THE REACTION OF FLAX AND WHEAT TO VARIOUS CONCENTRATIONS OF WILD MUSTARD (BRASSICA ARVENSIS (L.) RABENH.) AND TO THEIR REMOVAL WITH 2,4-DICHLOROPHENOXYACETIC ACID

by

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A Thesis

Submitted to the Committee on Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree of

MASTER OF SCIENCE

THE UNIVERSITY OF MANITOBA

May 1953

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INTRODUCTION

Recent weed research has concerned itself with the influence of weeds on crop plants and the effect of herbicides on weeds and crops growing separately or together. It is well known that weeds may lower crop yields seriously, and that the species of weeds as well as their abundance in the crop influence the magnitude of yield reduction. Investigations have shown that species of both weed and crop differ in their tolerance to 2,4-D. The common cereal crops and flax can be treated with reasonable safety only during certain growth stages. The logical aim of the grower, therefore, should be to treat his crop when the weeds are in the most susceptible and the crop in the most tolerant stage.

In view of the fact that the yield of crops is influenced by the abundance of weeds and, also because there may be some injury to the crop from treatment, various workers have questioned the economic value of removing light infestations of weeds with 2,4-D. The reduction in yield from such infestations may not be large enough to warrant the expense of treatment.

The investigation described here was concerned with (a) the study of the reaction of flax and wheat to various populations of wild mustard, (b) with the reaction of the two crops to 2,4-D, and (c) with the effect of chemical control of the weed when its population was at different levels. It was hoped that these studies would show the lowest levels of population at which treatment of wild mustard with 2,4-D in fields of wheat and flax, would be justified.

REVIEW OF LITERATURE

The literature dealing with the control of weeds in flax and wheat may be divided into three major categories: (a) studies on plant competition and cultural control, (b) studies on the susceptibility of the crops and weeds to 2,4-D, and (c) studies on the various aspects of chemical weed control in weedy stands.

Pavlychenko (28) defined plant competition as "a natural force whereby each living organism tends to obtain maximum advantages at the expense of other living organisms occupying a common feeding area". Weeds and crops compete for moisture, light and nutrients (28). Species of plants differ in their ability to compete for the essential growth elements (2, 32). Pavlychenko and Harrington (32) classified the competitive efficiencies of several species of weeds, several varieties of wheat, oats and barley and one variety of rye and flax, on the basis of the amount of assimilation surface, number of stomata per square centimeter of leaf surface, and the extensiveness of the root system, at periods of five and 21 days after emergence. They report that the cereals had greater assimilation surfaces, number of stomata and length of root system than the weeds, except wild mustard, at five days after emergence, but at 21 days, the situation was reversed with the exception of wild mustard, which had the most extensive root system of any plant studied. These investigators concluded that: (a) any advantage one plant has over another at an early stage of growth is of extreme importance in the final outcome, (b) wild mustard, wild oats and stinkweed are very serious weeds and (c) the competitive efficiencies of the cereals was in the order of barley, spring rye, wheat, oats and flax.

Various workers have shown that weeds reduce tillering of cereals (2, 22, 23) and Carter et al (5) found in the case of wheat that tillering and yield were reduced in proportion to the density of weeds. Blackman and Templeman (2) studied the nature of competition between weeds and cereals and found that weeds depressed the nitrogen and potassium content of cereals but did not influence the phosphorus content. The application of nitrogen fertilizers to barley infested with wild mustard increased tiller production and yield. They concluded that the response of a weedy crop to nitrogen fertilizer is dependent upon the relative amounts taken up by the weeds and crop and the critical period is confined to the early stages of development of the cereal. Godel (22) increased the yield of cereal crops on weedy land by increasing the seeding rate. With increased seeding, the number of tillers per plant was decreased but the number of tillers, bearing heads, per unit area of crop was increased. When normal rates of seeding were used on weedy land, yield reductions occurred because competition had reduced the size of heads or panicles, the number of tillers and the weight of kernels.

Robinson (33) studied the effect of annual weeds on the yield of wheat, oats and flax and found that complete weed removal when the crop was 4 inches tall frequently gave an increase in yield over weedy crops, that brought it nearly to the level of that obtained from weed-free crops.

The studies of Varma (35) show that the depressing effect of one species on another is due, at least in part, to soluble toxic substances probably formed in the roots. Both living and decaying root tissue produced these toxic substances but they appeared to be more prevalent in extracts from dead tissue. The toxic substances appeared to be selective in action and provided an effective weapon in plant competition.

Olson et al (27) found two critical periods in the growth of wheat where treatment with 2,4-D reduced the yield sharply. One was an early seedling period when the plants were one to five inches tall and the other was between the stages where the head was well into the boot until just before heading. These results have been substantiated by various other workers (21, 25). Flax is susceptible to 2,4-D from very early bud stage to about ten days past full bloom (8, 16, 17).

Erickson et al (14) reported that 2,4-D application to both weedy and weed-free wheat, increased the protein content of the grain in proportion to the concentration applied. This increase did not appear to be dependent on weed competition, variety, dryland or irrigated conditions, or the stage prior to heading. Friesen (19) reported that the greatest increase in protein content was secured when the chemical caused the greatest yield reductions. Aitken et al (1) determined the protein content of wheat seed samples derived from plots that had been sprayed with three formulations of 2,4-D at the blade and heading stages of growth in 1948 and 1949. They found in both years that the protein content was increased by 2,4-D. In 1948 the greatest increase was obtained with the ester formulation at the heading stage, while in 1949, there was no apparent difference between formulations or stages of treatment.

Chubb and MacKey (6) report that the oil content, iodine number, 1000-kernel weight, bushel weight and germination of seed from the varieties Liral Dominion, Liral Prince Toba and Royal flax were unaffected when the plants were sprayed with 2, 4, and 8 ounces acid equivalent of alkanolamine. Friesen (18) obtained no significant difference between treated and untreated flax for oil content and iodine number. However, Dunham (13) found that oil percentage of some varieties was seriously reduced by even a 4 ounce application of sodium salt and ester of 2,4-D. The iodine number of the linseed oil was reduced in some cases.

Burrows and Olson (4) applied 2,4-D at the rate of 4 ounces acid equivalent per acre to flax plots infested with 81 weeds per square yard and obtained a yield increase of 12.66 bushels per acre. In a similar experiment (3), wheat infested with 76 weeds per square yard was sprayed with 2,4-D at the rate of 6 ounces acid equivalent per acre, and no significant increase in yield was obtained. The chemical apparently had two effects: it tended to increase the yield by removing weed competition, but this was partly offset by damage to the wheat.

Friesen (20) sprayed Rescue wheat growing in association with 45 annual weeds per square yard, with 2,4-D ester and amine at acid equivalent rates of 2, 4, 6, 8, and 12 ounces per acre. There were no significant differences between the average yields of wheat.

Several papers (9, 10, 11, 12, 24, 29, 30, 31, 34) deal with the control of weeds in grain crops by the use of 2,4-D, but do not give quantitative information as to the comparative density of weed stands.

MATERIALS AND METHODS

This study, consisting of two experiments, one with flax and the other with wheat, was conducted on Red River clay soil at the University of Manitoba in 1952. Wheat and flax were selected because of their economic importance, their tolerance of 2, 4-D, and their different behaviour when grown in association with weeds. The weed (wild mustard) used in these experiments was chosen because of its prevalence in Canada and its susceptibility to 2,4-D.

Each experiment consisted of randomized blocks, in quadruplicate, each containing seven split-plots holding different populations (0, 10, 25, 50, 100, 200 and 400) of wild mustard plants. The population of flax and wheat plants, however, was uniform for all plots and was derived from seeding the wheat variety Lee at two bushels per acre, and the flax variety Dakota at 45 pounds per acre. One half of each plot was sprayed with 2,4-D butyl ester, at a rate of six ounces acid equivalent per acre in the case of wheat and four ounces per acre in the case of flax, while the other half was left untreated.

The wild mustard seed was sown by hand, a predetermined amount being broadcast over each plot. It was then covered by means of a garden rake. A horse drawn single-disc drill, was used to sow the wheat and flax in rows 6 inches apart, this sowing following the sowing of wild mustard. After both sowings were completed, the soil of the plots was packed to ensure uniform germination. The process of seeding was completed in one day.

