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THE RESULTS OF HERBICIDE AND CULTURAL
TREATMENTS ON WEED CONTROL AND THE
YIELD OF CRANBERRY, NAVY AND KIDNEY BEANS

Thesis for the Degree of M. S.
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THE RESULTS OF HERBICIDE AND CULTURAL TREATMENTS
ON WEED CONTROL AND THE YIELD OF CRANBERRY,
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By

Lawrence Eugene Foote

AN ABSTRACT

Submitted to the College of Agriculture
Michigan State University of Agriculture and
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Department of Farm Crops

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L. E. Foote

ABSTRACT

Twelve different chemical and cultural weed control treatments were applied to cranberry, navy and kidney field beans. Kloben, Neburon, CIPC and DNBP treatments generally failed to control weeds at the application rates used and produced reduced yields. The rotary hoe and post-emergence shield treatments produced intermediate results. CDAA and EPTC treatments generally had fair weed control with yields equal to the checks. CDAA showed some bean plant injury but plants recovered. The untreated check plots received three cultivations; weed control was fair and yields were equal to any of the other treatments.

No direct differences were observed as the result of the use of the different types of beans. Under weather conditions favorable to both beans and weeds, competition from the bean plants reduced weed populations about 50 per cent. Nut grass was less competitive than other weeds under the climatic conditions encountered. Comparisons of high and low yielding plots showed bean plant, broadleaved weed and grassy weed populations to be factors in yield. Yield and total weed population showed an inverse relationship for all treatments.

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THE RESULTS OF HERBICIDE AND CULTURAL TREATMENTS ON WEED CONTROL AND THE YIELD OF CRANBERRY, NAVY AND KIDNEY BEANS

INTRODUCTION

Field beans is one of the leading crops in Michigan. One of the largest problems involved in bean culture is weed control. In the past, mechanical methods have been the most successful in controlling weeds. However, the farmer may be prevented from cultivating when it is most needed by rainy weather, wet ground or the pressing needs of other work. Cultivating at the wrong time may injure the bean plants or increase the spread of disease in the bean fields.

In recent years chemical weed control has had considerable publicity. However, adoption of chemical weed control practices in bean culture has been rather slow. This has been due to (1) uncertainties involved in the use of the chemicals, (2) the constant introduction of new and untried chemicals, (3) the cost of the chemicals, and (4) the cost of equipment for application of the chemicals.

This research was conducted to evaluate certain chemicals, and ways of application for field control of weeds.

REVIEW OF LITERATURE

Antognini et al (1) found that EPTC at the rate of 4 pounds per acre gave good seasonal control of yellow nut grass in snap and field beans. They (2) also found that a disc, spike tooth harrow or rototiller gave excellent results when used to incorporate EPTC into the soil prior to seeding. Collins (3) in Eastern Canada, using EPTC at the rates of 6 and 8 pounds per acre, controlled smartweed and rough pigweed in snap beans without injury to the bean plants. Dabbs and Forsberg (4) had good early season control on rough pigweed and shepherds purse using EPTC at 5 pounds per acre. There was no injury to the bean plants. Dawson and Bruns (5) used EPTC at 6 and 9 pounds per acre, resulting in excellent season-long control of annual grasses and broadleaved weeds. Yields of beans were equal to weed free checks. EPTC at 3 pounds per acre gave good but not complete control. Furtick (6) in work on yellow nut grass, found indication that EPTC could be used for selectively controlling this weed in crops such as field beans. Sailak (13) found that EPTC at 5 and 10 pounds per acre, effectively controlled nut grass in beans. Sexsmith (14) used EPTC at 4 and 6 pound per acre rates. Greenfoxtail was 80 per

cent controlled without injury to beans. Szabo and Gould (17) applied both liquid and granular EPTC at the rates of 1, 2, 4, and 6 pounds per acre as a pre-emergence treatment on pinto beans. Weed control ranged from 61 per cent at the 1 pound rate to 90 per cent at the 6 pound rate, for the liquid and 45 per cent to 89 per cent for the granular.

In all cases reported above, the researchers applied the chemical on the surface and worked it into the soil, before planting the crop.

Hemphill (7) used DNBP at 4 pounds per acre and CDAA at 8 pounds per acre on green beans. Resulting yields of green beans were equal to the untreated plots. Weed control was satisfactory. Marshall, Bayer and Robinson (8) found that hot dry weather following application caused DNBP to be inadequate. However, the use of CDAA resulted in good weed control without injury when applied to red kidney beans. Noll and Odland (9) by band applications of CIPC on lima beans increased yield with good weed control. They also increased weed control without bean plant injury, using DNBP. Noll and Odland (10) used pre-emergence band spraying on lima beans. The results showed significant increases in both yield and weed control on the treated plots with the chemicals they used.

Noll (11) using DNBP and neburon at 4 and 6 pound per acre rates on lima beans, had good weed control and increased yields which were significant at the one per cent level. Rahn (12) found that when seeding and treatment were followed by a period of hot weather and then a heavy rain, DNBP was likely to be first volatilized and then leached, resulting in poor weed control. Singletary and Herron (15) in pre-emergence treatments on lima and snap beans, using DNBP at 4 pounds per acre and CIPC at 6 pounds per acre, had good results as to weed control and yield. The DNBP treatment was the highest yielding treatment.

Wilson and Bruner (18) used shields over rows of snap beans and sprayed with fuel oil. Results were good weed control without much injury to the bean plants in most cases.

Staniforth and Weber (16) found that weeds reduced soybean yields 10 per cent. Foxtail reduced yield less than broadleaved weeds. Greater bean yield reductions were associated with adequate early season moisture and subsequent greater weed growth.

MATERIALS AND METHODS

Field tests in this study were conducted during the spring and summer of 1959 on the "Farm Crops Department" farm at East Lansing, Michigan. The soil in the area used was conover loam.

Three types of beans, cranberry, navy pea and kidney were seeded with a 2-row tractor mounted planter. The ground was in excellent condition at planting time. The seed used was of the untreated commercial type. The fertilizer used was 5-20-20 at the rate of 150 pounds per acre in the row.

The cranberry beans were planted on June 4th at the rate of 60 pounds to the acre. Liquid chemical treatments were applied in the evening of the same day to avoid wind drift. The granular bands were applied on the 6th of June.

The navy pea beans (Sanilac variety) were planted on the 10th of June at the rate of 30 pounds of seed to the acre. Liquid chemical treatments were applied the evening of June 11th and the granular treatments were applied on the 12th.

The kidney beans were planted on the 17th of

June at the rate of 80 pounds of seed to the acre. Liquid spray treatments were applied the evening of the 18th and the granular treatments on the 19th.

The treatments used are given in table 1. The liquid broadcast treatments were applied with a power-boom type sprayer mounted on a "Cub" tractor. The liquid band treatments were applied with a hand knapsack type sprayer. The granular bands were applied with a hand, "Gandy", spreader. The band granular treatments were 14 inches wide. The liquid bands were 9 inches wide. All band treatments were placed directly over the row. EPTC treatments were incorporated into the soil; the broadcast ones with a tractor mounted spike-tooth harrow and the band treatments with a wooden hand-rake.

