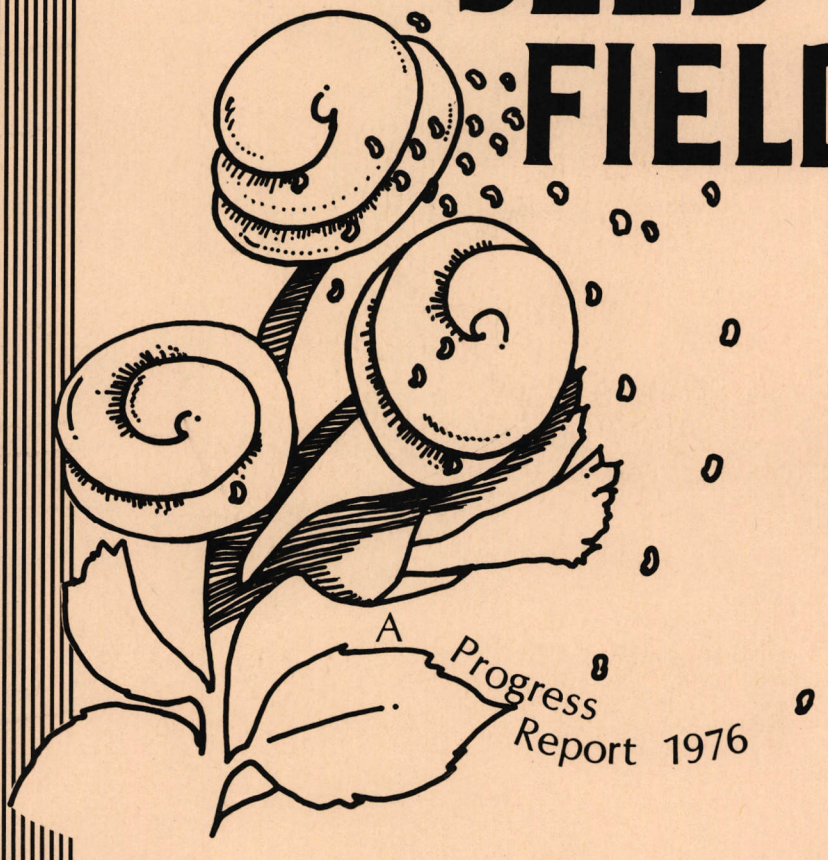
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VOL. 11

Dodder & Other Unwanted Vegetation Control in ALFALFA SEED FIELDS



A Progress Report 1976

Univ. of Calif. Coop. Extension
Fresno County

This is a report of work in progress only. The chemicals and uses contained in this publication are experimental data and should not be considered as recommendations for use.

Until the products and their uses given in this report appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in their original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical. Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

Consult your County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. **Never burn pesticide containers.**

PHYTOTOXICITY: Certain chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also result from excessive amounts or the wrong formulation or from mixing incompatible materials. Inert ingredients, such as wetters, spreaders, emulsifiers, diluents, and solvents, can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur, even though no injury was noted in previous seasons.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.

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ACKNOWLEDGMENT

The adaptive research studies, summarized in this progress report, was generously supported by the California Alfalfa Seed Production Research Board. I am grateful for their confidence and encouragement.

Grants for weed control studies conducted in Fresno County were also received from the following companies: Amchem, BASF, Eli Lilly, Fisons, FMC, Hercules, Monsanto, Rhom & Haas, Shell, Stauffer and US Borax. I greatly appreciate their support.

The purpose of this report is to inform members of the Research Board, representatives of the commercial companies, and cooperating alfalfa growers of our accomplishments. It is not intended and it should not be interpreted as a recommendation for the use of herbicides or techniques of applications described.

I wish to thank Gary McMullin, Extension Assistant, for his able assistance in conducting the trials. I am grateful to Fred Fischer of the Westside Field Station and cooperating growers for their managerial assistance.

The untiring secretarial labor of Mrs Rita Cassidy and the artwork of Gwen Okamoto are praiseworthy and they are sincerely appreciated.

BILL B. FISCHER
Farm Advisor

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DODDER AND OTHER UNWANTED VEGETATION CONTROL IN ALFALFA SEED FIELDS

A PROGRESS REPORT

Bill B. Fischer*

INTRODUCTION

Unwanted vegetation including parasitic dodder will continue to pester alfalfa seed growers as long as they endeavor to produce seed that meets the demand of alfalfa hay growers.

The adage, "The richest soil grows the rankest weeds," certainly applies to the fertile Central San Joaquin Valley. Therefore, alfalfa seed growers must be vigilant and well informed about effective methods of weed control to produce seed profitably, free of weed seeds.

The detrimental effects of weeds are well known to farmers. In the past weed seeds were widely distributed as impurities in many crop seeds. That is one reason why many species of weeds are commonly found infesting crops throughout the world. Seed producers must be doubly aware of and be concerned about producing clean, weed-free seed crops.

Alfalfa seed growers in California have been doing their best in producing certified seed free of weed seeds. They continue supporting projects searching for more effective and economical methods of weed control through the

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* Farm Advisor, University of California, Cooperative Extension, Fresno County

California Alfalfa Seed Production Research Board. This progress report is prepared to inform board members, growers and commercial companies of the results of our studies. It is not intended as recommendations for the use of herbicides or methods of application. For specific recommendations, please consult weed control guides and follow directions given on the labels of herbicides marketed for weed control in alfalfa seed fields.

PAST RESULTS

Applied research studies evaluating the use of herbicides for the selective control of weeds in alfalfa seed fields have been conducted in Fresno County since 1959. Summaries of earlier studies have been published. The more recent ones were progress reports of the 1974 and 1975 experiments. Copies of these earlier reports are not available; therefore, a brief review of some of the earlier findings is presented before the 1976 applied research studies are summarized.

THE CONTROL OF UNWANTED VEGETATION

When alfalfa seed growers inquire about effective methods of weed control they are interested in solving an existing and often urgent problem. Therefore, they want to know what herbicide to use, rate per acre, timing of application, etc., and are not interested in discussing other cultural practices that may have prevented or minimized their problem.

Weed control in alfalfa seed production requires more than the application of herbicides. To be effective and economical, unwanted vegetation control has to be an integral part not only of growing alfalfa for seed but of the total farming operation.

Decisions made prior to planting of the alfalfa and the cultural practices followed in growing the crop can greatly influence the cost of weed control.

Decisions made:

when selecting the field for planting

when preirrigation or crop irrigations are applied

when selecting herbicides

to insure a vigorously growing crop

All these decisions can prevent troublesome weed problems or can significantly reduce the cost of weed control.

Selecting Fields for Planting

Alfalfa seed fields cannot be certified when infested with perennial weeds such as field bindweed, Russian knapweed, silverleaf nightshade, johnsongrass, etc. Therefore, fields infested with perennial weeds should be avoided. Knowledge is available for the effective control of these perennial weeds but it should be done prior to planting the alfalfa.

Fields infested with dodder and other annual weeds that cannot be economically controlled with selective herbicides, should be planted with crops that are not hosts to dodder and in which selective herbicides can be used safely and economically.

The residual properties of herbicides that were used in the preceding crop should be considered also. Small quantities of certain herbicides may injure or retard the growth of seedling alfalfa.

Land and Seed Bed Preparation

Proper land and seed bed preparation can enhance the rapid, uniform germination of the alfalfa seed. In a well prepared seed bed, free of large clods, preplant incorporated as well as postemergence herbicides have provided better weed control.