When the mustard plants emerged, they were counted and thinned to the desired stand for each plot. Other species of weeds that emerged during the growing season were removed as soon as they could be detected.

The flax was sprayed on June 21, at which time the flax was two to three inches and the mustard three to four inches tall. The wheat was sprayed six days later, when the plants were in the five-leaf stage and measured 12 to 14 inches to the tip of the uppermost leaf. The mustard plants in the wheat plots then had six or seven true leaves and were nine or ten inches high. The spray (water solution of 2,4-D) was applied by means of a special apparatus consisting of a knapsack sprayer tank on wheels, connected to an auxiliary tank holding measured quantities of spray. From the latter tank the spray passed to a spray boom equipped with three nozzles (Monarch) of size 67. This apparatus was operated at 30 pounds pressure and delivered the spray at the rate of 60 gallons per acre from a uniform height. A single spraying gave excellent control of the mustard plants in all plots.

When the flax and wheat plants were ripe, the plots were trimmed to remove the "border effect". This trimming reduced the original size of 18.5 feet to 16.5 feet in length and to six drill rows in width. In the flax experiment, the plants were pulled and counts obtained for number of plants and main branches per plot. In the case of wheat, the number of culms per plot was determined. Before threshing, the crop plants were separated from the mustard and the dry weight per plot determined for the latter. After threshing, the weight of dry straw, the yield per acre, the bushel and 1000-kernel weight, and the seed grade was obtained for all plots. In addition, the number of seed bolls per plant, the oil content of the seed and the iodine number of the oil was obtained for all plots of flax, and the protein content of the grain obtained for all plots of wheat. The total number of bolls per plant was determined from a mean of bolls of 25 plants taken from comparable locations in each plot. The grade of the seed, the oil and protein content of flax and wheat, respectively, and the iodine number of the linseed oil was determined on the basis of bulked samples from the four replicates.

All the data obtained from this investigation were subjected to statistical analysis according to the methods described by Cochran and Cox (7). A separate method was used to analyze the data on protein content, grade, oil content and iodine number. The interaction term, treatments by concentrations, was assumed to be non-significant and was used to test the significance of treatments and concentrations. In the wheat experiment, there were two missing values in the grain yield data. These were calculated by the method described by Cochran and Cox (7).

RESULTS AND DISCUSSION

1. Reaction of Flax to Various Populations of Wild Mustard and the Effect of Their Removal with 2,4-D

Number of flax plants per plot

Observations made during the growing season indicated that the wild mustard had thinned the stand of flax through competition. In general, there was a decrease in the average number of flax plants per plot with an increase in the weed population, but the difference was not significant. Spraying the plots with 2,4-D did not significantly increase the average number of plants. Weeds reduced the vigor of the flax plants rather than their numbers.

Number of main branches per plot

Observations of flax in the field showed that the degree of branching at the base of the flax plant was affected by the populations of mustard. The differences were very noticeable when comparisons were made between treated and untreated plots. The average counts of basal branches for the treated and untreated plots at the various population levels are illustrated in Figure 1. There was first a sharp reduction and then a gradual decline in the number of main branches as the population of mustard increased. The differences between population levels of mustard were found to be significant. Spraying weedy plots with 2,4-D resulted in a significant increase in branching, while in mustard-free plots, it resulted in a non-significant decrease (slight damage). The reduction

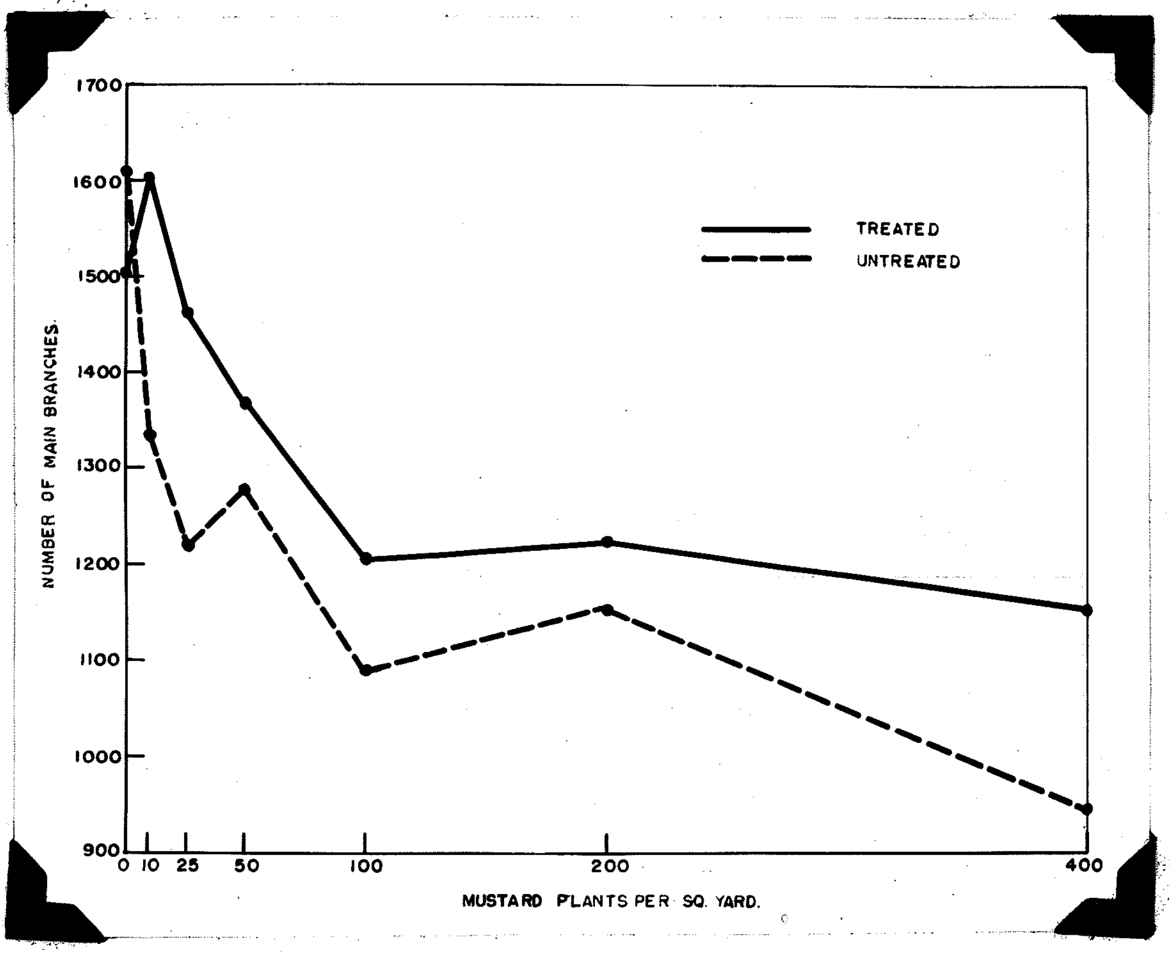

Figure 1 Average number of main branches in treated and untreated plots at the various levels of mustard population.

in the total number of main branches, caused by mustard competition, in the sprayed plots was unexpected since the mustard plants were killed at a very early stage in relation to the development of the flax. However, the data indicate that basal branching was adversely affected during the 14-day interval between emergence and time of treatment.

Wild mustard competes vigorously with cereals for nutrients and moisture (28). Pavlychenko and Harrington (32) showed that as early as 5 days after emergence, this weed had a greater root system, a greater number of stomata per unit area of leaf surface than any other weed or cereal crop studied. These characteristics of wild mustard enable it to provide strong competition, very early in the growing season, to the crop associated with it.

Varma (35) and Evanari (15) found that some plant species produce soluble toxic substances in their roots. These toxic substances reduced both the seed germination and root development of other species in the same association. The adverse effect of wild mustard on other species of plants were thought due to the toxic oils liberated by germinating mustard seeds. If such a factor operated in the flax plots, of the present study, it did not reduce the population density of flax, although it may have reduced the vigor of the plants. Flax does not seem capable of producing any noticeable quantity of inhibitory substances itself.