The one post-emergence treatment was applied with the knapsack sprayer. A metal shield was fixed to the hand spray boom. The shield was suspended over the bean row. Spray nozzles on each side of the shield were left open.

The plots were 32 feet long and four rows wide, randomized and replicated four times on each type of bean. Rows were 28 inches apart.

Spring weed population counts were taken. A welded metal frame 20.5 inches by 7 inches, equaling one square foot was used. In the case of broadcast treatments,

Table 1. Chemical treatments used, amount of chemical used, form in which applied, and type of coverage used.

Name of chemical	Amount of chemical used per acre	Form in which applied	Coverage used
<u>Checks</u> (no chemical treatment)	none	-	-
Rotary hoe	none	-	-
<u>DNBP</u> "Premerge" Dinitro-o-sec-butylphenol 53% Alkanolamine salts of the ethanol & isopropanol series	3/lb.	liquid	full
<u>CDAA</u> a-chloro-N-N-diallylacetamide	4/lb.	liquid	full
<u>Kloben</u> active ingredient Neburon ((1-n-butyl-3-(3,4-dichlorophenyl)-1-methylureal)) 50%	2/lb.	liquid	full
<u>EPTC</u> "Eptam", ethyl di-n-propylthiolcarbamate	2/lb.	liquid	full
<u>EPTC</u>	3/lb.	liquid	full
<u>EPTC</u>	3/lb.	granular	band
<u>EPTC</u>	3/lb.	liquid	band
<u>EPTC</u> Plus "Dow General" 1-1/2 pounds per acre post-emergence-shield spray, It is Dinitro-o-sec-butylphenol 55%	3/lb.	liquid	band
<u>CIPC</u> Isopropyl-n-(3 chlorophenyl) carbamate	6/lb.	liquid	full
<u>Neburon</u> ((1-n-butyl-3-(3,4-dichlorophenyl)-1-methylureal)) 4%	2/lb.	granular	band
* <u>CDAA</u> 20%	4/lb.	granular	band
* <u>CIPC</u> 20%	6/lb.	granular	band

*Treatments made on kidney beans only.

the frame was placed crosswise of the row. For the band treatments, the frame was placed length-wise over the row and after the weed count was taken it was moved to the middle of the row, directly beside it and another count taken. Weeds were pulled as counted.

Three categories were used in classifying the weeds counted. They were (1) broadleaved, (2) annual grasses and (3) nut grass. The separate class was used for nut-grass due to its irregular distribution. Three counts were taken in each plot. In the case of the band treatments 3 counts were taken of the row and 3 of the middles. Row and middle counts were also taken on the checks. The weed count data are presented on the basis of weeds per square yard.

Weed counts were started in the cranberry beans on June 29th and finished by July 2nd. Counts in the navy pea beans were started on the 29th of June and finished by the 6th of July. Counts were taken in the kidney beans from July 2 to July 9th.

The major broadleaved weed present was *Amaranthus retroflexus* (rough pigweed). It occurred in large numbers in all three types of beans with very heavy infestation in the kidney bean plots.

The major grassy weeds were *Echinachloa crus-galli* L., (barnyard grass), *Digitaria sanguinalis* L.,

(crab grass), *Panicum capillare* L., (tickle grass), *Setaria lutescens* L., (yellow foxtail), and *Setaria viridis* L. (green foxtail). The foxtails were the most numerous but the greatest growth was made by the barnyard grass which reached heights as high as five feet. *Cyperus esculentus* L., (yellow nut grass) was the species of this plant found. It occurred in locally heavy infestations in some plots of the cranberry and navy beans but in only minor numbers in the kidney bean plots.

Rotary hoe treatments were applied with a tractor-mounted pick-up-type rotary hoe. Treatments were applied on June 18th to the cranberry beans, on June 23rd to the navy beans and on July 2nd to the kidney bean plots.

Cultivation was carried out with a one row cultivator mounted on a "Cub" tractor. It had been planned to cultivate the checks three times, the band treatments twice and the full coverage treatments once. However, the cultivation of the cranberry beans was delayed by wet weather. The cranberries all received their first cultivation between June 30 and July 2nd. All plots except the ones that were to receive the post-shield spray were cultivated. It was thought necessary to do this because of the large size of both the weeds and the bean plants. The cranberry beans received their last cultivation on July 8th.

The navy beans checks were cultivated on July 2nd, the checks and band treatments on the 8th of July and all treatments of the navy pea type were cultivated on July 16th.

The kidney bean checks were cultivated on July 3rd, the checks and band treatments on the 8th of July and all treatments on the 16th of July.

The post-emergence shield treatment was applied to the cranberry and navy pea bean plots on the 3rd of July and to the kidney bean plots on the 8th of July.

Visual ratings were taken of all the plots. A rating of 1 was assigned to a plot if no weeds were present and a rating of 10 to a plot if no beans were visible because of weeds.

Visual ratings were taken because it was thought that numbers of weeds alone might not prove to be an adequate index of the harm caused. This was because the weeds had grown very large and rank in some of the plots with reduced weed populations.

An area 15-1/2 feet long of the two center rows of each plot was harvested by hand pulling. The harvested area was equal to one 600th of an acre. The beans were placed in gunnysacks and put in a drier at a temperature of about 83 degrees for about 36 hours.

At the same time the beans were pulled, counts were taken of the number of bean plants pulled, the number of broadleaved weeds present in the 600th of an acre area as well as the numbers of grassy weeds and nut grass present. Weed population counts results for both the spring and fall are presented as a percentage of the different types and total weeds present in the checks. Treatments which showed 70 per cent or less weeds than the checks were considered to be at least partly effective. Treatments which had a 110 per cent or more weeds than the check were considered ineffective. Judgment was reserved on treatments which showed from 70 to a 110 per cent as many weeds as the checks.

The beans were threshed with an experimental plot thresher. Yields, in bushels per acre were calculated from the weight of cleaned seed from each plot. The average yield of the four plots, of each treatment, was then obtained.

Differences between mean yields necessary for significance are given for bushels per acre at the 5% level and 1% level of significance. Any difference less than the R.E. value (Range of Equality) may be considered not significant at that level. Any difference greater than the R.E. value may be considered significant at that level.

RESULTS AND DISCUSSION

Tables: Table 2 presents the climatic data. All visual ratings are presented in table 3. The spring and harvest time weed populations along with the yields of the cranberry bean treatments are presented in tables 4-5 and 6. The same data for the navy bean trials are presented in tables 7-8 and 9; and for the kidney bean treatments in tables 10-11 and 12. The effects of competition of bean plants on weed populations are presented in table 13. Table 14 in the results of the comparisons of high and low yielding plots of all bean types and chemical treatments.

Weed populations: The soil of the area used for all three types of beans in these trials had a very heavy infestation of weed seed. The period of hot dry weather before, (table 2), and of cool dry weather after planting of the navy beans may have favored the growth of the grassy weeds. This would help account for the high amount of these weeds in the navy bean trials, (tables 4-5-7-8-10-11). Nut grass is generally known as a "wet soil weed". The long dry period before and after the planting of the kidneys and the lateness of the season

could account for the lack of this weed in the kidney bean trials, (tables 10-11).