Preirrigation is Essential

Preirrigation can enable a grower to prepare a better seed bed. It can also cause germination of weed seeds that can be destroyed with shallow cultivation prior to planting. With preirrigation and shallow harrowing of the beds additional weed seeds may not germinate until the first crop irrigation, therefore, preplant incorporated herbicides may not be needed.

Herbicide Selection

Intelligent herbicide selection without knowledge of the weed infestation is an impossible task. Records kept of weed infestations on cards, such as the one stapled inside the back cover of this progress report can enable one to plan the most effective and most economical weed control program.

A Competing Crop

A vigorously growing crop is an excellent competitor with weeds. Therefore, adequate fertilization, timely irrigation, proper insect and disease control are essential integral parts of an effective program to control unwanted vegetation, including dodder.

Tillage and Hand Hoeing

Selective herbicides can provide more effective and longer residual weed control at a lower cost than repeated cultivations. But no one herbicide, registered for use in alfalfa, controlled all the weeds that may be found infesting fields in Central California. (See weed susceptibility chart)

Timely cultivations, coupled with the intelligent use of selective herbicides in a well integrated program provided the best weed control in most commercial fields. The use of sled planters and later mounting cultivators on the sled made close

cultivation possible. But, complete weed control with mechanical tools in the planted row was not possible.

In newly planted fields the use of preplant and postemergence herbicides can be limited to an 8" to 10" bend centered on the planted row. This will minimize the cash outlay. The areas between the rows can be cultivated.

Hand hoeing is very costly and labor to perform the task is not readily available. Rarely should it be required in alfalfa seed fields if herbicide application is well timed. Hoeing may be needed in fields where the weeds have become too large before the herbicide was applied or to clean out sparse infestations of annual or perennial weeds.

In established fields repeated cross disking is used to destroy weeds and volunteer alfalfa. The effects of repeated cutting of the crowns by multiple cross disking is difficult to ascertain. It is safe to assume that it does not contribute toward the maintenance of a healthy stand.

Shallow cultivation is required to work the trash into the soil after seed harvest. It may be needed also in some soils to destroy surface seal to enhance water penetration.

Use of Herbicides

The intelligent use of selective herbicides enabled alfalfa seed growers to control unwanted vegetation more effectively and more economically than with repeated cultivations and hand hoeing. Selective herbicides can be used in newly planted and in established stands.

Choosing the most effective herbicide, combinations of herbicides or sequential applications of herbicides that will provide the most effective weed control at the lowest cost is not an easy task. The many herbicides available to alfalfa

seed growers can be grouped according to use, as follows:

a. Preplant incorporated - herbicides applied prior to planting of the alfalfa and mixed into the top 1½ to 2 inch layer of soil.

   The need for shallow incorporation must be emphasized when using herbicides such as Balan® and Tolban®. Deep incorporation can cause retardation of seedling growth by adversely affecting the growth of lateral roots.

b. Preemergence - herbicides applied on the surface of the soil after planting but before alfalfa emergence. Rainfall or sprinkler irrigation is essential to leach the herbicide into the top 2 inch layer of soil where the weed seeds germinate.

c. Postemergence - application made following the emergence of the crop as well as the weeds.

d. Post-Thinning or lay-by - herbicide applications made after the crop is well established in first year or in older stands. Certain herbicides such as Karmex® can be applied on the soil surface after the first seed harvest. Treflan® or Tolban® have to be incorporated into the soil soon after application. Eptam® can be injected into the irrigation water. These herbicides do not control established weeds, therefore, they have to be destroyed with shallow cultivation or with other herbicides.

There are many factors that influence the activity and performance of herbicides, such as: soil type, moisture, temperature, vigor of weed growth, weed maturity, timing of application, accuracy of the rate of application, weed

species and their degree of susceptibility, crop vigor, etc. Some of these are within the control of growers, some are beyond their control and still others are unpredictable and cannot be anticipated in planning a weed control program.

DODDER CONTROL - PAST EXPERIENCE

Alfalfa seed growers are very familiar with the yellow-orange parasitic weed, dodder. There are several species of dodder (Cuscuta); the most commonly occurring in alfalfa are field dodder (Cuscuta campestris) and largeseed dodder (Cuscuta indecora). They are annual (reproducing from seed every year) with a large number of host plants that include weeds as well as crop plants.

The more commonly occurring hosts of dodder in Central San Joaquin Valley crops are: alfalfa, asparagus, cantaloupes, onion, pepper, safflower, sugar beet and tomato. Weed hosts are: cheeseweed, field bindweed, fat-hen, knotweed, lambsquarter, pigweed and Russian thistle.

Dodder cannot be tolerated in seed fields. It should be destroyed as soon as its presence is detected. The seed of dodder can survive in the soil for many years, therefore, if alfalfa is planted in a field known to have contained dodder in the past, it should be judiciously monitored to detect and destroy the infestation early.

Experiments have been conducted by research workers in many areas of the world studying different methods of dodder control. A review of the literature by Ashton and Santana has been published in 1976.*

*F. Ashton and D. Santana, Aug 1976 Cuscuta Spp (Dodder) A Literature Review of its Biology and Control, Bulletin 1880, UC, Div Agricultural Sciences

Of the many selective herbicides evaluated, Furloe®, Dacthal® and Kerb® provided a certain degree of control. Of these Dacthal was the most effective, but its use in alfalfa is not registered by the Environmental Protection Agency (EPA).

Dodder infestations generally occur in limited areas in the field, seldom exceeding 1% to 3% of the total acreage. To control this limited infestation by treating the entire acreage with a selective herbicide would be economically questionable unless that herbicide would control other annual weeds also.

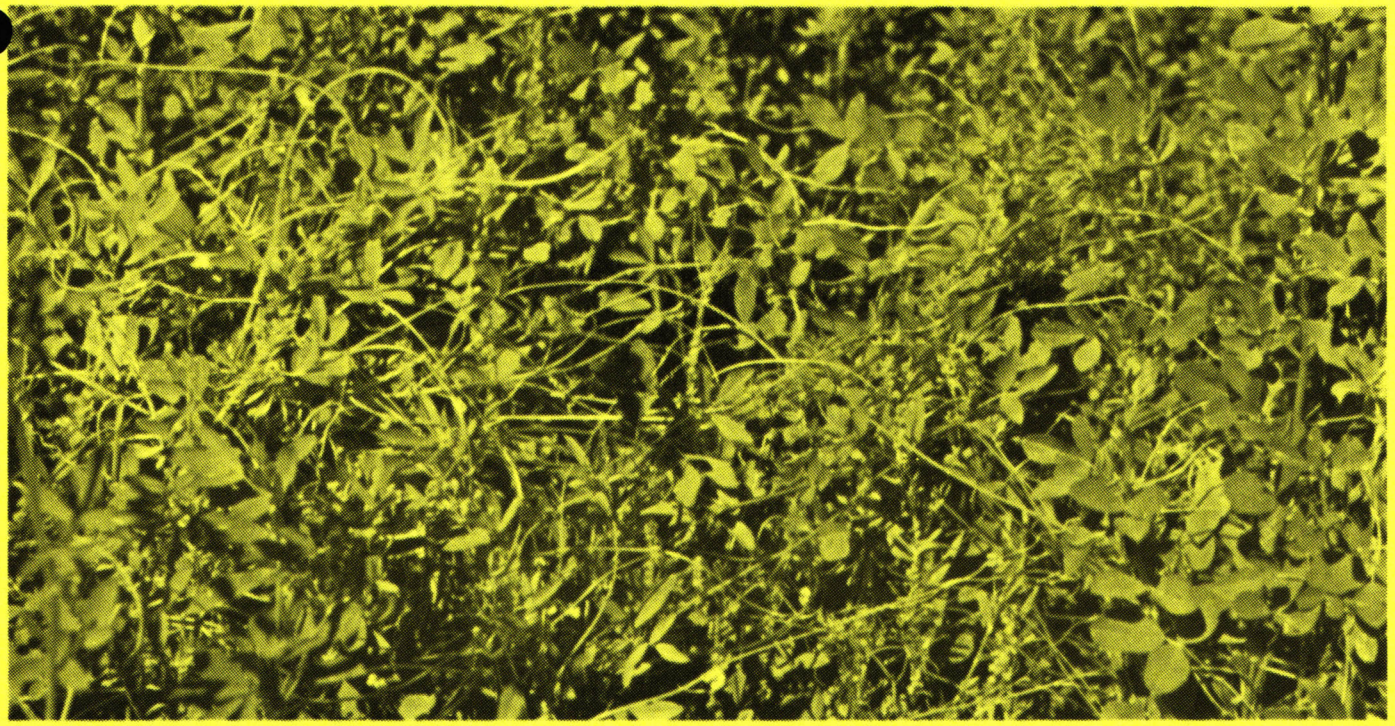
The use of selective herbicides such as Furloe® or Kerb® may be justified to treat limited areas. These herbicides have to be applied prior to germination of the dodder seed, before it becomes attached to the alfalfa. The effective use of Furloe® and Kerb® in alfalfa seed fields, planted in rows on beds, has not been adequately demonstrated.