Number of seed bolls per plant

Field observations indicated a striking difference between sprayed and unsprayed plots in the production of seed bolls. This is illustrated in Figure 2. Counts from the untreated plots showed a very sharp reduction in the number of bolls per plant from the 0 to 10 concentration. However, the slope of this decline levelled off at the 50 concentration point. A similar trend was found in the sprayed plots, but the decline levelled off at a higher number of bolls. It is noteworthy that in the sprayed plots, those with 10, 50, 100 and 200 mustard plants per square yard, produced significantly fewer seed bolls per plant than did the plants in the sprayed mustard-free control. This was not the case where the population was 25 and 400 per square yard, but the deviation from the trend could have been due to experimental error. In any case, the difference between the boll count for the weedy and weed-free sprayed plots seemed to give strong support to the view that the presence of even very young mustard plants, adversely affected the growth of flax.

Yield of flax straw

Since it was obvious that the growth of flax in the field was reduced by weeds, the weight of straw in each plot was determined. The average yields in pounds per acre for treated and untreated plots at the various population levels are shown by graph in Figure 3. Significant differences in weight of straw were obtained for weed concentrations and for treatments. The interaction of treatments

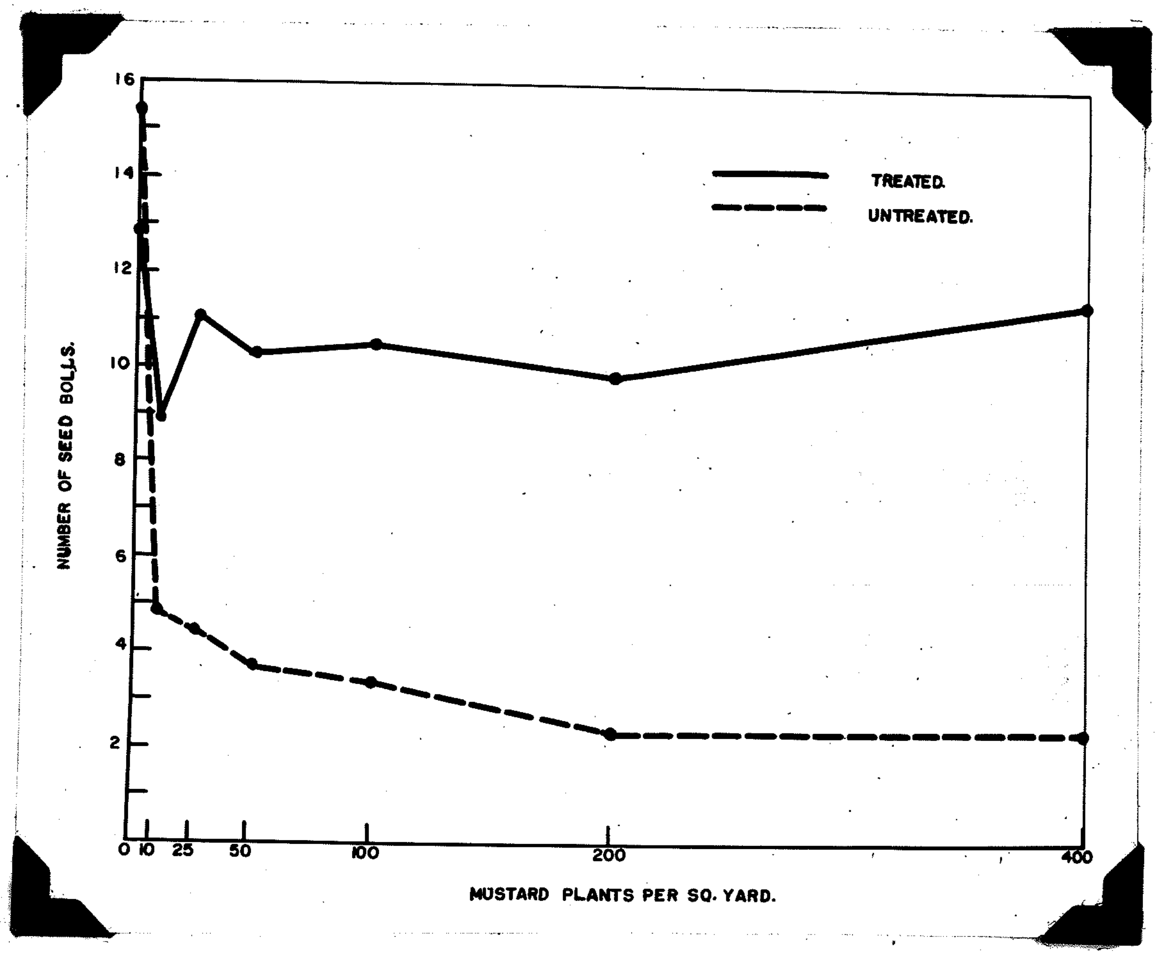

Figure 2 Average number of seed bolls per plant (mean of 25 plants) in treated and untreated plots at the various levels of mustard population.

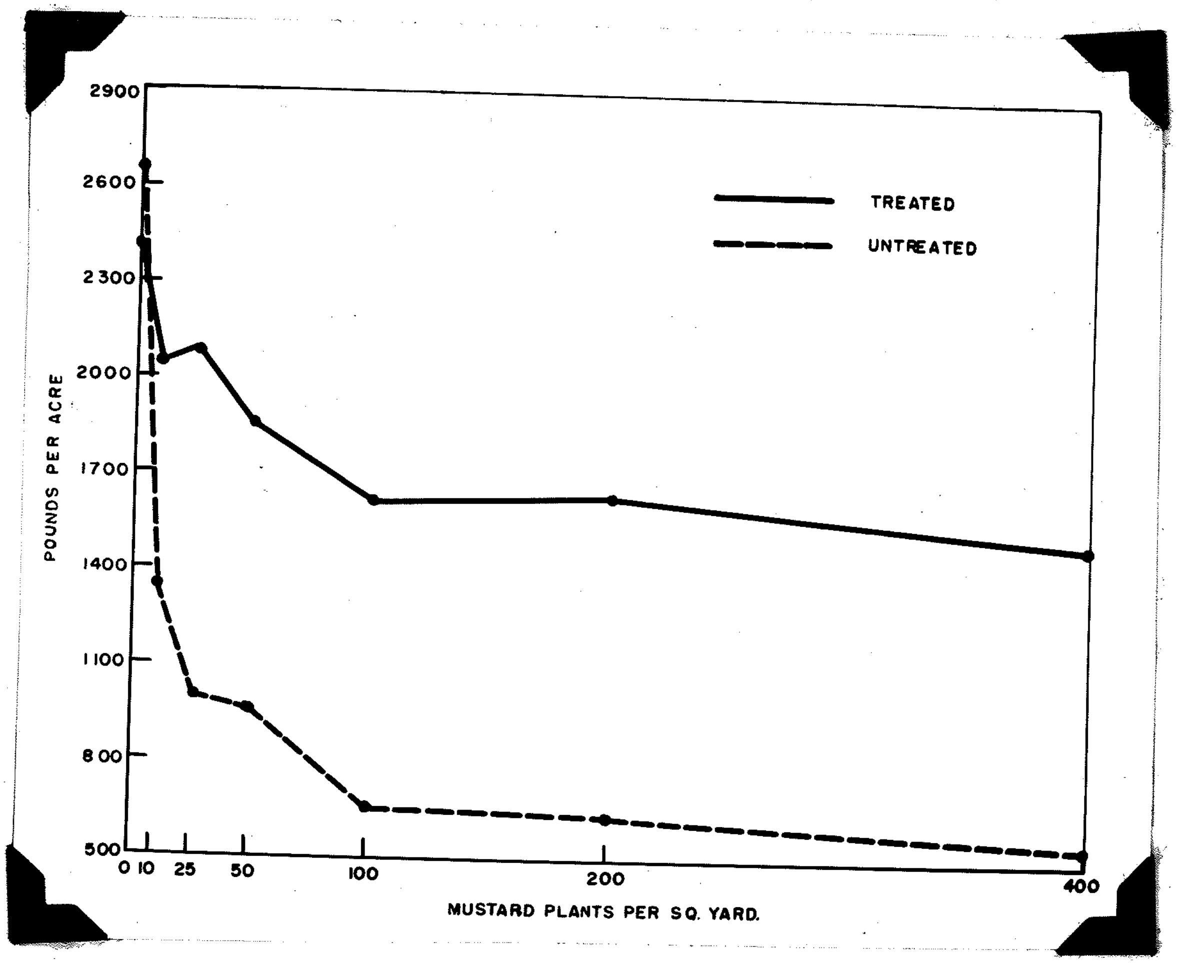

Figure 3 Average yield of flax straw in treated and untreated plots at the various levels of mustard population.

by concentrations was also significant. There was a general decline in weight of straw, as the concentration of mustard increased. This decline was very marked up to the 100 plant level. There was a further slight decline beyond this level. A comparison of Figures 2 and 3 shows that the trend for straw yields was very like that observed for the number of bolls.