Bean types: No direct effect due to the use of different types of beans was observed. There was a very definite indirect effect. Each type of bean encountered a different set of climatic factors and a different part of the growing season; when the bean and weed plants were in the critical seedling stage. The climatic factors and the period of the growing season could account for the three different types of weed populations, the disease factor in the navy type and also the insect damage from the Mexican bean beetle which occurred in the cranberry beans. At least some of the chemical treatments behaved differently under the different climatic conditions that prevailed for each type of bean. These chemicals were DNBP, CDAA, and EPTC in the granular form.

Cranberry Bean Trials

Cranberry bean plots: Four of the cranberry plots were discarded because of planter failure. Five more of the cranberry bean plots were discarded because of severe injury resulting from residual effects of simazine application on corn which had been in the field the year before. In no case was more than one plot of any one treatment discarded.

Table 2. Climatic data. Daily temperature high-lows plus rainfall in inches. Temperature taken at Lansing Airport. Rainfall at Farm Crops Farm, East Lansing, Michigan.

Date	Temperature high	low	Rain	Date	Temperature high	low	Rain
June							
1	68	51	.75	19	79	45	-
2	69	44	-	20	82	53	-
3	80	46	-	21	84	46	-
4	81	51	-	22	74	55	.14
5	83	56	-	23	73	47	-
6	78	56	-	24	81	57	-
7	86	58	-	25	87	64	.36
8	88	64	-	26	89	68	.01
9	88	64	-	27	91	72	.14
10	87	63	-	28	92	74	-
11	80	65	-	29	89	62	-
12	84	61	.36	30	75	55	.64
13	65	47	-	Average	80	54.8	Total 2.4
14	72	39	-				
15	73	46	-	Average temperature for June			
16	77	47	-	67.4			
17	72	43	-	high	77.1		
18	73	45	-	low	57.6		
				Average rain for June			
				3.4			
				Average temperature for June, 1959			
				67.4			

The cranberry bean plots showed a more balanced weed population than either the navy bean area or the kidney bean field. Weed control measures were more visible. (Figures 1 and 2).

Visual ratings: EPTC treatments had the four best ratings in the cranberry beans (table 3). CDAA rated fifth. The checks and the rotary hoe treatments rated the same. CIPC, DNBP, Kloben, Neburon and the 2 pound per acre rate of EPTC had ratings that were poorer than the check. The visual ratings were best for all treatments in the cranberry beans.

In two cases with the cranberry bean trials, weeds were few but very large at harvest. One was the rotary hoe treatment which had a visual rating equal to the check, considerably less total weeds but yielded less than the check (tables 3-5-6). The other was EPTC at 3 pound-per-acre-full-coverage which had a better visual rating than the check, more weeds and yielded the most of any treatment.

Spring weed populations: Table 4 shows the results of spring weed population counts as a per cent of the check plot averages. The checks had a total of 116 weeds per square yard. Though this is a very high



Figure 1. EPTC 3 pounds per acre band-granular treatment on cranberry beans. Note good weed control. The visual rating of this plot was 2. The plot yielded 51.5 bushels of beans per acre.



Figure 2. DNBP 3 pounds per acre full-coverage treatment on cranberry beans. This plot had a visual rating of 9; beans are barely visible in foreground. The yield was 18 bushels per acre.

Table 3. Average visual ratings of all treatments for cranberry, navy and kidney beans.

Name of treatment	Average rating cranberry beans	Average rating navy beans	Average rating kidney beans
Checks	4	7.3	4.8
Rotary hoe	4	6.8	5.3
DNBP 3/1b/a. full-coverage	5	8.8	7.8
CDAA 4/1b/a. full-coverage	3.7	8.3	4.8
Kloben 2/1b/a. full-coverage	6.3	9.3	7.8
EPTC 2/1b/a. full-coverage	5.3	6	5
EPTC 3/1b/a. full-coverage	3.3	4.8	3.8
EPTC 3/1b/a. band-granular	3	9.5	3.3
EPTC 3/1b/a. band-liquid	2.8	8.3	4
EPTC 3/1b/a. band-liquid post-shield	3.3	7.5	4.8
CIPC 6/1b/a. full-coverage	5.8	8.3	6.3
Neburon 2/1b/a. band-granular	5	9.3	6
CDAA 4/1b/a. band-granular			4.5
CIPG 6/1b/a. band-granular			4.8

Table 4. Spring weeds counts-given as per cent of checks-for the cranberry type beans.

Name of treatment	Broadleaved per cent of checks	Grassy weeds per cent of checks	Nut grass per cent of checks	Total weeds per cent of checks
Checks (actual count per sq. yd.)	42	47	27	116
Checks-band weeds in row as per cent of weeds in middles	59	66	50	56
Rotary hoe	92	70	36	70
DNBP	60	68	242	110
CDAA	45	30	11	30
Kloben	125	103	333	162
EPTC 2/1b/a. full-coverage	59	103	242	130
EPTC 3/1b/a. full-coverage	43	68	44	54
CIPC 6/1b/a. full-coverage	157	119	25	111
EPTC 3/1b/a. band-granular	51	32	27	40
EPTC 3/1b/a. band-liquid	34	88	52	55
Neburon 2/1b/a. band-granular	105	111	106	109

weed population, it was the lowest number per square yard of check in any of the three types of beans used. Grassy weeds were the most numerous weed type in the checks.

EPTC 3 pounds per acre-liquid-band treatment showed the best control of the broadleaved weeds. It was followed by (2) EPTC 3 pounds per acre-full-coverage, (3) CDAA and (4) EPTC 3 pounds per acre-granular-band, all of which had less than 60 per cent as many broadleaved weeds as the checks. EPTC showed the best control of broadleaved weeds in the apring. CIPC, along with Kloben showed no control of broadleaved weeds.

CDAA gave the best control of annual grasses, having only 30 per cent as many as the checks. It was followed by (2) EPTC 3-pounds-per-acre-granular-band and (3-4) DNBP and EPTC 3-pounds-per-acre-full-coverage. It is noteworthy that EPTC had two of the treatments which showed control. CIPC and Neburon showed a lack of control.

CDAA gave the best control of nut grass having only 11 per cent as many as the checks. Other treatments showing some control were (2) CIPC, (3) EPTC 3-pounds-per-acre-band-granular, (4) rotary hoe, (5) EPTC 3-pounds-per-acre-full-coverage, and (6) EPTC 3-pounds-per-acre-liquid-band. Kloben, DNBP and EPTC 2-pounds-per-acre-full-coverage showed a lack of control.

As to over-all control CDAA had the best results with 70 per cent less weeds than the check. Other treatments which had considerably less weeds than the checks were (2) EPTC 3-pounds-per-acre-granular-band, (3) EPTC 3-pound-per-acre-full-coverage, (4) EPTC 3-pound-per-acre-liquid-band, and (5) the rotary hoe. Kloben, CIPC, and EPTC 2-pound-per-acre-full-coverage showed no control.

The weather (table 2), following treatment of the cranberry bean plots, was hot and dry. This was favorable for volatilization of the DNBP. However, it showed some control of both the broadleaved weeds and the grassy ones to the time of the spring population counts. But it showed a lack of control at harvest time.