Contact herbicide such as weed oil, diesel fuel, dinitro general and emulsions of weed oil plus water or dinitro general plus weed oil plus water has been used very effectively to control attached dodder. Two treatments at three to five day intervals may be necessary because the alfalfa foliage to which the dodder is attached has to be destroyed also.

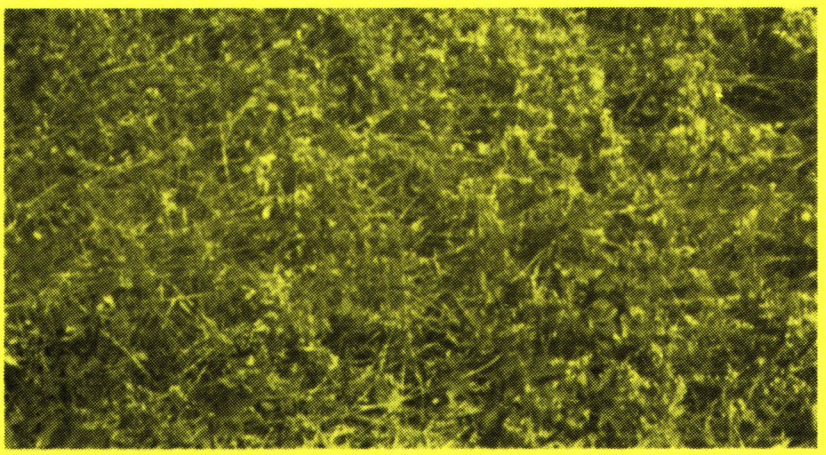
Butane or propane burners can be used to destroy the dodder and alfalfa foliage. As with the use of contact herbicides, the infested area should be flamed a second time in two or three days to insure good control. Two treatments are essential if the alfalfa is growing luxuriantly.

An experimental herbicide, H-26905, has been demonstrated to effectively control dodder after it is attached to the alfalfa. For a discussion of our studies see the summary of the 1976 trials on the following pages.

LARGESEED DODDER - Cuscuta indecora Choisy



VIGOROUSLY GROWING IN ALFALFA



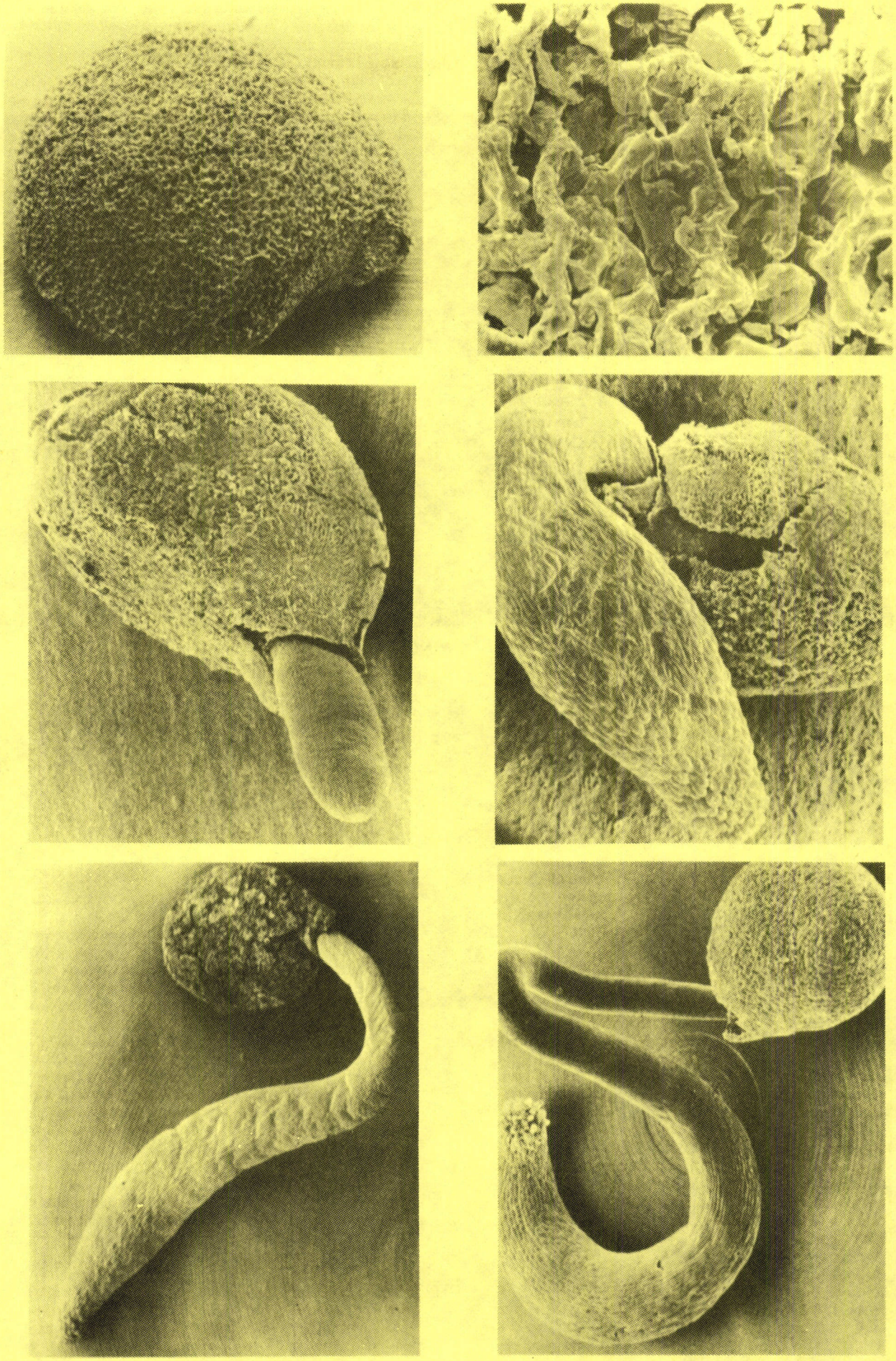
HEAVY INFESTATION DESTROYING ALFALFA



YOUNG DODDER ATTACHED TO ALFALFA



FLOWER



Dodder seed enlarged 50 times and the seed coat enlarged 1,200 times, in the upper left and right pictures. The other four pictures show germinating dodder seed at 6, 9, 12 and 24 hours. All enlarged scanning electron photomicrographs by James Hutchins and F.D. Hess.