Yield of seed

The yields of linseed for treated and untreated plots at seven weed population levels are illustrated in Figure 4. The yield of linseed decreased as the number of mustard plants per square yard increased. The untreated plots showed a sharp decline from the 0 to 10 plant level, and only a slight decline beyond. The sprayed plots showed a similar decline in yield except that the reduction at the 10 plant level was much less marked. The over all difference between yields of treated and untreated flax was very pronounced and showed the gain from weed control, notwithstanding the fact that the spray caused some injury in the weed-free plots. This loss from spraying injury was close to being significant. An analysis of variance showed a significant interaction between treatments and concentrations.

Although spraying of weedy plots resulted in substantial increases in yield of seed, the harmful effects of competition from mustard plants during the 14-day period up to the time of treatment, seemed to have been carried through to maturity, regardless of the number of weeds.

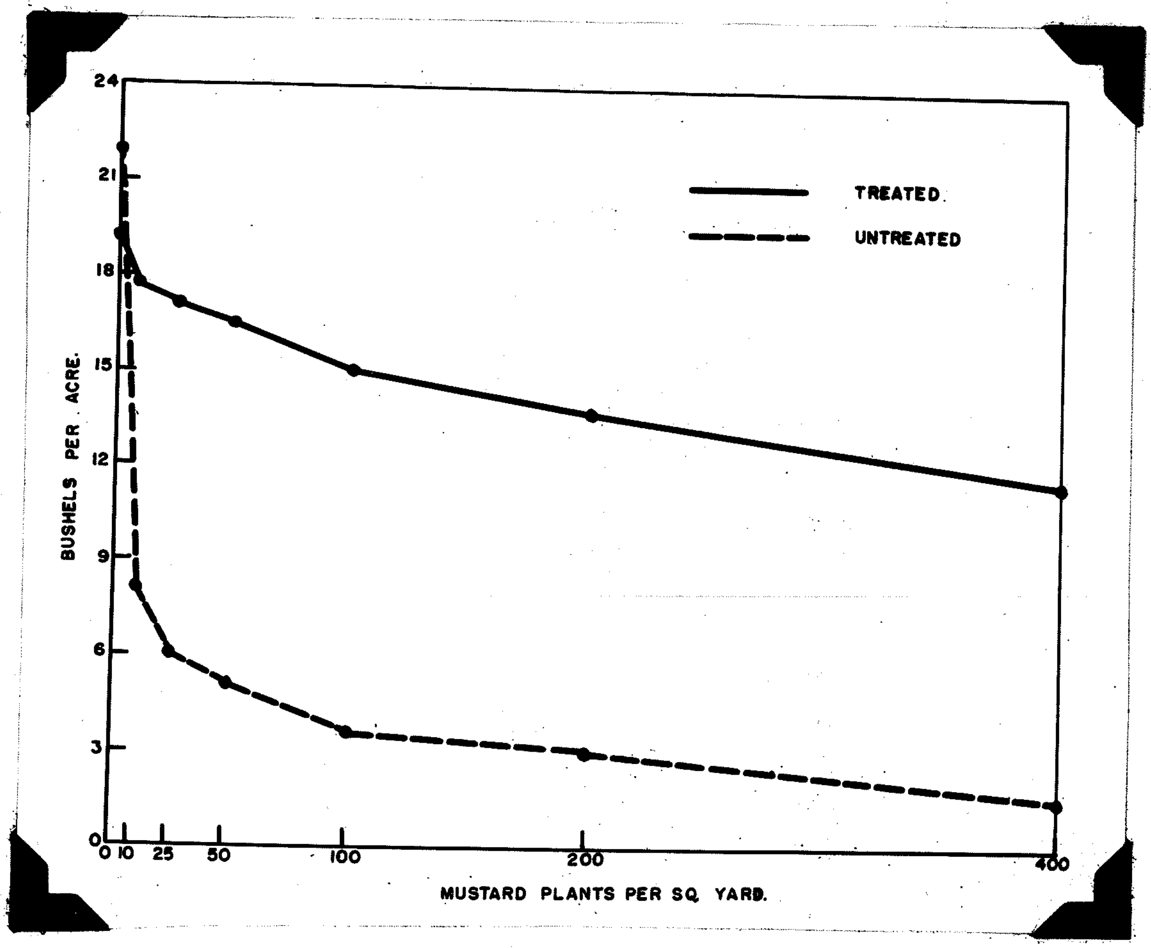

Figure 4 Yield of linseed of treated and untreated plots at the various levels of mustard population.

The flax plants did not seem able to recover sufficiently to cancel out this initial setback, particularly with respect to basal branching. It may be concluded that weedy crops should be treated with 2,4-D as early in the growing season as possible to shorten the duration of early competition.

The bushel weight, 1000-kernel weight, commercial grade, oil content and iodine number of the oil were not influenced by either 2,4-D or the various mustard plant densities. However, the 1000-kernel weight was significantly higher in the weedy plots.

Total dry weight of mustard plants

At harvest time the mustard plants in each plot were separated from the flax plants and weighed. Their average yields are shown in Figure 5. Field observations showed that the vigor of the individual mustard plants decreased as the number of plants per square yard increased. The data on dry weight showed that beyond the 25 plant per square yard level, the total dry weight of mustard remained about the same. At and below the 25 plant level, the mustard plants grew very large because the flax associated with them, offered very little competition. However, as the density of the weed population increased, the mustard plants competed with themselves, and, as a result, the total dry matter produced was nearly constant. The weeds at the 10 plant level were very tall and vigorous but, because of their small number, the total yield of dry matter was less than at the 25 plant level.

It has already been pointed out that spraying weed-free flax with 2,4-D resulted in some injury to the crop. The rate of application (4 ounces acid equivalent per acre) was probably too high, but it was used because it was considered necessary in order to obtain control of the weed where it was abundant.

The flax seed yield data show the obvious advantage of controlling even the smallest (10 and 25 mustard plants per square yard) mustard populations. At the lowest level (10 mustard plants per square yard), spraying resulted in a 45.96 percent increase in yield, an increase obtained in spite of the fact that spraying damaged the flax slightly.

