY SIDA, WILL BARLEY, MORNINGGLORY, SUNFLOWER, CHEAT, JOINTED GOATGRASS, AND WHEAT 31 DAYS AFTER PREEMERGENCE APPLICATION OF DIMETHIPIN (GREENHOUSE EXPERIMENT G3)

Dimethipin Rate	Emergence (Percent of Total Seeds Planted)										
	RG[A]	WO	VL	BG	PS	WB	MG	SF	C	JG	T
(kg/ha)	(%)										
0.00	77.5	80.0	32.5	1.4	25.0	60.0	45.0	60.0	15.8	80.0	80.0
0.14	75.0	87.5	25.0	8.0	62.5	75.0	42.5	52.5	12.0	97.5	67.5
0.28	82.5	97.5	7.5	0.3	0.0	20.0	25.0	40.0	1.3	90.0	55.0
0.56	47.5	97.5	0.0	0.0	0.0	12.5	42.5	50.0	0.5	77.5	42.5
1.12	42.5	92.5	0.0	0.0	0.0	0.0	0.0	20.0	4.0	57.5	47.5
LSD 0.05	26.5	NS	19.0	3.7	35.6	19.5	27.7	19.9	6.2	NS	NS
CV %	26.4	21.1	94.9	51.9	131.9	39.8	58.1	29.2	60.4	22.8	35.3

[A]RG = rescuegrass; WO = wild oat; VL = velvetleaf; BG = barnyardgrass, PS = prickly sida; WB = Will barley; MG = morningglory; SF = sunflower; C = cheat; JG = jointed goatgrass; T = TAM W 101 wheat

TABLE XVI

FRESH FOLIAGE WEIGHT OF RESCUEGRASS, WILD OATS, VELVETLEAF, BARNYARDGRASS, PRICKLY SIDA, WILL BARLEY, MORNINGGLORY, SUNFLOWER, CHEAT, JOINTED GOATGRASS, AND WHEAT 31 DAYS AFTER PREEMERGENCE APPLICATION OF DIMETHIPIN (GREENHOUSE EXPERIMENT G3)

Dimethipin Rate	Fresh Foliage Weight										
	RG[A]	WO	VL	BG	PS	WB	MG	SF	C	JGG	T
(kg/ha)	(g/pot)										
0.00	1.1	4.3	0.5	3.4	0.1	2.9	2.4	7.1	2.6	2.2	3.6
0.14	0.6	3.4	0.1	1.1	0.2	3.2	1.4	5.8	1.3	1.4	2.4
0.28	0.2	0.8	0.0	0.0	0.0	0.2	0.3	1.4	0.0	0.5	0.3
0.56	0.1	0.8	0.0	0.0	0.0	0.1	0.6	2.5	0.0	0.3	0.4
1.12	0.1	0.7	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.1
LSD 0.05	0.2	0.7	0.2	1.0	0.1	1.7	1.4	1.9	0.7	0.7	1.9
CV %	33.5	22.9	100.6	74.1	156.3	90.5	100.9	37.3	60.4	22.8	93.2

[A]RG = rescuegrass; WO = wild oats; VL = velvetleaf; BG = barnyardgrass; PS = prickly sida; WB = Will barley; MG = morningglory; SF = sunflower; C = cheat; JG = jointed goatgrass; T = TAM W 101 wheat.

and turned the lower leaves chlorotic from the tip to the sheath as rates increased from 0.14 to 1.78 kg/ha. At all rates dimethipin caused a significant reduction in the fresh foliage weight of the wheat (Table XVII).

TABLE XVII

FOLIAGE WEIGHT OF WHEAT 21 DAYS AFTER APPLICATION OF DIMETHIPIN AT THE FOUR TO FIVE LEAF STAGE OF GROWTH (GREENHOUSE EXPERIMENT G3)

Dimethipin Rate	Foliage Weight
(kg/ha)	(g)
0.00	1.99
0.14	1.46
0.28	1.23
0.56	1.10
1.12	0.84
1.78	0.47
LSD 0.05	0.31
CV %	35.28

In experiment G5, dimethipin applied postemergence to wild buckwheat in the greenhouse retarded plant growth as rates increased from 0.14 to 0.56 kg/ha. Dimethipin significantly reduced the fresh foliage weight and dry weight of wild buckwheat at all application rates, but did not kill the plants (Table XVIII).

TABLE XVIII

EFFECT OF DIMETHIPIN APPLIED PREFLORESENCE ON WILD BUCKWHEAT GROWTH

Dimethipin Rate	Wild Buckwheat GW[A]	DW
(kg/ha)	- - -(g)- - -	
0.00	5.9	1.59
0.14	4.1	1.10
0.28	3.8	1.10
0.56	3.2	1.00
LSD	0.8	0.30
CV %	14.9	23.80

[A]GW = Green weight of wild buckwheat
DW = Dry weight of wild buckwheat

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APPENDIX

TABLE XIX

RAINFALL DATA, LAKE CARL BLACKWELL RESEARCH AREA, (PAYNE COUNTY) FROM PERRY (NOVEMBER 1, 1980 TO JULY 31, 1982)