IN THE FINAL ANALYSIS

There are a lot of known and unpredictable factors (enumerated on page 6) that can influence the activity of herbicides. Consequently, one must face the probability of poor weed control and crop injury. Nevertheless, with proper planning and accurate, timely application, failures or injury will rarely occur.

Conditions that favored the effectiveness of herbicides and those that resulted in poor weed control or crop injury are summarized in the following chart. On the reverse side of the chart the susceptibility of weeds to herbicides, registered for use in alfalfa, is tabulated. These charts can be used as guides in planning an effective weed control program.

Reliable and reproducible information is available relative to the use of herbicides in alfalfa seed production. The manufacturer can supply effective herbicides, salesmen, fieldmen and advisors can provide the information, but it requires a good organizer and manager to put it together.

And in the final analysis the most important individual may be the one who is sitting behind the wheel driving the application equipment. No scientist, no advisor and no manufacturer can make an herbicide safe and effective, only the person who applies it can do that.

SUMMARY OF HERBICIDE PERFORMANCE IN SEED ALFALFA IN THE CENTRAL SAN JOAQUIN VALLEY

METHOD OF APPLICATION	HERBICIDE	Conditions That Resulted in Most Effective Control	Conditions That Resulted in Poor Control or Injury
PREPLANT INCORP-ORATED	Balan® or Tolban®	Shallow incorporated in well prepared seed bed. When temperature was favorable for rapid seedling growth. Only susceptible weeds were present.	Cool temperature, deep incorporation, volunteer cereals and other resistant weed species were present.
	Eptam®	Thorough incorporation early fall or in spring planted fields. Where nutsedge was present; where 4 to 8 weeks control was needed.	Winter application, cloddy seed bed and resistant weeds present. Where longer than 6 weeks of residual control was needed.
	Chemoe®	Where volunteer cereals and canary-grass were the only weeds present. Also, postemergence under sprinkler irrigation to control volunteer cereals.	Fields infested with broadleaf weeds. When used as a surface application and not irrigated within 24 hours. When unfavorable growing conditions prevailed, injury occurred.
POST-EMERGENCE	Dow Selective® or Sinox-W®	When alfalfa had two trifoliate leaves and weeds were not emerged or in their seedling stage and ½ inch of rainfall or sprinkler irrigation was applied following treatment.	When broadleaf weeds were beyond the seedling stage of growth. When grassy weeds were present.
	Butyrac 200® or Butoxone Ester®	When broadleaf weeds in their seedling stage were the only weeds present.	Broadleaf weeds beyond their seedling stage were present.
	Kerb®	When alfalfa had two trifoliate leaves and weeds were not emerged or in their seedling stage; rainfall or sprinkler irrigation was applied following treatment.	When alfalfa was in the seedleaf or unfoliate leaf stage of growth severe injury occurred. When weeds were beyond their seedling stage. When water was not applied soon after treatment.
ESTABLISHED STANDS	Karmex®	When applied on soil free of clods and volunteer alfalfa seed germination. Addition of dinitro general and weed oil improved weed control when groundsel was present.	Applied on trashy or cloddy soil. Applied after Feb. 1st on non-dormant varieties resulted in injury
	Eptam®	Applied in the irrigation water and only when thorough wetting of the bed top was obtained. Timely repeated application was made.	Poor water distribution and not wetting the bed top. Repeated application was not made.
	Treflan® or Tolban®	Thoroughly incorporated with rolling cultivators in fields free of established weeds. Summer annual grasses, pigweeds and lambsquarter, the only weeds present.	Not incorporated thoroughly or when resistant weed species predominated.
	Furloe®	Applied on wet soil immediately following irrigation provided dodder control if applied prior to attachment and repeated applications were made.	Applied on dry soil and/or repeated applications were not made. Dodder attached prior to treatment.

SUSCEPTIBILITY OF WEEDS TO HERBICIDES USED FOR THE SELECTIVE CONTROL OF WEEDS IN SEED ALFALFA PRODUCTION *

KEY

- ▩ = Effectively Controlled
- ▨ = Partially or Erratically Controlled
- □ = Not Controlled
- W = Winter Annual
- S = Summer Annual
- ▽ = Perennial

		PREPLANT INCORPORATED				POSTEMERGENCE			ESTABLISHED STAND				
		BALAN®	CHEMHOE®	EPTAM®	TOLBAN®	DOW SELECTIVE® or SINOX W®	KERB®	BUTYRAC 200® or BUTOXONE ESTER®	EPTAM®	FURLOE®	KARMEX®	TREFLAN®	TOLBAN®
BROADLEAF WEEDS													
CHICKWEED	W	▩		▩	▩	▩	▩	▨	▩	▩	▩	▩	▩
COCKLEBUR	S							▨			▨		
DOCK SEEDLING	W + S	▩		▩	▩	▨	▨	▩	▩	▩	▩	▩	▩
FAT HEN	S	▩		▩	▩	▨	▨	▩	▩	▨	▩	▩	▩
FIDDLENECK	W	▨		▩	▩	▩	▩	▨	▩	▩	▩	▩	▩
FILAREE	W			▨		▨		▨	▨	▨	▩		
GOOSEFOOT	S	▩		▩	▩	▩	▩	▩	▩	▨	▩	▩	▩
GROUND CHERRY	S			▩		▩	▩	▩	▩	▨	▩		▩
GROUNDSEL	W			▩		▨		▨	▩	▨			
HENBIT	W			▩		▨	▩	▨	▩	▨	▩		
KNOTWEED	W + S	▩		▨	▩	▨	▩	▨	▨	▨	▩	▩	▩
LAMBSQUARTER	S	▩		▩	▩	▩	▩	▩	▩	▨	▩	▩	▩
LONDON ROCKET	W			▨		▩	▩	▩	▨	▩	▩		
MARESTAIL	S			▩		▩		▩	▩	▨	▩		
MONOLEPIS	W + S	▩		▩	▩	▩	▩	▩	▩	▨	▩	▩	▩
MUSTARD	W					▩	▩	▩	▩	▩	▩		
NETTLE	W			▩		▩	▨	▩	▩	▩	▩		
NIGHTSHADE	S			▩		▩	▩	▩	▩	▨	▩		
PIGWEED	S	▩		▩	▩	▩	▩	▩	▩	▩	▩	▩	▩
PINEAPPLE WEED	W			▩		▨	▩	▩	▨	▩	▩		
PRICKLY LETTUCE	W + S			▩		▩	▩	▩	▩	▩	▩	▩	▩
PURSLANE	S	▩		▩	▩	▨	▩	▨	▩	▨	▩	▩	▩
RED MAIDS	W	▩		▩	▩	▩	▩	▩	▩	▨	▩	▩	▩
RUSSIAN THISTLE	S	▨		▨	▨	▨	▨	▨	▨	▨		▨	▨
SHEPHERD'S PURSE	W			▨		▩	▩	▩	▨	▩	▩		
SOW THISTLE	W + S			▩		▩	▩	▩	▩	▩	▩		
SUNFLOWER	W + S					▩	▩	▨	▩	▩	▩		
TOLGUACHA	▽ S					▨	▨	▨	▨	▨	▨		
GRASSY WEEDS													
ANNUAL BLUEGRASS	W	▩	▩	▩	▩		▩		▩	▩	▩	▩	▩
BARNYARDGRASS	S	▩	▨	▩	▩		▩		▩		▩	▩	▩
CANARYGRASS	W	▩	▩	▩	▩		▩		▩	▩	▩	▩	▩
CRABGRASS	S	▩	▨	▩	▩		▩		▩		▩	▩	▩
FEATHER FINGERGRASS	S	▩	▩	▩	▩		▩		▩	▨	▩	▩	▩
FOXTAIL (BRISTLEGRASS)	S	▩	▩	▩	▩		▩		▩	▨	▩	▩	▩
JOHNSONGRASS (SEED)	S	▩	▨	▩	▩		▨		▩		▩	▩	▩
LOVEGRASS	S	▩	▩	▩	▩		▩		▩	▨	▩	▩	▩
MILO	S	▩		▩	▩		▨		▩		▩	▩	▩
NUTSEDGE	▽ S			▩					▩				
RABBITFOOTGRASS	W	▩	▩	▩	▩		▩		▩		▩	▩	▩
RYEGRASS	W	▩	▨	▩	▩		▩		▩		▩	▩	▩
VOLUNTEER CEREALS	W		▩	▩			▩		▩		▩		
WILD OATS	W		▩	▩			▩		▩		▨		