It is hard to explain why the spring weed populations of the Kloben and neburon treatments were higher than the check. All weed population counts of the cranberry bean trials were taken within two days' time of each other. Weed counts were taken using only the two center rows of each plot. No counts were taken over the area that had been compacted by the tractor wheels.

All CDAA 4 pounds-per-acre-full-coverage plots in both the cranberry and navy bean trials showed considerable injury and burning to the bean plants in the early stages of growth. However, recovery was fast.

Also in at least the case of the navy bean plots recovery of the weeds was rapid.

Mature weed population at harvest: At harvest time the weeds present in the harvested area (600th of an acre) were counted, (table 5). The checks averaged 28 weeds per 600th-acre or 3.5 weeds per square yard. The percentage of broadleaved weeds in the check had dropped from 36 per cent in the spring counts to 19 per cent at harvest time. The drop in broadleaved weeds resulted in a higher relative percentage of grassy weeds in the checks at pulling time.

By fall no treatment showed any real control of broadleaved weeds. Only two treatments, EPTC 3-pounds-per-acre-liquid-band at 86 per cent of check and EPTC 3-pounds-per-acre-liquid-band-post-shield at 88 per cent of the check had less broadleaves than the untreated plots.

The least amount of grassy weeds were found in the EPTC 3-pound-acre-band-liquid treatment followed by the EPTC 3-pound-acre-band-granular, (3) the rotary hoe, (4) CDAA and (5) EPTC 3-pound-per-acre-band-liquid-post-shield; all of which had at least 30 per cent less grassy weeds than the check. Kloben, CIPC, and DNBP did not control annual grasses.

CDAA treatments had the least nut grass in the

Table 5. Mature weeds present at harvest time-given as a percentage of the checks. Cranberry bean type.

Type of treatment	Broadleaved weeds-per cent of checks	Grassy weeds per cent of checks	Nut grass per cent of checks	Total weeds per cent of checks
Checks-actual count for 600th/a.	45	15	8	28
Rotary hoe	175	51	25	67
DNBP 3/lb/a. full-coverage	131	156	188	160
CDAA 4/lb/a. full-coverage	113	67	17	61
Kloben 2/lb/a. full-coverage	188	198	173	191
EPTC 2/lb/a. full-coverage	406	96	100	155
EPTC 3/lb/a. full-coverage	125	69	171	108
CIPC 6/lb/a. full-coverage	197	143	78	135
EPTC 3/lb/a. band-granular	132	47	93	76
EPTC 3/lb/a. band-liquid	86	38	22	42
EPTC 3/lb/a. band-liquid-post-shield	88	98	63	86
Neburon 2/lb/a. band-granular	125	118	34	95

fall, as in the spring counts. Others with minor amounts of nut grass in the fall were (2) EPTC 3-pound-per-acre-band-liquid, (3) rotary hoe, (4) neburon, (5) EPTC 3-pounds-per-acre-band-liquid-post-shield, DNBP, Kloben, and EPTC 3-pound-full-coverage had high populations of nut grass.

EPTC 3-pounds-per-acre-band-liquid, CDAA, and the rotary hoe treatments all had more than 30 per cent less total weeds than the check. CIPC, DNBP, EPTC 2-pound-per-acre-full-coverage, and Kloben all failed, in general, to control weeds.

There is a possible explanation for the large relative increase from spring to fall, of broadleaved weeds in the EPTC 2-pounds-per-acre-full-coverage plots, (tables 4-5). All EPTC plots showed many stunted weeds. In the case of this smaller application recovery may have been faster and more complete. Also there may have been many germinated weed seed present which due to the stunting effect had not appeared yet. The rains came about the time of the weed counting in the spring, (table 2), and could have leached the chemical. EPTC 3 pounds-per-acre-band-granular showed somewhat the same results though not as large a change. In no case was any injury to the bean plants observed as a result of the EPTC treatments.

Yield results: Five treatments yielded as much

or more than the check. They were CDAA, and all the EPTC treatments which used the 3 pounds-per-acre rate. All the rest yielded at least 10 per cent less and two treatments yielded over 20 per cent less. They were CIPC and Kloben.

No trend could be established involving the number of bean plants harvested per plot as a percentage of the number harvested from the check plots. Spring weed count ratings, fall weed ratings and yield showed close relationship for five treatments; DNBP, CDAA, Kloben, EPTC 2 pounds-per-acre-full-coverage, and EPTC 3 pounds-per-acre-band-liquid-post-shield. In general all cranberry bean plots were high yielding.

Navy Bean Trials

Navy bean plots: All navy bean plots had a very weedy appearance at harvest time. The bean plants became infected with root rot quite early and were unhealthy in appearance up to the time they became obscured by the weeds. The disease factor may have caused the bean plants to be much less competitive and helped contribute to the high weed infestation. In observation of pulled bean plants from the alleyways at the time spring weed populations were taken, it appeared that about seven

Table 6. Yield results in bushels per acre, as percentage of check, plus average number of bean plants harvested per plot. Cranberry type trials.*

Type of treatment	Yield actual in bu/acre	Yield as a per cent of check	Number of plants harvested as a per cent of check
Check actual count	42.8	100.0	95
Rotary hoe	35.3	82.4	105
DNBP 3/lb/a. full-coverage	35.1	81.9	101
Kloben 2/lb/a. full-coverage	32.6	76.2	98
CDAA 4/lb/a. full-coverage	43.2	100.9	98
EPTC 2/lb/a. full-coverage	34.2	80.1	108
EPTC 3/lb/a. full-coverage	44.3	103.5	97
CIPC 6/lb/a. full-coverage	30.8	71.3	91
EPTC 3/lb/a. band-granular	42.2	98.9	99
EPTC 3/lb/a. band-liquid	40.5	94.6	90
EPTC 3/lb/a. band-liquid post-shield	43.0	100.5	100
Neburon 2/lb/a. band-granular	34.7	81.2	108

*No significant difference. This was partly due to the large number of discarded plots which decreased the number of replications.

out of ten plants were infected with the root rot. Even at harvest time the effect of the disease was apparent in the lack of roots on the pulled plants.

Visual ratings: The visual ratings of the navy beans were the poorest for all treatments when compared to the other types of beans. Only one treatment received a rating that was even fairly clean; it was EPTC 3-pounds-per-acre-full-coverage. Three treatments received ratings of over nine, which was very poor. This denotes the fact that in these plots no bean plants were visible at a casual glance.

The treatments which ranked 1-2 in the visual rating also ranked 1-2 as to yield, (tables 3-9). They did not always rank this way as to weed populations, (tables 7-8).

Spring weed populations: The spring weed population counts in the navy beans showed the most control by the chemical treatments in relation to the checks, (tables 4-7-10). All treatments had less total weeds and less broadleaved weeds than the untreated plots. The weather, (table 2), following treatment was cooler and so more favorable and chemicals showed better results on broadleaved weeds at this time, (table 7). The EPTC

Table 7. Spring weed counts as percentage of check for the navy bean plots.