Date		Rainfall (cm)	Date		Rainfall (cm)
November	14, 1980	1.70	June	15, 1981	0.20
	15	0.07		16	1.50
				27	0.20
December	7, 1980	0.50		30	2.30
	8	3.40			
			July	1, 1981	0.03
January	19, 1981	0.05		4	0.80
				9	2.90
February	1, 1981	0.40		18	0.03
	10	0.50		20	0.08
				22	0.05
March	2, 1981	0.10		23	0.05
	3	0.50		28	3.10
	4	1.50		29	2.30
	8	0.20		30	4.30
	15	1.00			
	29	0.70	August	7, 1981	4.60
				10	0.10
April	14, 1981	1.20		11	0.30
	16	0.07		16	1.50
	19	1.30		17	0.30
	20	0.20		26	0.02
	21	0.03			
			September	1, 1981	1.50
May	1, 1981	0.03		7	0.20
	5	1.40		12	0.20
	9	0.80		13	0.60
	10	5.60		25	0.07
	16	0.30			
	17	2.60	October	4, 1981	0.50
	18	0.05		6	0.02
	23	1.80		8	0.20
	29	2.20		10	0.02
	30	1.20		12	3.00
				13	0.08
June	2, 1981	0.60		14	0.20
	3	0.10		16	2.50
	4	0.60		17	0.20
				22	0.50
				25	0.30
				26	1.10

TABLE XIX (CONTINUED)

Date	Rainfall (cm)
November 1, 1981	3.60
2	0.20
3	0.30
4	0.07
8	0.40
9	1.40
29	1.40
30	1.00
December 14, 1981	0.20
23	0.20
January 3, 1982	0.90
7	0.20
22	0.07
30	2.50
31	0.20
February 3, 1982	2.50
9	0.90
12	1.00
March 6, 1982	0.02
7	2.80
16	0.20
27	0.60
28	0.30
30	0.10
April 8, 1982	0.10
18	0.10
19	0.05
25	0.90
26	0.20
28	2.90
30	1.20
May 1, 1982	0.05
6	2.80
12	4.80
13	1.80
14	0.03
May 15, 1982	0.07
16	0.10
17	8.90
19	0.02
20	2.30
24	1.20
25	1.40
27	0.50
28	1.50
31	0.70
June 2, 1982	0.30
3	0.20
4	0.70
11	0.90
12	0.30
15	1.80
19	0.60
21	0.40
24	2.30
25	0.20
27	1.60
July 9, 1982	0.05
10	0.70
13	0.08
28	2.70
29	0.20

TABLE XX

RAINFALL DATA, AGRONOMY RESEARCH STATION, PERKINS, OKLAHOMA (DECEMBER 1, 1980 TO AUGUST 20, 1981)

Date		Rainfall (cm)	Date		Rainfall (cm)
December	8, 1980	3.30	May	23, 1981	2.10
	9	0.07		25	0.30
	16	0.20		29	3.20
				30	0.40
January	21, 1981	0.10		31	0.10
February	1, 1981	0.70	June	2, 1981	1.90
	6	0.20		3	0.07
	10	1.20		4	0.99
	11	0.10		6	0.20
	21	0.10		15	0.20
	28	0.30		16	1.12
				27	2.10
March	3, 1981	0.07		30	5.00
	4	1.20			
	15	1.50	July	1, 1981	0.07
	29	0.40		4	2.00
				28	6.35
April	11, 1981	0.08		29	0.50
	13	1.70		30	3.10
	18	0.20		31	0.30
	20	0.70			
			August	1, 1981	4.40
May	1, 1981	0.10		7	3.40
	5	3.90		13	0.40
	9	1.70		16	1.90
	10	5.60			
	16	0.30			
	17	0.08			

TABLE XXI

RAINFALL DATA, AGRONOMY RESEARCH STATION, STILLWATER, OKLAHOMA (NOVEMBER 1, 1980 TO JULY 30, 1982)

Date		Rainfall (cm)	Date		Rainfall (cm)
November	15, 1980	0.20	June	5, 1981	0.30
	16	0.20		16	1.40
	18	0.60		27	3.60
				30	4.50
December	9, 1980	3.90			
	17	0.10	July	1, 1981	0.05
				4	0.90
January	20, 1981	0.10		9	3.90
	21	0.07		28	3.40
				29	2.80
February	1, 1981	0.70		30	2.90
	7	0.07		31	0.10
	10	0.50			
	11	0.90	August	1,1981	1.30
	22	0.50		2	0.60
	28	0.07		7	4.80
				13	0.40
March	8, 1981	0.90		16	1.10
	15	2.70			
	29	1.90	September	1, 1981	0.80
				7	0.40
April	11, 1981	0.20		12	2.70
	14	1.60		13	2.10
	18	0.10		14	0.20
	19	0.40		27	0.40
May	1, 1981	0.20	October	8, 1981	0.50
	5	3.90		9	0.10
	9	1.30		12	3.70
	10	4.10		13	0.40
	16	0.10		14	0.20
	17	0.30		16	2.40
	23	2.20		17	0.60
	29	3.80		26	1.50
	30	0.40		31	1.30
June	2, 1981	1.20	November	1, 1981	2.40
	4	1.10		2	0.20

TABLE XXI (Continued)

Date		Rainfall (cm)	Date		Rainfall (cm)
November	4, 1981	0.50	May	17, 1982	6.10
	9	4.10		19	0.10
	29	0.20		20	2.40
	30	0.20		21	1.90
				24	1.20
December	14, 1981	0.20		25	4.30
	22	0.10		27	0.40
	23	0.20		28	1.90
				31	0.70
January	3, 1982	0.90			
	22	0.40	June	2, 1982	0.60
	30	4.90		3	0.05
	31	0.40		4	0.30
				11	1.10
February	3, 1982	5.00		12	0.60
	5	0.40		15	1.50
	12	0.70		16	0.20
				19	1.70
March	14, 1982	2.20		21	0.40
	27	0.80		24	0.30
				25	4.50
April	25, 1982	0.90		27	0.10
	26	0.60			
	29	2.20	July	6, 1982	0.07
	30	2.60		7	0.60
				10	0.70
May	1, 1982	0.20		13	0.07
	6	4.50		28	0.05
	12	11.40		29	2.80
	13	1.80		30	0.80

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