* This chart is tentative, based on experiments conducted in the Central San Joaquin Valley. Proper timing and accurate application is imperative. Additional information may warrant changes.

APPLIED RESEARCH STUDIES - 1976

A Progress Report

SYNOPSIS

Effective dodder control was obtained with H-26905 in a time series study, demonstrating excellent tolerance of alfalfa with this experimental herbicide. The use of H-26905 in combination with 2, 4-DB ester and other herbicides controlled a broad spectrum of weeds including dodder. Preplant incorporated, Vegadex® or Dacthal® alone and in combination with other herbicides, failed to control dodder. The experimental herbicide, BAS 90210, looks very promising for postemergence control of grasses with good selectivity. Several herbicides were evaluated for the control of annual weeds in established alfalfa.

PROCEDURES USED IN CONDUCTING THE TRIALS

Trials were conducted at the Westside Field Station and in commercial fields with the generous cooperation of Fresno County alfalfa growers. They were replicated four times in randomized block designs. All of the trials were conducted on soils low in organic matter content (1% or less).

Herbicides were applied with CO_2 constant pressure sprayer in 60 to 70 gallons of water per acre. In the trials summarized in Tables 5 and 6 the contact herbicides on the west half of the plots were applied with a commercial type sprayer in 112 gallons of water per acre. In the preplant trial the herbicides were incorporated with a harrow.

To evaluate attached dodder control and the susceptibility of alfalfa to H-26905, scarified dodder seed was mixed with alfalfa seed in the hopper box at the time of planting. After emergence, H-26905 was applied at varying rates, three times at ten day intervals.

Weed control, alfalfa vigor and injury evaluations were based on a 0 to 10 scale. A rating of "10" means perfect weed control, or as a vigor rating it indicates vigorously growing alfalfa. In evaluating injury a rating of "10" denotes severe injury or death. A "0" rating can denote: no weed control, poor alfalfa vigor (retardation in growth) or it can mean no injury.

Soil type, plot size, herbicides used, rate of application, dates of treatment and irrigation methods used are given in the tables summarizing the evaluations.

DISCUSSION OF OBSERVATIONS

Frustration and disappointment must be the fate of an experimenter who endeavors to pursue studies on how to control parasitic dodder. As an illustration, two replicated experiments were established in two fields (one following a tomato crop, one in a second year alfalfa) that were heavily infested with dodder in 1975. In neither of these fields did dodder seed germinate, or become attached, to make possible the reliable evaluation of the effectiveness of the treatments.

Additional experiments were conducted in newly planted alfalfa, at the Westside Field Station, where dodder seed was sown when the alfalfa was planted.

Notwithstanding the setback experienced in the two preemergence trials conducted near Mendota, significant results were obtained in the 1976 studies. They can be briefly summarized as follows:

IN NEWLY PLANTED ALFALFA

Preplant Incorporated

Effective dodder control was obtained in tomato fields with preplant incorporation of Vegadex and in established alfalfa with Dacthal. These two herbicides along with others were included in a trial where dodder seed was planted mixed with the alfalfa seed. The herbicides were incorporated to a depth of 2 to 2½ inches with a harrow. The alfalfa and dodder seeds were broadcast and harrowed. A summary of this trial is presented in Table 1.

Vegadex® (sulfallate) provided about 60% dodder control when used alone. In combination with Balan only 10% control was obtained. No good explanation for the different level of control can be advanced.

Vegadex, used alone, failed to control other annual weeds. The alfalfa tolerance was very good.

Dacthal® (chlorthal) at 8.0 lb ai/A did not control the dodder when applied alone or in combination with Chemhoe® (IPC). It effectively controlled the broadleaf weeds and grasses except sowthistle and groundsel.

Tolban® (profluralin), a recently registered herbicide for alfalfa, provided good broadleaf and grass control but it did not control sowthistle, groundsel nor dodder.

Tolban caused temporary retardation in the growth of the alfalfa, but as the soil temperature increased, the alfalfa recovered and no evidence of retardation was noted by the

first week of June. The shallow incorporation of this herbicide is essential, especially when the alfalfa is planted in late fall or winter, to minimize the adverse effect of the herbicide on the secondary root development.

Balan® (benefin) is a substituted dinitroaniline compound (related to Tolban with shorter residual properties) long registered for use in alfalfa. It controlled annual grasses, but not volunteer cereals and wild oats. It controlled many broadleaf weeds except those in the thistle, potato and mustard families.

Amex® (butralin), related to Balan and Tolban, controlled the same species of weeds.

Chemhoe® (IPC) was combined with other herbicides to study the tolerance of alfalfa to them. The use of Chemhoe in combination with Dacthal or the dinitroaniline compounds may be justified in fields infested with volunteer cereals and wild oats.

POSTEMERGENCE, DODDER AND OTHER WEED CONTROL

The effectiveness of H-26905 (0-ethyl-0-(3-methyl-6-nitrophenyl)-N-sec-butyl phosphorothiamidate) to control dodder after it became attached to its host plant was demonstrated in earlier trials conducted in Fresno County. It was learned that H-26905 was not selective when preplant incorporated or applied preemergence on newly planted alfalfa.

This year emphasis was placed on the further evaluation of H-26905 alone and in combination with other herbicides for the control of dodder and other annual

weeds. Summaries of these trials are presented in Table 2 and 3 and the observations can be outlined as follows:

H-26905 provided excellent dodder control at 1.0 lb ai/A with good selectivity. The shorter the dodder strands at the time of treatment the more effective was the control, as shown in Table 2. H-26905 caused temporary growth retardation and some deformity of the growing points (meristematic tissue). This was reflected in the height of the alfalfa when measured three weeks after treatment. See Table 3.

H-26905 did provide fairly good control of established weeds but its activity was slow in developing. It was most evident after a couple of irrigations.

When evaluated in combination with Brominal® (bromoxynil) and 2,4-DB ester the broadleaf control was excellent. (Summarized in Table 3) Brominal caused retardation in the growth of the alfalfa and it persisted through the first cutting.

BAS 90210 provided good annual grass control. The alfalfa showed excellent tolerance to this new experimental herbicide. It was also evaluated in combination with Brominal, Betanex® (phasmadipham) and 2,4-DB ester to study their effectiveness in controlling a broad spectrum of weeds. In combination with Brominal and Betanex yellowing and burning of the alfalfa leaflets were observed but these symptoms were not readily evident a month later. Differences in height of the alfalfa persisted until the first cutting.