Type of treatment	Broadleaved weeds-per cent of checks	Grassy weeds-per cent of checks	Nut Grass per cent of checks	Total weeds per cent of checks
Check-actual count per sq. yard	131	107	69	307
Check-row actual count per sq. yard	86	89	60	236
Rotary hoe	50	59	76	61
DNBP 3/lb/a. full-coverage	36	84	20	49
CDAA 4/lb/a. full-coverage	70	62	98	72
Kloben 2/lb/a. full-coverage	61	164	54	88
EPTC 2/lb/a. full-coverage	52	66	63	61
EPTC 3/lb/a. full-coverage	40	27	70	42
CIPC 6/lb/a. full-coverage	54	78	154	81
EPTC 3/lb/a. band-granular	62	40	45	49
EPTC 3/lb/a. band-liquid	79	81	66	77
Neburon 2/lb/a. band-granular	74	129	60	91

treatments all showed at least some control of nut grass at this time.

The check had an average population of all weed types totaling 307 per square yard. Broadleaved weeds numbering 131 were the most numerous. Counts in the check rows had a total average population of 236 per square yard of row, (a band 7 inches across).

DNBP with 36 per cent of the check broadleaved weeds and EPTC 3 pounds-per-acre-full-coverage with 40 per cent, gave considerably the best control of this type of weed. Eight of the ten treatments reduced the broadleaved weed population by 30 per cent or more.

EPTC 3 pounds-per-acre-full-coverage and EPTC 3 pounds-per-acre-band-granular, showed the most control over grassy weeds. Five treatments showed at least 30 per cent reduction in grassy weeds. Two treatments, Kloben and Neburon showed a complete lack of control for this type of weed.

Seven treatments showed a 30 per cent or more reduction in nut grass as compared to the checks. CIPC gave no control of nut grass.

EPTC 3 pounds-per-acre-full-coverage at 42 per cent followed by (2-3) DNBP and EPTC 3 pounds-band-granular with 49 per cent of the check, showed the most control

of the total weed population. Two other treatments reduced total weed population by more than 35 per cent. They were EPTC 2 pounds-per-acre-full-coverage and the rotary hoe. All treatments showed some reduction in total weed population over the checks. This was the only weed population count in all the trials where all the treatments had lower weed numbers.

Mature weed populations at harvest: Table 8 shows that total weeds in the checks were reduced to 6.2 weeds per square yard which is still quite a high population.

EPTC 3 pounds-per-acre-full-coverage and EPTC 3 pounds-per-acre-band-liquid-post-shield were the only treatments which had less broadleaved weeds than the check.

EPTC 3 pounds-per-acre-full-coverage was the only treatment with less grassy weeds than the check.

Treatments with more than a 35 per cent reduction of nut grass were DNBP, EPTC 3 pounds-per-acre-band-liquid and Kloben.

The check had the least total weeds, followed by (2) EPTC 3 pounds-per-acre-full-coverage, (3) rotary hoe, and (4) EPTC 2 pounds-per-acre-full-coverage. All other treatments had over 150 per cent more total weeds than the check.

Table 8. **Mature** weeds present at harvest time as a percentage of the check. Navy pea bean type.

Type of treatment	Broadleaved weeds per cent of checks	Grassy weeds per cent of checks	Nut grass per cent of checks	Total weeds per cent of checks
Checks-actual count per 600th/acre	12.3	21.3	16.3	
Rotary hoe	120	129	109	121
DNBP 3/lb/a. full-coverage	137	293	65	180
CDAA 4/lb/a. full-coverage	218	152	138	164
Kloben 2/lb/a. full-coverage	218	326	26	202
EPTC 2/lb/a. full-coverage	159	126	137	139
EPTC 3/lb/a. full-coverage	78	87	160	111
CIPC 6/lb/a. full-coverage	216	241	252	238
EPTC 3/lb/a. band-granular	192	209	82	163
EPTC 3/lb/a. band-liquid	216	283	65	198
EPTC 3/lb/a. band-liquid post-shield	82	174	125	136
Neburon 2/lb/a. band-granular	159	319	103	209

The fact that all treatments on the navy beans showed more weeds in the fall than the check can best be accounted for by the early cultivation which the checks received and the other treatments did not receive. This cultivation undoubtedly buried many small weeds.

Yields: In general the yields of the navy beans were low. This was due to the high weed population present and to a heavy infestation of root rot in this type of bean. The check yielded 22.6 bushels per acre, (table 9), and was the third highest yielding treatment. The first, second, fourth and fifth yielding treatments all had more bean plants than the check. Of the six lower yielding treatments only one had more plants than the check. There was a ten per cent drop in yield from the fifth highest yielding treatments to the sixth highest.

The lower bean plant population, in the lower yielding plots could have been caused by a combination of the disease factor, the dry weather and the heavy weed competition. This could have caused the death of some bean plants.

Two treatments, EPTC 3-pounds-per-acre-full-coverage and EPTC 2 pounds-per-acre-full-coverage yielded as much or more than the check. Both of these treatments had a higher bean plant and total weed population than

Table 9. Yield results for navy pea beans in bushels per acre, as percentage of check, plus average number of bean plants as a percentage of the check.*

Type of treatment	Yield actual in bu/acre	Yield as a per cent of check	Number of plants harvested as a per cent of check
Check-actual count	22.6		123
Rotary hoe	20.3	90.1	106
DNBP 3/lb/a. full-coverage	15.5	68.9	95
CDAA 4/lb/a. full-coverage	16.3	72.3	104
Kloben 2/lb/a. full-coverage	12.4	55.1	97
EPTC 2/lb/a. full-coverage	24.1	106.7	112
EPTC 3/lb/a. full-coverage	27.7	122.2	107
CIPC 6/lb/a. full-coverage	17.8	79.3	96
EPTC 3/lb/a. band-granular	15.3	67.9	95
EPTC 3/lb/a. band-liquid	16.8	74.6	96
EPTC 3/lb/a. band-liquid post-shield	22.1	98	109
Neburon 2/lb/a. band-granular	12.8	57	97

*R.E. 5% = 6.7 bushels.

R.E. 1% = 8.9 bushels.

the check. EPTC (2 pound rate) had more of all three separate types of weeds than the check. However, EPTC 3 pounds-per-acre-full-coverage had less broadleaved and grassy weeds than the check but many more nut grasses. Its yield increase of 122 per cent of the check equals 5.1 more bushels per acre. Four treatments yielded less than 70 per cent of the check. They were DNEP, EPTC 3 pound-per-acre-band-granular, Kloben and Neburon. These four treatments had very high infestations of annual grasses.

In general, treatments which had low populations of nut grass had high populations of other weeds and treatments which had lower populations of other weeds had higher populations of nut grass. Nut grass did not seem to stand the competition from the high populations of other weeds.

This was not true for CIPC and CDAA treatments, both of which had high populations of all three weed types, (table 9).

DNEP had shown good control of nut grass and broadleaved weeds in the spring counts, (table 7), but by harvest time it had the second heaviest infestation of grassy weeds and was the fourth lowest yielding treatment, (tables 8-9).

None of the band treatments which received two cultivations yielded very well in these trials, (table 9).

Kidney Bean Trials

Visual ratings: For visual ratings of the kidney bean plots, see table 3. The kidney beans contained a heavy infestation of "rough pigweed". There were few grassy weeds and only minor numbers of nut grass. The three best ratings were EPTC treatments. DNBP and Kloben had by far the poorest ratings. The visual ratings were better for all treatments than in the navy beans and poorer than in the cranberry beans.