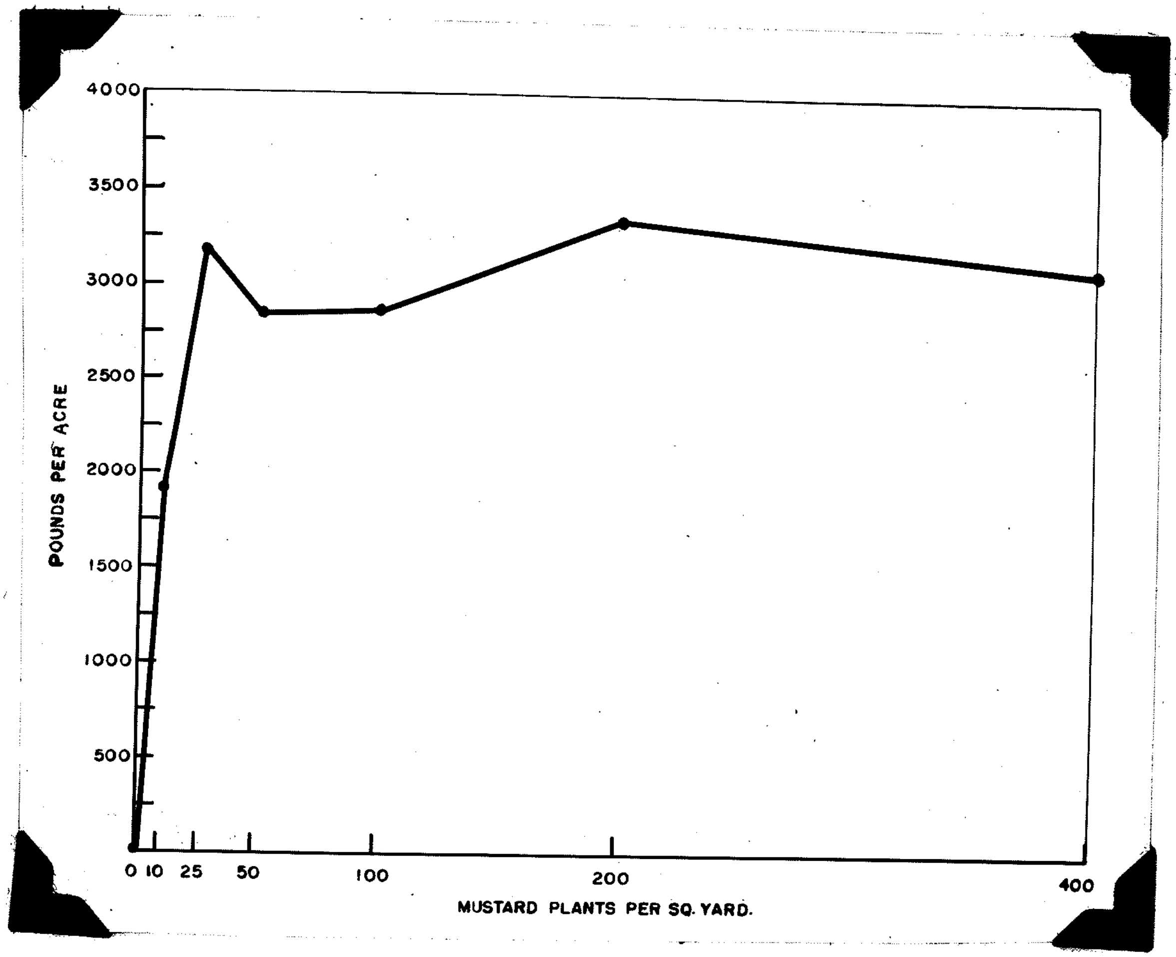

Figure 5 Total dry weight of mustard plants at various levels of density.

2. Reaction of Wheat to Various Populations of Wild Mustard and the Effect of Their Removal with 2,4-D

Number of culms per plot

Field observations made during the growing season suggested that the density of mustard population affected tillering. This was checked by counting the number of culms per plot and the results are shown in Figure 6. The average number of culms per plot was found to decrease with increase in mustard population, the differences at the different levels being significant. The removal of weeds 20 days after emergence did not induce a significant increase in the number of tillers. Apparently, the number of tillers was determined prior to treatment.

It has been reported already that weeds affect the degree of tillering in cereals (2, 22, 23). Cereal crops grown on weedy land produced less tillers than those on weed-free land, and in one case, it was shown that the number of wheat culms produced per unit area decreased proportionately with increase in the weed density (5). These findings agree in general with those from the present investigation.

The competition between mustard and wheat plants for soil moisture probably influenced the degree of tillering. Soil moisture was very inadequate at seeding time. The total precipitation received during the months of April and May was only 0.38 inches, while the total received during the interval between seeding (May 31) and time of treatment (June 21) was 4.77 inches. Of this latter amount

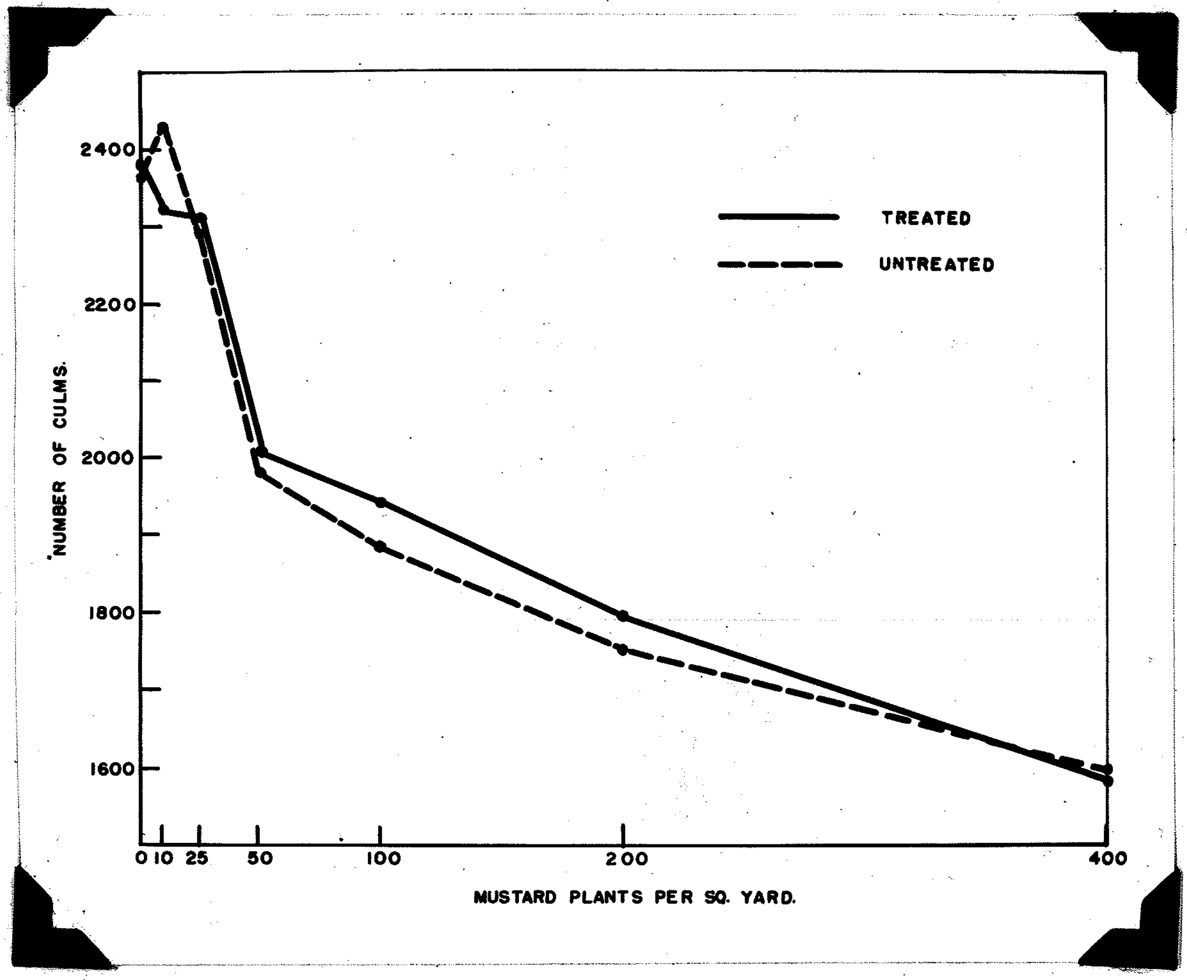

Figure 6 Average number of culms in treated and untreated plots at the various levels of mustard population.

2.80 inches were received only four days before spraying.

Yield of straw

The amount of growth in the wheat plots was determined by weighing the straw at harvest time. The yields are shown in Figure 7. The yield of straw declined as the number of mustard plants per square yard increased, and the differences between the plots with different levels of mustard density were significant. Spraying the plots with 2,4-D did not affect the amount of straw.

In the sprayed plots, the decline in straw weight with increase in mustard population suggests that the plots with fewer culms did not compensate for their reduced numbers by producing larger plants and thus increase the total yield. Soil moisture was adequate from the time of spraying to harvest, for 5.29 inches of rain fell during this period. This suggests that the number of tillers, not the amount of soil moisture determined the yield of straw.

The absence of a significant increase in straw yield after the removal of weeds suggests that soil moisture was adequate in all the plots to support the weeds and the crop. It may be plausibly assumed that had soil moisture not been adequate, the yields of straw from the unsprayed plots would have been lower than they were and that the difference between yields from the unsprayed and sprayed plots would have been greater.