BAS 90210 should be further evaluated. It is the only herbicide that provided good postemergence control of annual grasses with excellent selectivity. The herbicidal activity of this compound was slow in developing. It required four to five weeks to kill the grasses. In combination with 2,4-DB ester it looks very promising for the postemergence selective control of grass and broadleaf weeds in newly planted alfalfa. See Tables 3 and 4.

IN ESTABLISHED STANDS

Several trials were conducted in a four-year-old alfalfa stand to study the effectiveness of several herbicides and combinations of herbicides. Dinitro general, a contact herbicide, was applied with wetting agent and weed oil in 39 and 78 gallons of water per acre to observe its effectiveness in killing back the alfalfa foliage and the established weeds. These studies are summarized in Tables 5, 6 and 7. The significant observations were:

Goal (RH 2915) provided good control of broadleaf weeds except mare's tail. It was less effective on grasses. It burned back the alfalfa but no evidence of injury was noted on the regrowth. The further evaluation of this compound at 2.0 and 4.0 lb ai/A is warranted.

FMC 25213 provided good control without injuring the alfalfa. The further development of this compound is not being pursued by its manufacturer.

H-26905 provided poor control of established weeds. At 4.0 and 8.0 lb ai/A it caused temporary retardation of the alfalfa growth.

Sencor® (metribuzin) at 0.5 and 1.0 lb ai/A in combination with Karmex® (diuron) provided good weed control. It caused severe injury to the alfalfa foliage, especially at 1.0 lb ai/A but on the regrowth phytotoxicity was not evident.

Dinitro General® (dinoseb) and Contact® (dinitrogeneral + petroleum distillate plus surfactant) was more effective applied in 78 gallons of water per acre than in 39 gallons of water per acre. Grass control was more effective when weed oil or paraquat was used in combination with dinitrogeneral.

Five gallons of weed oil per acre in combination with dinitrogeneral or Contact controlled the weeds less effectively than was obtained with 10 gallons of weed oil in the mixture.

A single application of dinitrogeneral at 1.5 to 2.0 lb ai/A plus 10 gallons of weed oil in 70 or 80 gallons of water per acre was adequate to burn back the alfalfa foliage and clean up dodder infestation. The same amount of herbicide applied in 35 to 40 gallons of water required two applications. This was observed in several commercially treated fields.

The advantage of higher gallonage of spray volume was also demonstrated in the application of Karmex in combination with nonselective contact herbicides to control established weeds. See Table 7. To control grasses and broadleaf weeds such as groundsel, cudweed and mares tail, weed oil plus dinitrogeneral (Dow

General® Sinox®) was more effective than other combinations as shown in Table 7.

IN CONCLUSION

The feasibility of controlling attached dodder with H-26905 was clearly demonstrated. Good selectivity of alfalfa in the seedling and mature stages was demonstrated. Although retardation in growth and deformity of the growing points (meristems) of the alfalfa foliage was observed, these symptoms were short lived.

The compatibility of H-26905 with other herbicides was demonstrated. The further evaluation of this compound should be pursued in older, established stands. It should be tested in combination with other herbicides, and as multiple applications in a time series study to learn whether it could be used economically to obtain seasonal control of dodder.

To control other annual weeds alfalfa seed growers have a number of good tools available - chemical and mechanical. With their judicious use alfalfa seed can be produced economically, free of competing unwanted vegetation.

Table 1

Evaluation of Dodder Control in Alfalfa - Preplant Incorporated
C-52, 425, 94, 10, 76-3

Soil Type: Panoche Clay Loam
Alfalfa Planted: 26 March 1976
Alfalfa Variety: Moapa 68

Herbicides Applied: 26 March 1976
Plot Size: 6.5' x 40' - 4 reps
Irrigation Method: Sprinkler to establish basin flood

	Herbicide	lb ai/A	Weed Control and Alfalfa Vigor Evaluations 1/ 5 May 1976 Bdlf Weed Control 2/	5 May 1976 Alfalfa Vigor	26 May 1976 Dodder Control
A	Vegadex	4.0	0.5	9.5	6.0
B	Dacthal WP	8.0	8.5	9.7	2.0
C	Tolban	0.5	8.7	7.0	0
D	Tolban	0.75	8.7	7.0	0.5
E	Amex Chemhoe	0.75 > 4.0 >	9.2	7.7	1.5
F	Balan Chemhoe	1.0 > 4.0 >	9.0	7.0	3.0
G	Balan Vegadex	1.0 > 4.0 >	8.5	8.2	1.0
H	Dacthal Chemhoe	8.0 > 4.0 >	8.7	7.5	2.7
J	Untreated	---	0	10.0	0

Remarks: Herbicides applied with a CO_2 sprayer in 1325cc of water per plot and incorporated with harrows. The alfalfa and scarified dodder seed was broadcast and harrowed in.

1/ Weed control and vigor rating based on a scale of 0 to 10. 0=no weed control or very poor vigor, 10=perfect weed control or vigorously growing alfalfa seedlings.

2/ Weeds present: Lambsquarter, pigweed, sowthistle, groundsel, monolepis and grasses.

Table 2

Evaluation of Dodder Control in Alfalfa Seed Production
A Time Series Study
C-52, 425, 94, 10, 76-9

Soil Type: Panoche Loam
Alfalfa Planted: 5 May 1976
Alfalfa Variety: Moapa 68

Herbicides Applied: 5/24, 6/4 & 6/14
Irrigation Method: Furrow
Evaluated: 29 June & 28 July 1976

				Dodder Control and Alfalfa Vigor Evaluations[1/]			
				29 June		28 July	
	Herbicides	lb ai/A	Date of Treatment	% Dodder Control	Alfalfa Vigor	% Dodder Control	Alfalfa Vigor
	alfalfa - one trifoliate leaf attached dodder ¼" to 1" long						
A	H-26905	1.0	5/24	95	8.0	90	10
B	H-26905	2.0	5.24	98	7.0	90	10
C	H-26905	4.0	5/24	98	6.5	90	9.5
	alfalfa - 1 to 8 trifoliate leaves, attached dodder 2" to 10" long						
D	H-26905	1.0	6/4	90	8.0	75	10
E	H-26905	2.0	6/4	95	8.2	85	10
F	H-26905	4.0	6/4	95	6.2	95	10
	alfalfa - 8 to 14 trifoliate leaves attached dodder 4" to 10" long						
G	H-26905	1.0	6/14	75	9.0	60	8.0
H	H-26905	2.0	6/14	80	9.0	70	8.5
J	H-26905	4.0	6/14	90	7.5	80	9.0
K	H-26905	8.0	6/14	95	7.0	85	8.5
L	Untreated	---	----	20	6.0	20	5.0

1/ Vigor evaluation based on a 0 to 10 scale: 10=vigorously growing alfalfa, 0=very poor vigor.