Spring weed populations: Broadleaved weeds out-numbered the other weeds combined by more than two to one in the kidney beans. The checks had a total population of 159 weeds per square yard, (table 10).

EPTC treatments gave the best control of the broadleaved weeds. DNBP, CIPC, Kloben and Neburon again showed no control.

CDAA, EPTC, CIPC and the rotary hoe treatments had more than 35 per cent less grassy weeds than the check. Neburon again showed a lack of control. Nut grass numbers were so minor as to be of no importance in the kidney bean trials.

EPTC, 3 pounds-band-granular, ranked first as to control of total weeds with only 23 per cent as many as the checks. This was the only granular treatment to

Table 10. Spring weed population counts as percentage of checks for the kidney beans.

Type of treatment	Broadleaved weeds per cent of checks	Grassy weeds per cent of checks	Nut grass per cent of checks	Total weeds per cent of checks
Checks-actual count per sq. yard	116	41	1.5	159
Checks-row actual count per sq. yd.	131			170
Rotary hoe	100	64	200	92
DNBP 3/1b/a. full-coverage	115	87	400	110
CDAA 4/1b/a. full-coverage	87	17	200	69
Kloben 2/1b/a. full-coverage	130	104	400	126
EPTC 2/1b/a. full-coverage	95	26	-	78
EPTC 3/1b/a. full-coverage	66	29	100	57
CIPC 6/1b/a. full-coverage	132	33	2.3*	106
EPTC 3/1b/a. band-granular	22	21	2.3*	23
EPTC 3/1b/a. band-liquid	40	110	3*	61
Neburon 2/1b/a. band-granular	123	183	6.3*	172
CDAA 4/1b/a. band-granular	76	49	3*	75
CIPC 6/1b/a. band-granular	80	73	-	78

*Equals actual count.

rank first in any trial. Other treatments which had less than 70% of the weeds in the checks were the 3 pounds-per-acre rates of EPTC and the CDAA liquid-full-coverage. Kloben and Neburon gave no control. DNBP proved ineffective as the temperature was higher and there was some rain, (table 2), following treatment.

Mature weed populations at harvest: These weed population count results are presented in table 10. The checks had the third lowest broadleaved weed population and a total weed population of 2.5 per square yard. Only two treatments had less broadleaved weeds at harvest time than the check. They were EPTC 3 pound-per-acre-band-granular (58 per cent of check) and EPTC 3 pounds-per-acre-band-liquid (81 per cent of check). All other treatments had more than 110 per cent as many broadleaved weeds as the checks.

EPTC and CDAA treatments showed reductions of more than 30 per cent from the grassy weeds of the checks. Neburon and Kloben had more grassy weeds than the check.

EPTC 3 pounds-per-acre-band-granular gave by far the best total weed control in the kidney plots. It had 38 per cent as many total weeds as the checks. No other treatment reduced the total weed population by as much as 30 per cent. Nine treatments had over 115

Table 11. Mature weeds present at harvest time as a per cent of the checks. Kidney bean type.

Type of treatment	Broadleaved weeds per cent of checks	Grassy weeds per cent of checks	Nut grass per cent of checks	Total weeds per cent of checks
Check-actual count per 600th/acre	11	9	0	20
Rotary hoe	133	100	.8*	122
DNBP 3/lb/a. full-coverage	451	94	1.8*	297
CDAA 4/lb/a. full-coverage	121	8	.5*	72
Kloben 2/lb/a. full coverage	349	226	1.5*	292
EPTC 2/lb/a. full-coverage	174	44	0.0	115
EPTC 3/lb/a. full-coverage	152	8	0.0	86
CIPC 6/lb/a. full-coverage	268	25	0.0	157
EPTC 3/lb/a. band-granular	58	8	.5*	38
EPTC 3/lb/a. band-liquid	81	67	2.3*	86
EPTC 3/lb/a. band-liquid post-shield	256	28	2.8*	166
Neburon 2/lb/a. band-granular	119	153	1.5*	145
CDAA 4/lb/a. band-granular	114	53	0.0	86
CIPC 6/lb/a. band-granular	148	8	0.0	130

*Equals actual count.

per cent as many total weeds as the check.

When the two full coverage treatments for CDAA and EPTC 3 pounds-per-acre are compared with the two band treatments of CDAA and EPTC liquid-band, no effect from the extra cultivation on the band treatments can be found, (tables 11-12). Effects of the lack of chemical weed control and the lack of early cultivations combined were clearly visible in the kidney plots for the rough pigweeds stood in large rows just like the beans.

Yields: Yield results of the chemical weed control trials on the kidney beans are presented in table 12. All treatments which had lower weed populations at harvest time yielded more than the check. These treatments also had less weeds in the spring population counts. There did not seem to be any trend with regard to the number of bean plants present and the yield.

EPTC 3 pounds-per-acre-band-granular had the highest yield which was 5.6 bushels per acre more than the check. Of all the trials, this was the only treatment that had the highest yield, combined with the best visual rating and lowest weed counts for all types of weeds. Kloben, DNBP and CIPC 6 pounds-per-full-coverage all yielded less than 75 per cent as much as the check. All other treatments yielded within 7 per cent above or below the check except Neburon which was 14 per cent below the check.

Table 12. Yield results for kidney beans in bushels per acre, as percentage of check, plus average number of bean plants as a percentage of the check.*

Type of treatment	Yield actual in bu/acre	Yield as a per cent of check	Number of plants harvested as a per cent of check
Check-actual count	26.3	-	81
Rotary hoe	26	98.9	100
DNBP 3/lb/a. full-coverage	14.3	54.2	94
CDAA 4/lb/a. full-coverage	27.5	104.6	99
Kloben 2/lb/a. full-coverage	17.5	66.4	83
EPTC 2/lb/a. full-coverage	25.7	96.5	98
EPTC 3/lb/a. full-coverage	27.3	103	95
CIPC 6/lb/a. full-coverage	19.7	74.9	94
EPTC 3/lb/a. band-granular	31.9	121.1	104
EPTC 3/lb/a. band-liquid	27.7	105.1	106
EPTC 3/lb/a. band-liquid post-shield	24.4	92.9	103
Neburon 2/lb/a. full-coverage	23.4	86	99
CDAA 4/lb/a. band-granular	27.7	105.3	96
CIPC 6/lb/a. band-granular	25.1	95.4	92

*R.E. 5% = 10.3 bushels.

R.E. 1% = 13.5 bushels.

Competition of Bean Types and Weeds

Effects of soil moisture, rainfall and bean plant competition on weed populations in the bean row as compared to the row middles: Results of the weed population counts of the rows and the row middles are presented in table 13. The effects of the cranberry and the navy bean plants were very similar. However, the results in the kidney beans were much different. This difference can best be explained on the basis of soil moisture and rainfall. On June 1st there was .75 inches of rain. This assured abundant soil moisture to germinate the weed seed present on the cranberry bean plots. No rain fell from the 1st until the 12th of June. On the 12th, two days after the navy beans were planted, a timely rain of .36 inches fell. This assured moisture for germination of both bean and weed seed.