Yield of grain

The trends observed for the number of culms per plot and the straw yields were also found in the yields of

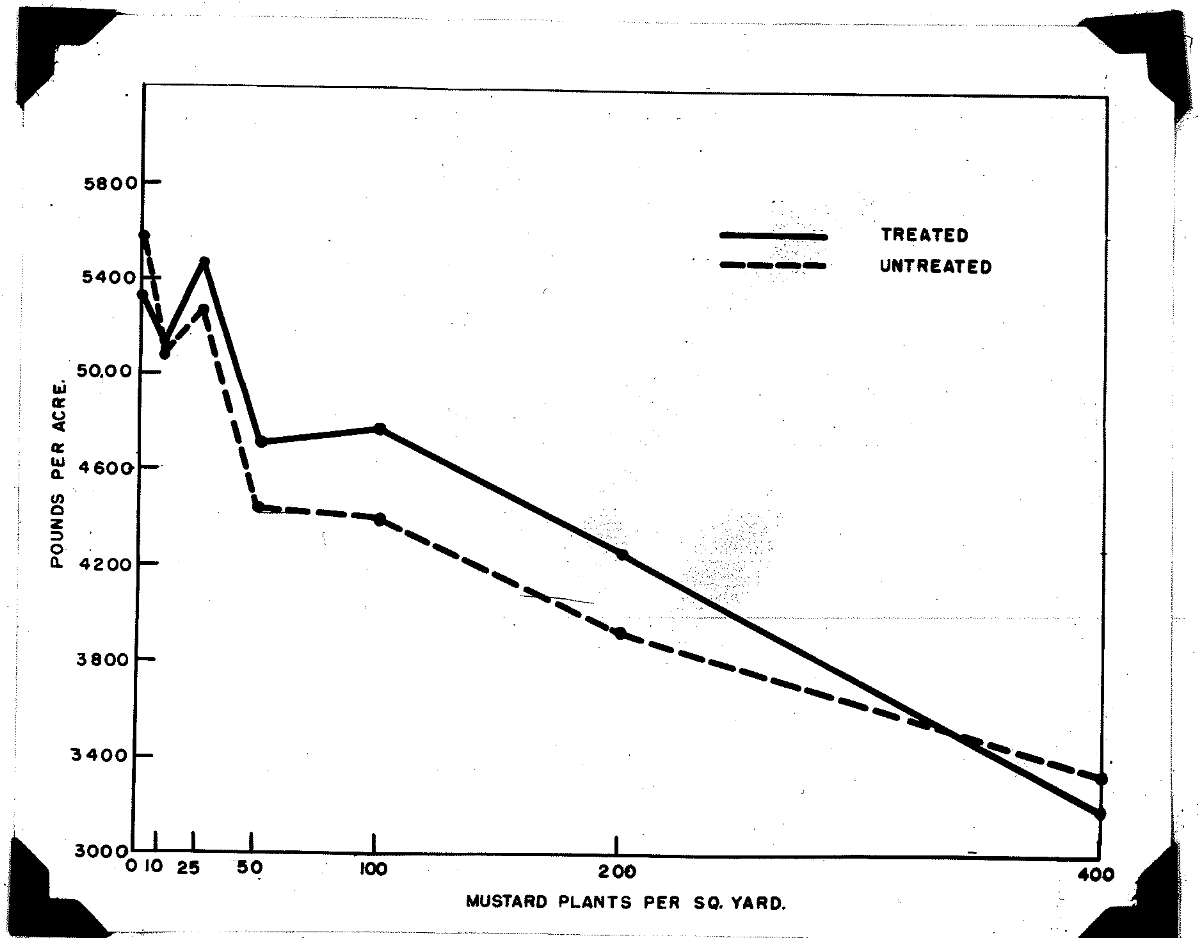

Figure 7 Average yields of straw in treated and untreated plots at the various levels of mustard population.

grain. The results obtained are shown in Figure 8. In general, the yield of wheat decreased as the density of mustard increased. Although differences in the population of weeds in the plots were found to cause significant differences in yield, spraying the plots with 2,4-D to destroy weeds did not increase the yield significantly.

The difference between the yields of sprayed and untreated plots both at the 0 and 200 concentration levels is not significant.

It is difficult to account for the absence of an increase in yield of the plots where the mustard plants were killed by 2,4-D. Several factors may have led to this result but no definite reason can be given. High soil moisture in the plots between spraying and harvest may be partly responsible and delayed spraying may be a factor. Originally it was intended to apply the chemical when the wheat was in the 3-leaf stage of growth but wet weather delayed spraying until the 5-leaf stage was reached. Possibly, if 2,4-D had been applied earlier, the number of culms might have increased, thereby producing a higher yield in the treated plots.

The various mustard plant densities did not significantly affect the 1000-kernel weight, commercial grade or protein content of the grain. The bushel weight

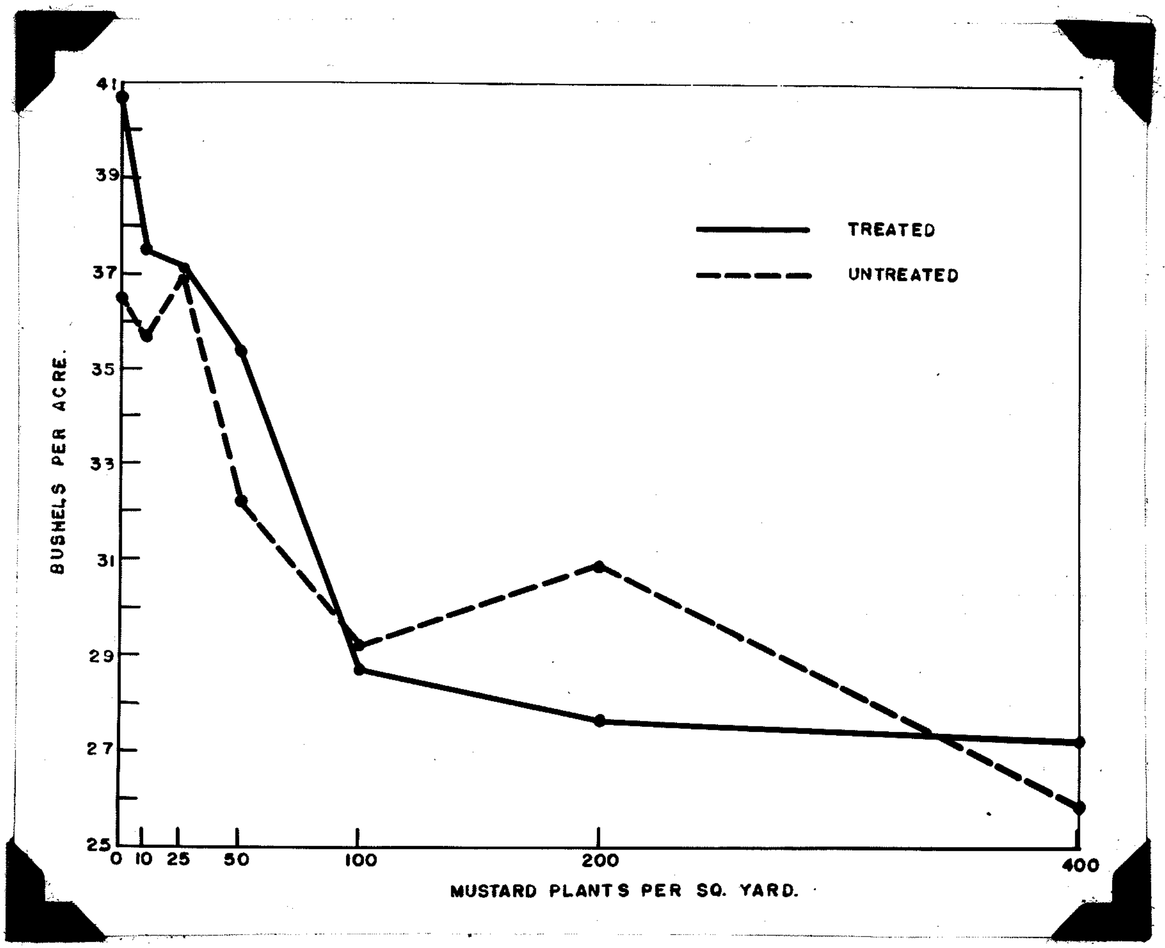

Figure 8 Average yield of wheat in treated and untreated plots at the various levels of mustard population.

was significantly higher in the weedy plots but there was no differential response to weed density. Treatment with 2,4-D did not influence the bushel weight, 1000-kernel weight or commercial grade but it increased the protein content significantly. These results re: protein content agree with those of Erickson et al (14).