Table 3

Evaluation of Dodder and Other Weed Control in Alfalfa - Postemergence
C-52, 425, 94, 10, 76-8

Soil Type: Panoche Loam
Alfalfa Planted: 26 Mar 76
Alfalfa Variety: Moapa 68
Herbicides Applied: 5 May 1976

Plot Size: 10'x15' - 4 reps
Irrigation Method: Border Flood
Evaluated: 5/11, 5/26 and 5/28/76

	Herbicide	lb ai/A	Weed Control and Alfalfa Injury Evaluations 1/						
			11 May 1976			26 May 1976			28 May 1976
			Bdlf Control	Grass Control	Alfalfa Injury	Dodder Control	Bdlf Control	Grass Control	Alfalfa Height in Inches 2/
A	H-26905	1.0	0	0	0.5	9.2	3.0	3.0	13.2
B	H-26905	2.0	0.5	0	1.2	9.7	7.0	6.0	11.3
C	H-26905	4.0	1.0	0	1.5	10.0	7.0	5.0	11.2
D	H-26905	8.0	1.7	0	2.7	10.0	7.5	8.2	8.7
E	H-26905 + Brominal	2.0 + 0.5	10.0	2.0	4.5	10.0	10.0	3.0	8.4
F	H-26905 + Brominal	2.0 + 1.0	10.0	2.0	6.5	10.0	10.0	4.0	6.7
G	H-26905 + 2,4-DB ester	2.0 + 0.75	6.2	0	1.0	9.7	9.2	3.5	12.2
H	Brominal + BAS 90210 + X-77	0.5 + 2.0 + 0.5%	10.0	8.0	4.2	3.2	9.7	6.0	8.5
J	Betanex + BAS 90210	1.0 + 2.0	10.0	5.5	2.2	0	7.8	6.7	11.1
K	BAS 90210 + X-77	4.0 + 0.5%	0	0	0	0	0	8.7	13.8
L	Endothal + BAS 90210 + X-77	1.0 + 2.0 + 0.5%	0	0	0	0.5	0	7.0	12.9
M	Betanex + Endothal 273	1.0 + 1.0	9.5	2.6	2.2	2.0	8.0	3.0	10.4
N	Endothal 273 + X-77	2.0 + 0.5%	0	2.0	1.0	0	0	2.0	12.2
P	Untreated	---	0	0	0	1.0	0	0	14.2

1/ Weed control and alfalfa injury evaluations are based on a 0 to 10 scale; 0=no weed control or no alfalfa injury, 10=perfect weed control or very severe alfalfa injury.

2/ Alfalfa height was measured in 3 areas in each plot. Values represent the average of 12 measurements.

Remarks: The untreated plots were heavily infested with broadleaf weeds-it being the tallest may be due to its spindly growth.

Table 4

Evaluations of Weed Control Trial in Alfalfa - Postemergence
C-52, 425, 94, 10, 76-7

Trial Location: Lyon Ave ¼ mi S of Belmont
Coit Ranch-Mendota
Herbicides Applied: 30 April 1976

Soil Type: Panoche Loam
Plot Size: 5'x20' - 4 reps
Evaluated: 7 May, 20 & 26 May 1976

Herbicide	lb ai/A	Weed Control and Alfalfa Injury Evaluations 1/ 7 May 76 Bdlf Control	7 May 76 Alfalfa Injury	20 May 76 Alfalfa Height in Inches	26 May 76 Bdlf Control	26 May 76 Grass Control
A BAS 90210	2.0	0	0	18.8	0	8.0
X-77	0.5%					
B BAS 90210	4.0	0	0	18.1	0	8.5
X-77	0.5%					
C Brominal	0.5	9.5	2.0	13.3	10.0	6.0
BAS 90210	2.0					
X-77	0.5%					
D Brominal	1.0	9.7	3.7	13.4	10.0	7.0
BAS 90210	4.0					
X-77	0.5%					
E Betanex	1.0	8.5	4.5	13.5	9.0	7.0
BAS 90210	2.0					
F Endothal 273	1.0	1.5	2.7	12.9	8.0	6.0
BAS 90210	2.0					
X-77	0.5%					
G Endothal 273	1.0	9.3	4.0	12.1	10.0	7.0
Brominal	0.5					
BAS 90210	2.0					
X-77	0.5%					
H Betanex	1.0	9.0	3.0	12.1	10.0	7.5
Endothal	0.5					
BAS 90210	2.0					
J 2,4-DB ester	0.75	8.2	1.7	15.3	10.0	8.5
BAS 90210	2.0					
X-77	0.5%					
K Untreated	---	0	0	18.4	0	0

1/ Evaluation based on a 0 to 10 scale. 0=no weed control or no injury, 10=perfect weed control or severe injury.

On May 7th the alfalfa in the Brominal treated plots was slightly chlorotic and the alfalfa leaflets were burned (necrotic). A week later the alfalfa was green but differences in the height of the alfalfa was evident - differences in height persisted through 5/26.

Remarks: Herbicides applied in 360cc of water per plot.
Alfalfa - well established 2-3 stems
Grasses - 5 leaves stooled
Lambsquarter - 2 to 8 leaves
Pigweed - 2 to 4 leaves
Goosefoot - 2 to 6 leaves
Sowthistle - 4 to 5 leaves
Fiddleneck - 6 to 8 leaves

Table 5

Evaluation of Weed Control in Alfalfa - Established IV & V
C-52, 425, 94, 10, 75-76

Trial Location: Westside Field Station
Soil Type: Panoche Loam
Herbicides Applied: 8 Jan 76

Plot Size: 10'x32' - 4 reps
Irrigation Method: Border Flood
Evaluated: Feb 19 and Apr 29, 1976

	Herbicide	lb ai/A	Alfalfa Injury and Weed Control Evaluations[1] 19 Feb 1976[2] Alfalfa Injury	Bdlf[4] Control	Grass[4] Control	29 Apr 1976 Alfalfa Injury	Bdlf Control East	Bdlf Control West	Grass Control East	Grass Control West[3]
	Series IV									
A	FMC 25213	2.0	0	3.7	1.7	0	9.2	9.2	10.0	10.0
B	FMC 25213	4.0	0	7.5	8.5	0	10.0	10.0	10.0	10.0
C	H-26905	2.0	0	0	0	0	2.7	9.2	0	1.7
D	H-26905	4.0	2.2	1.2	1.0	0	2.5	7.0	2.0	1.7
E	H-26905	8.0	2.2	6.7	6.2	0	7.7	8.0	5.5	7.2
F	Karmex	2.4	0	1.7	0	0	7.7	8.0	10.0	10.0
G	Untreated	---	0	0	0	0	0	2.5	0	1.0
	Series V									
H	FMC 25213 + Contact *	2.0 + 1 gpa	5.5	8.7	7.2	0	9.7	10.0	9.7	10.0
J	FMC 25213 + Contact *	4.0 + 1 gpa	5.7	8.5	8.0	0	9.2	9.7	9.7	10.0
K	Goal	2.0	7.7	9.7	8.0	0	10.0	10.0	7.2	7.5
L	Goal	4.0	8.2	9.7	8.5	0	10.0	10.0	8.2	8.7
M	H-26905 + Contact *	4.0 + 1 gpa	4.2	8.5	0	0	7.7	9.0	1.0	0
N	H-26905 + Contact *	8.0 + 1 gpa	5.0	5.7	1.5	0	8.2	9.2	2.0	3.7
T	Untreated	---	0	0	0	0	1.5	2.5	0.7	0.7

Remarks: Herbicides applied in 80 gallons of water per acre.
* Contact contains 2 lb of dinitrogeneral, petroleum distillate and wetting agent.

1/ Evaluations based on a 0 to 10 scale. 0=no weed control or no alfalfa injury, 10=perfect weed control or very severe alfalfa injury.

2/ Evaluated only the East half of each plot where no Contact herbicide was used.

3/ West half of each plot was treated with 2 gallons per acre of Contact in 112 gallons of water per acre on 23 Dec 1975.

4/ Weeds present were: Common groundsel, sowthistle, chickweed, mare's tail, wild barley, and annual bluegrass.