No amount of rain then fell until the 25th of June. By this time the soil was dry and considerable rain was needed to wet and firm the soil enough for germination of the weed seed to occur in the row middles. However, the rows were firmed at planting time by the planter shoes and press wheels so weed seed germination in the kidney bean rows was higher than in the row middles. At the time weed counts in the kidney beans were taken,

Table 13. Effects of competition of bean plants on weed populations in the row. Averages of twelve counts each, of row and middle, for cranberry and kidney types and of 24 counts each for navy type.

Type of weed	Number weeds per sq. yd. in row	Number weeds per sq. yd. in middles	Weeds in row as a percent- age of weeds in middles
<u>For cranberry beans</u>			
Nut grass	43	87	50
Broadleaved weeds	19	32	59
Grassy weeds	26	39	65
Total weeds	88	168	52
<u>For navy beans</u>			
Nut grass	46	119	39
Broadleaved weeds	69	141	49
Grassy weeds	113	170	67
Total weeds	229	430	53
<u>For kidney beans</u>			
Nut grass	0	1.5	-
Broadleaved weeds	131	102	128
Grassy weeds	39	44	90
Total weeds	170	146	116

the weed seedlings in the row middles were just starting to appear but by this time the weeds in the bean plant rows had already made considerable growth. No weed counts were taken in the area compacted by the tractor wheels, however it was observed that there appeared to be more weeds in these areas than in the uncompacted row middles.

Bean plant competition in the cranberry and navy bean rows reduced weed numbers by about 50 per cent. Nut grass was the most reduced in numbers and grassy weeds the least.

Nut grass is known as a "wet soil" weed. In the cranberry bean plots there was abundant soil moisture, at planting time, so the nut grass became well established before the dry period. Nut grass was somewhat more reduced in numbers in the navy bean rows. Here it did not become so well established before the dry period and had to compete with higher populations of both bean plants and weeds for the limited moisture. The dry period before and after planting of the kidney beans accounts for the lack of nut grass in this bean type. Under more moist conditions than those encountered in these trials nut grass might prove to be a stronger competitor.

Results of comparison of high yielding plots and low yielding plots: Results of comparisons of the

high yielding and the low yielding plots are presented in table 14. In all three types of beans the highest yielding plots had the most bean plants. The high yielding plots had a bean plant population 9.8 per cent higher than did the low yielding plots in the case of navy beans; 9.2 per cent more for the kidneys; and 7.7 per cent more for the cranberry beans. In all cases the high yielding plots had less broadleaved weeds, less grassy weeds and less total weeds per square yard than the low yielding plots. In both the cranberry type and the kidney type the amount of nut grass was also reduced. In the navy beans the high yielding plots had more nut grass than the low yielding plots. This is probably due to the bean and nut grass plants being of a less competitive nature in regard to each other than in regard to the other weeds. Neither nut grass nor navy bean plants could compete with the heavy broadleaved and grassy weed infestations. The difference between the average yield of the high plots and the average yield of the low plots was over 10 bushels per acre for all three types of beans.

Comparison of the one-third highest yielding plots with the 1/3 lowest resulted in more definite conclusions as to the effect of weed and bean plant population than did the comparison of the different treatments,

Table 14. Results of comparisons of highest and lowest yielding plots of all treatments as to weed populations of the different types and bean plants present. Averages of 13 cases each for the cranberries and of 16 cases each for the navy pea and kidney beans.

Comparison	Cranberry	Navy pea	Kidney
Highest low yield used	32.2	14.9	19.2
Lowest high yield used	41.7	21.2	27.5
Average plants 600th/acre low yield	89	119	75
Average plants 600th/acre high yield	97	132	83
Difference	8	13	8
Average broadleaved weeds per sq. yd. low yield	1.3	3.1	4.9
High yield	.8	1.8	.8
Difference	.5	1.3	4.1
Average grassy weeds per sq. yd. low yield	2.6	7.6	.9
High yield	1.1	3.1	.6
Difference	1.5	4.5	.3
Average nut grass per sq. yd. low yield	1.1	1	.2
High yield	.9	3	.1
Difference	.2	-2	.1
Average total weeds per sq. yd. low yield	5	11.7	6
High yield	2.8	7.9	1.5
Difference	2.2	3.8	4.5

(tables 6-9-12). The plots which were high or low in yield came from nine or more weed control treatments. The kidney beans showed the greatest difference between the weed populations of the high yielding plots and the low yielding ones. Only the high yielding plots of kidney beans showed fairly low weed population, (1.5 per square yard). Even the high yielding navy beans were very weedy, with almost 8 weeds per square yard. The high and low yielding cranberry bean plots had the least difference in weed populations and in bean plant numbers. Yet these plots had the greatest variance in yield: 31.4 bushels per acre between the highest yielding plot and the lowest.

Effect of weed and bean plant populations on yield: Figure 3 shows the effects of bean plant population and total weed population on yield. The yield line was derived by totaling the average bushels per acre yield of each treatment, on each type of bean and dividing by three. The bean plant line is derived by totaling the average number of bean plants present per plot at harvest time for each treatment, on each type of bean and dividing by nine. The total weed line was derived in the same way; all weeds were totaled and divided by nine.

The bean plant line shows little relationship to yield. The total weed line shows an inverse relationship in all cases. When the separate types of weeds were