Total dry weight of mustard plants

Field observations indicated a reduction in the growth of mustard as the number per square yard increased. It was evident that wheat could compete more successfully with mustard than could flax when comparisons were made between the two experiments in the field. This observation was substantiated by measurement of the dry weight of mustard and the trend is shown in Figure 9. In general, the total weight of weeds steadily increased as the number of mustard plants per square yard increased. This trend was quite different from the one found where mustard was in association with flax. Competition from wheat at the lower mustard densities prevented the mustard plants from producing as much dry matter as they did at the higher densities.

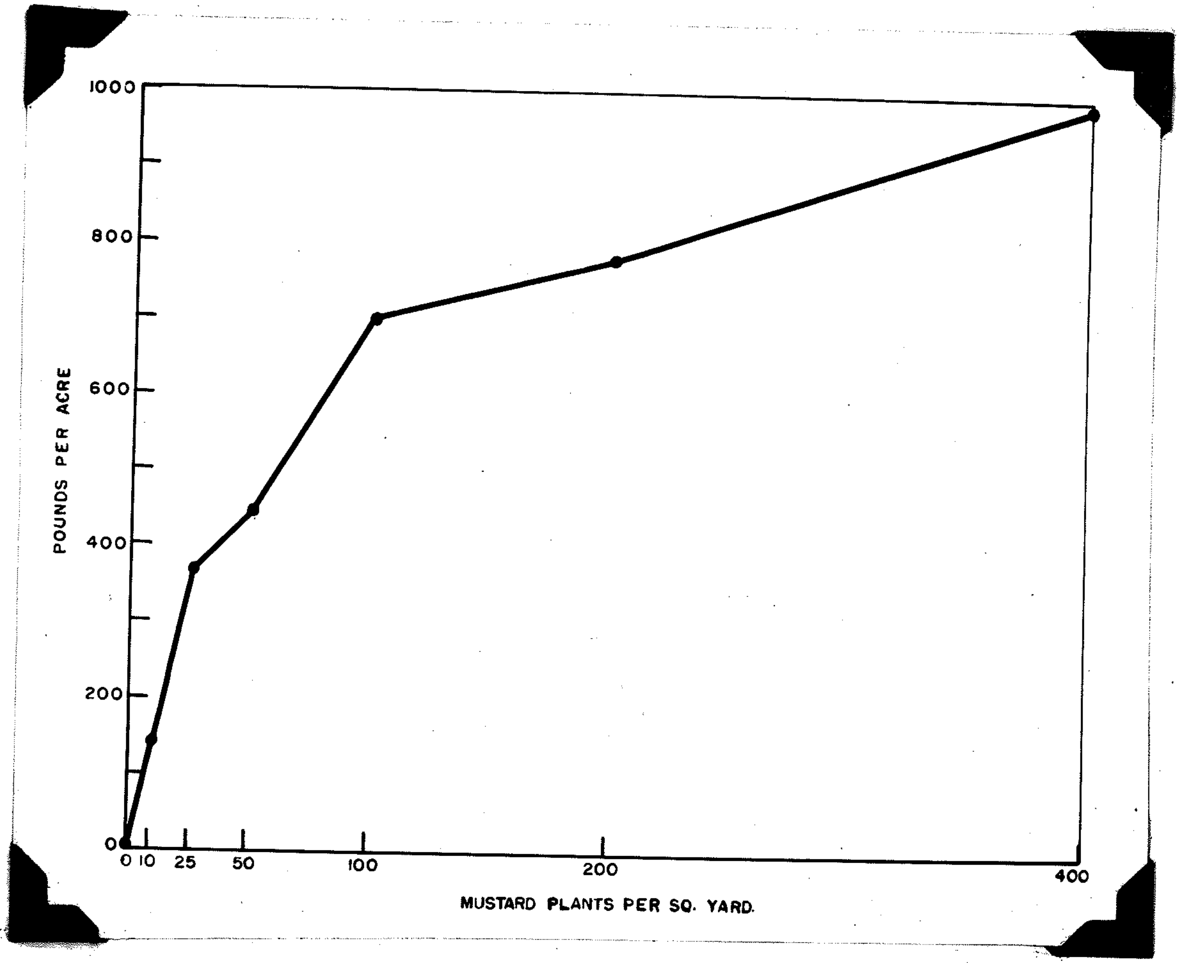

Figure 9   Total dry weight of mustard plants at various levels of density.

The early competition between mustard and wheat was of paramount importance with respect to the final outcome of the competition between the two species. Competition first resulted in a reduction in tillering of wheat. Tillering decreased as the mustard density increased; and the straw and grain yields followed the same general trend.

The destruction of mustard by 2,4-D did not significantly increase tillering, nor the yield of grain and straw. Abundant soil moisture and delayed spraying probably led to this result.

Godel (22) found that the yield of cereals growing on weedy land was higher at high rates of seeding than at low rates. Heavier than normal seeding rates reduced the number of tillers per plant but increased the total number of culms per unit of area above that obtained with lighter seeding rates. It would seem, therefore, that if it was possible to spray wheat early in the season, to shorten the duration of early weed competition, an increased seeding rate might not be required. However, wheat plants at early stages of growth are usually damaged by 2,4-D treatment (27).

The results of this study suggests that spraying wheat at the 5-leaf stage of growth to control wild mustard does not significantly increase the yields of grain. This holds for all the weed densities. The injury to wheat from competition between the two species occurred before spraying. Early competition seems to be more important in the case of wheat than in flax. After having been sprayed, flax has the power to recover its yielding ability in part, by top branching, but with wheat, tillering occurs early in the season.

SUMMARY AND CONCLUSIONS

Dakota flax and Lee wheat were sown alone or in association with plants of wild mustard (*Brassica arvensis* (L.) Rabenh.) in uniform populations ranging from ten to 400 plants per square yard. When the flax plants were 2-3 inches high and the wheat plants were in the fifth-leaf stage of growth, the plots were sprayed with 2,4-D butyl ester at acid equivalent rates of four ounces per acre for flax and six ounces per acre for wheat. In the flax experiment, the total number of plants, main branches per plot and seed bolls per plant were determined, as well as the yield of straw and seed, bushel and 1000-kernel weight, commercial grade, oil content and iodine number; while in the case of wheat, a determination was made of the number of culms per plot, yield of grain and straw, bushel and 1000-kernel weight, and the grade and protein content of the seed. Also, for flax and wheat, the total dry weight of the mustard plants was determined for each plot. All these determinations were made at or after the maturity of the two crops.

The competition provided by wild mustard caused a serious reduction in the vigor of flax and wheat. Basal branching of flax and tillering of wheat were reduced by mustard competition during the interval between emergence and time of spraying. In the case of flax, this reduction in basal branching was carried through to maturity and the number of seed bolls per plant and yields of straw and seed were adversely affected. Removal of weeds with 2,4-D significantly increased basal branching, seed bolls per plant and straw and grain yields. With wheat, the yields of straw and grain followed the same trends as that found for tillering (number of culms per plot) and the removal of weeds with 2,4-D did not increase tillering, straw and grain yields. It may be concluded that early competition with wild mustard was very important in the growth of these two crops and that spraying for mustard control should begin as early in the season as possible to shorten the duration of early competition.

The average number of plants per plot, bushel weight, commercial grade, oil content and iodine number of flax, and the 1000-kernel weight and grade of wheat were not significantly affected by the weeds or by 2,4-D. The 1000-kernel weight of flax and bushel weight of wheat were significantly increased by the mustard plants in the weedy plots.

The yields of dry mustard plants at harvest time in the two crops showed that flax offered less competition with wild mustard than wheat.

A yield reduction of 2.7 bushels per acre was suffered when weed-free flax was sprayed with 2,4-D, but in spite of this loss, highly significant yield increases were obtained when each of the mustard populations were removed.

These experiments indicate that even a population of 10 mustard plants per square yard in flax warrants the expense of chemical treatment. However, control of the wild mustard populations in the wheat by 2,4-D did not result in an increase in yield.

Since other investigators have shown that spraying of susceptible weeds in wheat has generally given yield increases, this study should be repeated and expanded in order to take account of varying moisture conditions and treatment, at somewhat earlier growth stages.

ACKNOWLEDGEMENTS

This study was made possible by Canadian Industries Limited fellowships for which the author wishes to express his appreciation.