Table 6

Evaluation of Weed Control in Established Alfalfa - I
C-52, 425, 94, 10, 75-76

Trial Location: Westside Field Station
Herbicides Applied: 23 Dec 75 (Series I)
Soil Type: Panoche Loam
Irrigation Method: Border Flood
Plot Size: 10'x32' - 4 reps
Evaluated: 1/14, 4/14 and 4/29 1976

	Herbicide	lb ai/A	Alfalfa Injury and Weed Control Evaluations[1]					
			Alfalfa Injury[2]		4/29 East		4/29 West	
			14 Jan	14 Apr	Broadleaf	Grass	Broadleaf[3]	Grass
A	Karmex	2.4	2.0	0	2.6	7.6	9.6	10.0
B	Karmex X-77	2.4 0.5%	3.0	0	3.3	7.3	8.0	9.3
C	Karmex Sencor	2.4 > 0.5 >	3.2	0	6.0	10.0	10.0	10.0
D	Karmex Sencor	2.4 > 1.0 >	6.2	0	6.0	10.0	10.0	10.0
E	Karmex Devrinol	1.6 > 4.0 >	3.0	0	5.6	7.3	9.3	9.0
F	Karmex Devrinol	2.4 > 4.0 >	3.0	0	5.3	7.6	8.6	8.0
G	H-26905	2.0	0	0	0	2.0	4.3	4.3
H	H-26905	4.0	0	0	0	0	5.0	2.6
J	H-26905	8.0	0	0	3.6	2.0	7.6	5.6
K	Goal	1.0	8	0	2.3	0	3.0	0
L	Goal	2.0	9	0	4.0	3.3	6.0	5.6
M	Untreated	---	0	0	0	0	0	0

Remarks: Herbicides applied with a CO_2 sprayer in 1360cc of water per plot. The West half of all plots were treated with Contact at 2 gal/A in 112 gallons of water on 23 Dec 1975.

1/ Injury and weed control ratings are based on a 0 to 10 scale. 0=no weed control or no alfalfa injury, 10= perfect weed control or very severe alfalfa injury.

2/ Rating on January 14th were made only in the East half of the plots where no contact herbicide was applied Dec 23.

3/ Broadleaf weeds were common groundsel, mares tail, chickweed and sowthistle. Grasses were wild barley and annual bluegrass.

Table 7
Evaluation of Herbicides in Established Alfalfa - II & III
C-52, 425, 94, 10, 75-76

Trial Location: Westside Field Station
Herbicides Applied: 14 & 16 Jan 1976 (Series II & III)
Alfalfa: 4 yr old stand
Plot Size: 10'x32' - 3 reps
Evaluated: 4/14/76

	Herbicide	lb ai/A	Weed Control Evaluations 1/ Low Gallonage (39gpa) Broadleaf Control	Low Gallonage (39gpa) Grass 2/ Control	High Gallonage (78gpa) Broadleaf Control	High Gallonage (78gpa) Grass 2/ Control
	Series II					
A	Karmex Contact	2.4 1 gpa	9.0	8.0	9.7	9.3
B	Karmex Paraquat X-77	2.4 1.0 .5%	8.7	9.5	9.0	9.7
C	Karmex Amm. Sulfate X-77	2.4 5.0 .5%	7.0	7.0	7.0	8.0
D	Karmex Amm. Sulfate Weed Oil	2.4 5.0 5 gpa	8.5	8.5	9.3	9.3
E	Karmex Sinox General X-77	2.4 2.0 .5%	9.0	8.0	9.5	9.3
F	Karmex Sinox General Weed Oil	2.4 2.0 5 gpa	9.0	8.5	10.0	9.6
G	Karmex Sinox General Weed Oil	2.4 2.0 10 gpa	9.0	9.0	10.0	10.0
H	Karmex Sinox General Weed Oil X-77	2.4 2.0 5 gpa 0.5%	9.5	9.0	10.0	10.0
J	Untreated	---	0	0	0	0
	Series III					
K	Dow General Amm. Sulfate X-77	2.0 5.0 .5%	8.0	6.5	9.5	8.0
L	Dow General Weed Oil Amm. Sulfate	2.0 5 gpa 5.0	10.0	9.0	10.0	10.0
M	Dow General Weed Oil X-77	2.0 10 gpa .5%	10.0	10.0	10.0	10.0
N	Contact	2 gpa	8.5	6.5	9.0	7.0
O	Contact Weed Oil	2 gpa 5 gpa	10.0	10.0	10.0	10.0

1/ Evaluations based on a 0 to 10 scale 0=no control, 10=perfect control
2/ Weeds present were: sowthistle, mares tail, groundsel, cudweed, annual bluegrass-wild barley

WEED INFESTATION RECORD

FIELD LOCATION _____ CROP _____ HERBICIDE USED _____

DATE PLANTED _____ DATE NOTES TAKEN _____ PREVIOUS CROP _____

BROADLEAF ANNUALS	Anise	Atriplex	Bassia Five Hook	Black Bindweed	Bristly Oxtongue	Burweed	Carpetweed	Cat's Ear	Cheeseweed
Chickweed	Clover	Cocklebur	Corn Spurry	Cudweed	Dandelion	Dock	Dodder	Fat Hen	Fiddleneck
Filaree	Flaxleaved Fleabane	Ground-cherry	Groundsel	Hemlock	Henbit	Jimson Weed	Knotweeds	Lambsquarters	Lettuce Wild
London Rocket	Mare's Tail	Mayweed	Milk Thistle	Minerslettuce	Morning Glory	Mustard	Nettle	Nettleleaf Goosefoot	Nightshade
Nuttalls Monolepis	Phacelia	Pigweed	Pineapple Weed	Plantain	Popcorn Flower	Puncture Vine	Purslane	Red Maids	Russian Thistle
Scarlet Pimpernel	Shepherd's Purse	Sow Thistle	Spiny Clotbur	Spurge	Sunflower, Common	Tarweed	Telegraph-plant	Toadflax	Turkey Mullein
Velvet Leaf	Venice Mallow	Veronica	Willow Herb	Yellow Starthistle					
GRASSES ANNUAL	Annual Bluegrass	Barley, Volunteer	Barnyard-grass	Bromegrass	Canarygrass	Crabgrass	Cupgrass	Dallisgrass	Diffuse Lovegrass
Feather Finger-grass	Foxtails (Bristle grass)	Jungle Rice	Orcutts Lovegrass	Rabbitfootgrass	Ripgut Brome	Ryegrass	Sandbur	Sprangletop	Wild Barley (Foxtails)
Wild Oats	Witchgrass								
PERENNIALS	Alkali Sida	Bermudagrass	BINDWEED (Morning Glory)	Cattail	Chickory	Heliotrope	Hoary Cress	Johnsongrass	Nutsedge, Purple
Nutsedge, Yellow	Russian Knapweed	Saltgrass	SILVERLEAF NIGHTSHADE (Horsenettle)	Swamp Smart-weed (Kelp)	Tolgoucha	Tule			

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1 = very few weeds present
2 = light infestation
3 = moderate infestation
4 = heavy infestation
5 = very heavy infestation

A good record of weed infestation will enable you to select a crop rotation system that can minimize your weed control costs and enable you to select the most effective tools whether chemical or mechanical.

Bill B. Fischer, Fresno County Farm Advisor
University of California Agricultural Extension Service

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Weed infestations recorded on weed infestation cards, such as the one below, will enable you to select a crop rotation system that can minimize your weed control costs. It can enable you to select the most effective tools whether mechanical or chemical. Cards such as this are available free from farm advisors and pest control advisors

To help you identify weeds the Growers Weed Identification Handbook with colored photographs of 151 commonly found weeds in California may be helpful. The handbook can be purchased from the Publications Division of Agricultural Sciences of the University of California. Order forms are available from Cooperative Extension offices.

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