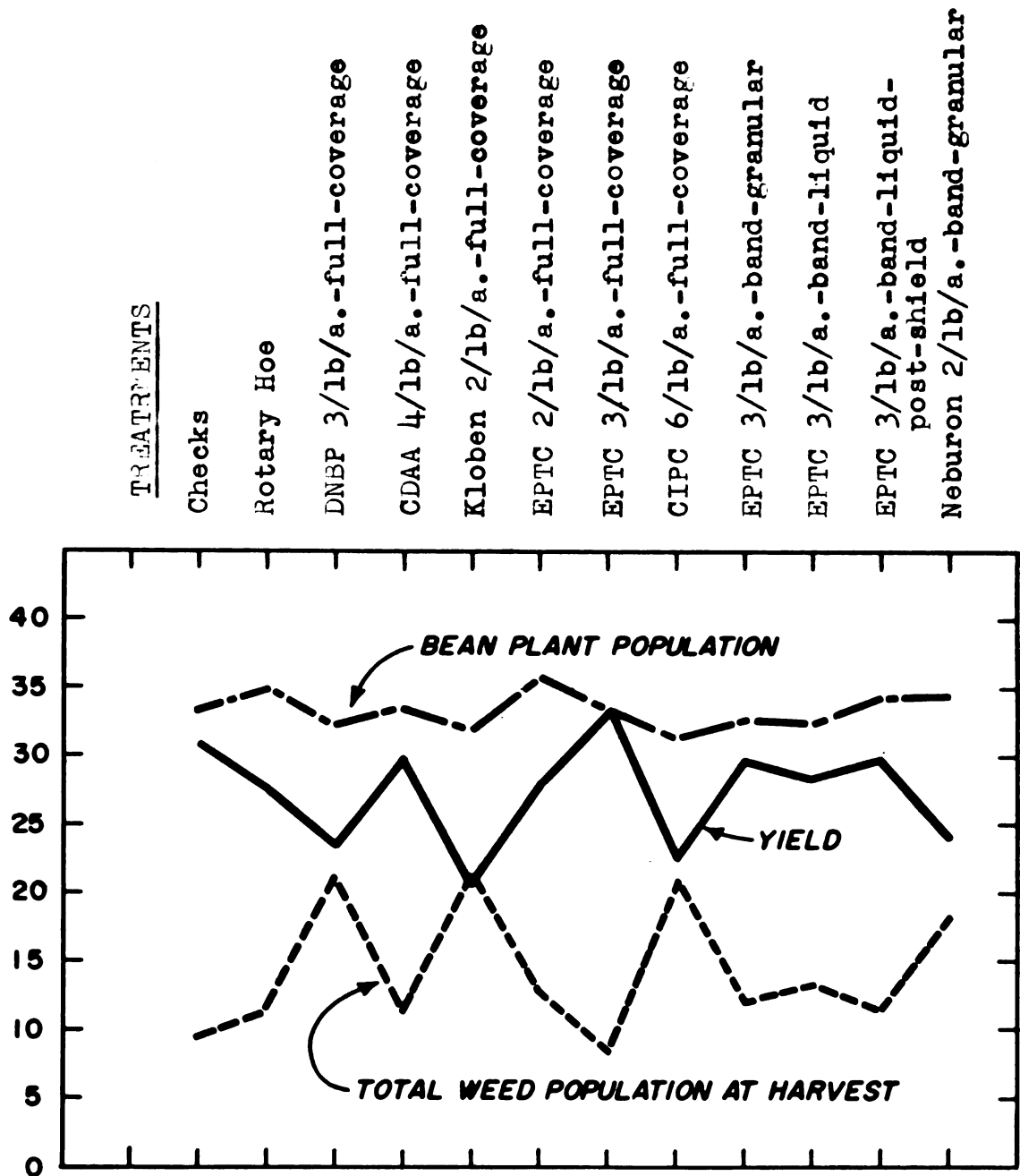


Figure 3. The average yield of each treatment for all three types of beans compared to the average number of bean plants and total weeds present at harvest.

compared to yield the inverse relationship held in all cases for broadleaved weeds. Grassy weeds held the inverse relationship in all cases save two; the rotary hoe and EPTC 3 pounds-per-acre-band-granular. The range of grassy weed numbers was much greater. This would seem to mean that a single grassy weed did not effect yield as much as a single broadleaved one; so a higher infestation of grassy weeds would be needed to have the same effect on yield that a lower infestation of broadleaved weeds would have.

Nut grass did not show the clear inverse relationship to yield that the other types had. Under different climatic conditions the results might be different.

Effectiveness of Chemical and Cultural Treatments

Chemical and cultural treatments: The check yielded and ranked relatively high in all cases, (tables 2 through 11). It ranked the highest in the navy bean plots where the weed population was the highest. It must be concluded that good early cultivation was one of the best weed control measures used in these trials. Due to its ease of application and the ready availability of equipment, it would seem that its use should still be most strongly recommended.

Rotary hoe: This treatment generally showed fair weed control in the spring but had higher mature weed populations in the fall than the check. In no case did it yield more than the check and in the cranberry bean trials it yielded 28 per cent less.

DNBP 3 pounds-per-acre-full-coverage: DNBP treatment failed to control weeds and in all cases led to lower yields than the check. In both the cranberry and navy bean trials it failed to control grassy weeds and in the kidney beans it failed to control broadleaves. In both the cranberry and the kidney bean trials it was adversely affected by the climatic conditions.

CDAA 4 pounds-per-acre-full-coverage-and-band-granular: CDAA controlled weeds and gave yields equal to the checks in both the cranberry and kidney bean trials. It failed to control weeds in the navy bean trials. In general it controlled grassy weeds better than broadleaves. Due to the fact that it caused injury to both the cranberry and navy bean plants in the early stages of growth; it would not seem advisable to increase the application rates. The granular band on the kidney beans gave excellent results.

Kloben 2 pounds-per-acre-full-coverage: Kloben treatment failed to control weeds in any of the trials and led to lower yields than the checks.

EPTC 2 pounds-per-acre-full-coverage: This treatment was spotty in its weed control; however, resulting yields were equal to the checks in two of the three trials. In the cranberry beans the yield was reduced because of a locally heavy infestation of Canadian thistle in one plot.

EPTC 3 pounds-per-acre-full-coverage: This treatment had the highest yields in two of the trials and yielded higher than the checks in all three. It showed good general weed control with reduced cultivation. Generally it seemed to control the grassy weeds best. It did not show any selectivity for control of nut grass.

CIPC 6 pounds-per-acre-full-coverage: and band-granular: CIPC treatment did not control any type of weed. It resulted in lower yields than the checks. The granular form did better than the liquid form in the kidney trials.

EPTC 3 pounds-per-acre-band-granular: This was the highest yielding treatment in the kidney bean

trials and gave excellent control of all weed types. In the navy bean trials it failed to control weeds and had a much reduced yield, (table 9). This may have been due to the rain which fell on the same day the treatment was applied, (table 2). The other EPTC treatments did not show this effect; however they were applied a day earlier. In the cranberry bean trial it gave fair control of grassy weeds and nut grass but not of broadleaves, (table 5). The yield was equal to the check.

EPTC 3 pounds-per-acre-band-liquid: In the cranberry and kidney bean trials this treatment showed some weed control and yielded about the same as the checks. In the navy beans it failed to control weeds and produced a much lower yield.

EPTC 3 pounds-per-acre-band-liquid-post-shield-dow-general: This treatment gave spotty weed control but yielded about as much as the checks. Due to its added cost and work it is hard to see why further investigation with it is warranted.

Neburon 2 pounds-per-acre-band-granular: This treatment failed to show any weed control and produced much reduced yields in all trials.

CIPC, Kloben, and Neburon might be investigated more at increased application rates. All EPTC treatments, except the post-shield, should be further investigated. The CDAA treatments should be tested further, too. The granular bands look the most interesting when considered for work of applying, amount of chemical needed, cost of equipment for application and weed control.

SUMMARY

Twelve different chemical and cultural weed control treatments were applied to three types of field beans. Kloben, Neburon, CIPC and DNBP failed to control weeds with the application rates used. They produced lower yields than the checks. The rotary hoe and post emergence shield treatments gave intermediate results. CDAA and EPTC treatments generally gave fair weed control with yields equal to the checks. CDAA showed some bean plant injury, but plants recovered. No injury was noted from treatments with EPTC. The untreated plots received three cultivations. They gave good results and were the most economical.

No direct differences were observed as the result of the use of the different types of beans. Effects of bean plant competition on weed populations in the row were evaluated. Under weather conditions favorable to both beans and weeds, competition from the bean plants reduced weed populations about 50 per cent. Nut grass was less competitive than other weeds under the climatic conditions encountered.

Comparisons of high and low yielding plots

showed bean plant, broadleaved weed and grassy weed populations to be factors in yield.

Yield and total weed population showed an inverse relationship. The more weeds, the less yield. This inverse relationship held true for all treatments.

The number of replications should be increased so as to make statistical analysis more feasible.

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