Grateful acknowledgement is extended to: Dr. P. J. Olson, Professor and Head of the Division of Plant Science, for his continual guidance and assistance; Dr. S. B. Helgason, Assistant Professor of Plant Science for helpful suggestions throughout the study; Dr. J. E. Machacek, Senior Plant Pathologist, Dominion Laboratory of Plant Pathology, Winnipeg, for reading and making helpful suggestions in the manuscript; Dr. J. A. Anderson, Chief Chemist, Grain Research Laboratory, Board of Grain Commissioners, for making the chemical determinations on wheat and flax seed reported in this study; and to Mr. H. R. Hikida for his aid in the preparation of photographs.

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APPENDIX

TABLE I

The reaction of Dakota flax to various concentrations of wild mustard and to their removal with 2,4-D butyl ester

Character Studied	Treat. vs Untreated	Mustard plants per square yard: 0	10	25	50	100	200	400	Ave.
Number of flax plants per plot	T	1139.7	1301.5	1342.5	1235.5	1130.5	1132.7	1080.2	1194.7
	U	1236.0	1290.2	1231.5	1277.5	1087.5	1152.0	809.5	1152.3
	Ave.	1187.9	1295.9	1280.5	1256.5	1109.0	1142.4	944.9	
Number of main branches per plot	T	1500.2	1602.7	1461.2	1368.7	1205.5	1221.7	1153.0	1359.0
	U	1608.5	1332.0	1219.0	1278.2	1089.0	1153.5	948.7	1232.7
	Ave.	1554.4	1467.4	1340.1	1323.5	1147.2	1187.6	1050.9	
Number of seed bolls per plant	T	12.9	8.9	11.0	10.3	10.5	9.8	11.4	10.7
	U	15.4	4.8	4.2	3.7	3.4	2.3	2.3	5.2
	Ave.	14.2	6.9	7.6	7.0	6.9	6.1	6.9	
Yield of straw in pounds per acre	T	2410.7	2040.9	2087.1	1855.3	1624.7	1637.3	1508.8	1880.7
	U	2651.7	1357.4	1007.9	960.3	657.5	623.7	559.3	1116.7
	Ave.	2531.2	1699.1	1547.5	1407.8	1141.1	1130.5	1034.1	
Yield of linseed in bushels per acre	T	19.3	17.7	17.1	16.6	15.3	13.7	11.6	15.9
	U	22.0	8.1	6.2	5.9	3.6	3.2	1.7	7.3
	Ave.	20.7	12.9	11.6	11.2	9.5	8.4	6.7	
Weight of seed per bushel	T	58.4	58.4	58.2	57.8	58.2	56.2	57.5	57.8
	U	58.4	58.6	59.2	58.1	59.4	58.7	58.5	58.7
	Ave.	58.4	58.5	58.7	58.0	58.8	57.5	58.0	
1000-kernel weight	T	5.7	5.8	5.8	5.6	5.7	5.8	5.8	5.7
	U	5.7	6.0	6.0	6.1	6.1	6.2	6.0	6.0
	Ave.	5.7	5.9	5.9	5.8	5.9	6.0	5.9	
Oil content of seed	T	41.4	41.6	41.5	41.5	41.6	41.1	41.0	41.4
	U	41.4	41.7	42.1	41.8	41.1	41.3	41.1	41.5
	Ave.	41.4	41.6	41.8	41.6	41.3	41.2	41.0	
Iodine number of oil	T	187.0	190.0	190.0	190.0	190.0	189.0	189.0	189.3
	U	190.0	188.0	190.0	190.0	190.0	191.0	190.0	189.7
	Ave.	188.5	189.0	190.0	190.0	190.0	190.0	189.5	
Dry weight of weeds	U	0.0	1920.6	3182.9	2840.3	2861.5	3343.8	3089.5	
Grade *									

* All samples graded 1 C. W.

Note: Least significant differences appear in Table II.

TABLE II

Table of least significant differences for flax experiment

Character	Level of significance (%)	Concentrations	Concentration at the same treatment level	Treatments T vs U	Interaction T x C	Treatments at the same concentration level
Number of flax plants per plot	5	*	*	*	*	*
	1	*	*	*	*	*
Number of main branches per plot	5	282.7	244.5	7.5	*	396.1
	1	*	335.7	10.3	*	538.9
Number of seed bolls per plant	5	2.9	2.2	0.4	1.4	1.0
	1	3.9	3.0	0.5	2.0	1.4
Straw yields in pounds per acre	5	410.6	451.8	100.9	377.7	267.1
	1	563.1	618.7	137.3	513.9	363.3
Seed yields in bushels per acre	5	2.6	2.9	1.1	4.4	3.1
	1	3.6	3.9	1.6	6.0	4.3
Weight per bushel	5	*	*	*	*	*
	1	*	*	*	*	*
1000-kernel weight	5	*	*	0.2	*	*
	1	*	*	0.2	*	*
Grade of seed	5	*	*	*	*	*
	1	*	*	*	*	*
Oil content	5	*	*	*	*	*
	1	*	*	*	*	*
Iodine number	5	*	*	*	*	*
	1	*	*	*	*	*

* Difference not significant at level indicated.

Note: Mustard plant yields not statistically analyzed.

TABLE III

The reaction of Lee wheat to various concentrations of wild mustard plants and to their removal with 2,4-D butyl ester

Character Studied	Treat. vs: Untreated	Mustard plants per square yard: 0	10	25	50	100	200	400	Ave.
Number of culms per plot	T	2376.0	2345.0	2311.0	2003.0	1941.0	1793.0	1583.0	2050.0
	U	2369.0	2428.0	2290.0	1979.0	1881.0	1750.0	1597.0	2042.0
	Ave.	2372.0	2386.0	2301.0	1991.0	1911.0	1772.0	1590.0	
Straw yield in pounds per acre	T	5331.5	5141.9	5489.8	4705.5	4794.2	4263.4	3208.4	4704.9
	U	5574.6	5083.6	5347.9	4431.3	4399.7	3926.5	3364.1	4468.1
	Ave.	5453.0	5112.8	5418.8	4568.4	4596.9	4094.9	3286.3	
Seed yield in bushels per acre	T	40.7	37.5	37.1	35.3	28.7	27.6	27.2	33.4
	U	36.5	35.7	37.0	32.2	29.2	30.9	25.9	32.5
	Ave.	38.6	36.6	37.0	33.8	28.9	29.3	26.5	
Bushel weight	T	62.9	62.9	62.3	63.2	63.5	63.3	64.1	63.2
	U	63.5	63.8	63.5	63.3	64.6	64.5	64.5	64.0
	Ave.	63.2	63.4	62.9	63.2	64.1	63.9	64.3	
1000-kernel weight	T	30.8	32.3	32.2	32.4	36.4	35.5	35.0	33.5
	U	32.6	34.1	32.6	35.8	33.2	35.0	36.0	34.2
	Ave.	31.7	33.2	32.4	34.1	34.8	35.2	35.5	
Protein content of the grain	T	12.5	12.9	12.7	13.7	12.9	13.4	13.4	13.1
	U	12.7	12.1	12.4	12.6	11.3	13.3	12.5	12.4
	Ave.	12.6	12.5	12.5	13.1	12.1	13.3	12.9	
Grade	T	3.0	3.0	4.0	3.0	3.0	3.0	3.0	3.1
	U	4.0	3.0	3.0	4.0	2.0	3.0	3.0	3.1
	Ave.	3.5	3.0	3.5	3.5	2.5	3.0	3.0	
Dry yield of weeds	U	0.0	138.8	364.0	439.5	712.0	781.7	987.6	

Note: Least significant differences appear in Table IV.

TABLE IV

Table of least significant differences for wheat experiment

Character	Level of significance (%)	Concentrations	Concentration at the same treatment level	Treatments T vs U	Interaction T x C	Treatments at the same concentration level
Number of culms	5	254.9	247.2	*	*	*
per plot	1	349.6	338.3	*	*	*
Straw yields in	5	994.4	814.6	*	*	*
pounds per acre	1	1363.8	1118.6	*	*	*
Yield in bushels	5	5.9	7.8	*	*	*
per acre	1	8.1	10.8	*	*	*
Weight per	5	*	*	0.7	*	*
bushel	1	*	*	*	*	*
1000-kernel	5	*	*	*	*	*
weight	1	*	*	*	*	*
Protein content	5	*	*	0.6	*	*
of the grain	1	*	*	*	*	*
Grade of seed	5	*	*	*	*	*
	1	*	*	*	*	*

* Difference not significant at level indicated.

Note: Mustard plant yields not statistically analyzed.