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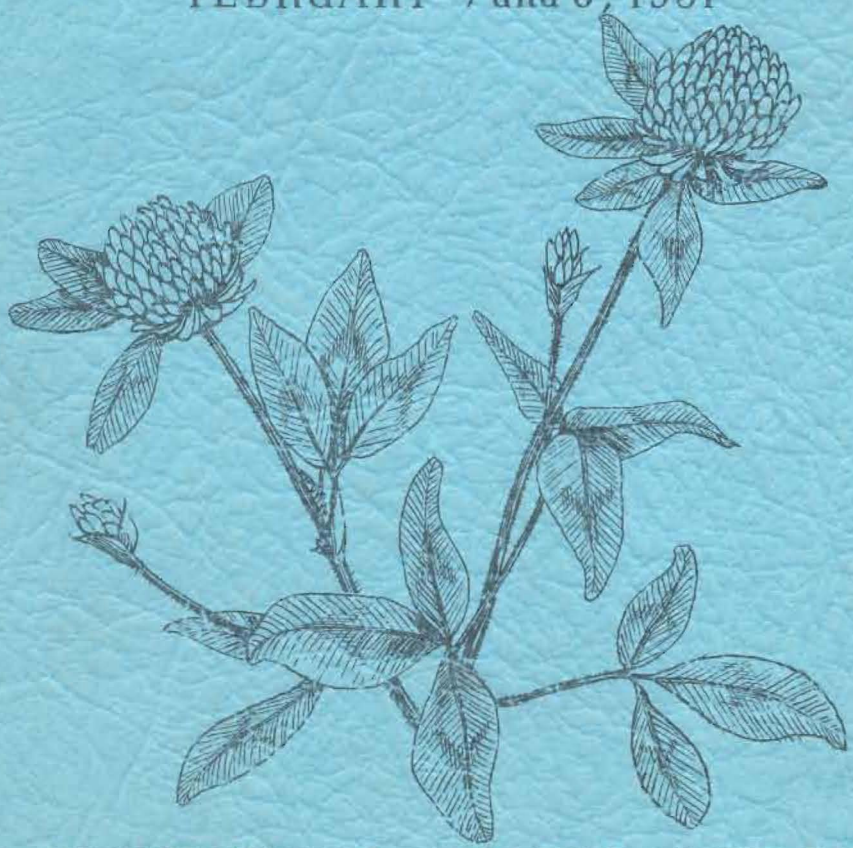
PROCEEDINGS

THIRD ANNUAL MEETING

Legume Research Committee in Ontario

FEBRUARY 7 and 8, 1951



ONTARIO AGRICULTURAL COLLEGE, GUELPH, CANADA

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OF THE

THIRD ANNUAL MEETING

OF

THE LEGUME RESEARCH COMMITTEE IN ONTARIO

HELD FEBRUARY 7 and 8, 1951

1. OFFICERS AND COMMITTEE MEMBERS PRESENT

Chairman: Dr. J.R. Weir
Secretary: Dr. D. MacDougall

Executive Committee:

Dr. J.D. MacLachlan	President, O.A.C.
Prof. G.N. Ruhnke	Director of Research, O.A.C.
Prof. A.W. Baker	Department of Entomology, O.A.C.
Dr. R.O. Bibbey	Department of Botany, O.A.C.
Prof. C.G.E. Downing	Department of Agr. Eng. O.A.C.
Prof. E.H. Garrard	Department of Bacteriology, O.A.C.
Dr. F.A. Stinson	Department of Soils, O.A.C.
Prof. G.F. Townsend	Department of Apiculture, O.A.C.

Committee Members:

Mr. D.A. Arnott	Dom. Entomological Laboratory, Chatham
Mr. R.S. Fulkerson	Dept. of Field Husb., O.A.C.
Prof. H.W. Goble	Dept. of Entomology, O.A.C.
Prof. T.J. Heeg	Dept. of Soils, O.A.C.
Dr. W.E. Heming	Dept. of Entomology, O.A.C.
Mr. G.F. Manson	Dominion Entomological Laboratory Chatham
Dr. G.P. McRostie	Dept. of Field Husb. O.A.C.
Mr. L.B. Mehlenbacher	Cayuga
Prof. F.H. Montgomery	Dept. of Botany, O.A.C.
Prof. F.F. Morwick	Dept. of Soils, O.A.C.
Prof. A.H. Musgrave	Dept. of Entomology, O.A.C.
Prof. R.T. Riddell	Dept. of Botany, O.A.C.
Mr. A.G. Skinner	Ag. Rep., Cayuga
Mr. J.G. Smith	Dept. of Physics, O.A.C.
Mr. M.V. Smith	Dept. of Apiculture, O.A.C.
Prof. E.G. Webb	Dept. of Agr. Eng., O.A.C.

2. VISITORS

Mr. A. Bartlett	Plant Products Division, Dept. of Agr., Toronto
Mr. L. Busch	Dept. of Botany, O.A.C.
Mr. F.S. Chidley	Hogg and Lytle Ltd., Oakwood
Mr. H.W. Couse	Streetsville
Mr. John Eros	Ont. Seed Cleaners & Dealers Toronto
Mr. D.N. Graham	Ag. Rep., Brantford
Mr. R.J. Hewitt	Hagersville, Ontario.
Mr. D.C. Jordan	Dept. of Bacteriology, O.A.C.
Prof. S.H. Lane	Dept. of Agr. Economics, O.A.C.
Mr. A.W. Love	Ontario Seed Cleaners and Dealers, Toronto
Mr. A.H. Martin	Crops, Seeds and WeedsBranch Dept. of Agr., Toronto
Mr. R.E. McIntyre	Douglas Seed Co., Brantford
Mr. E.T. McLaughlin	A.E. McKenzie Co. Ltd., Toronto
Mr. J.J. Neilson	West. Ont. Exp. Farm, Ridgetown
Mr. L. O'Neil	Bursar, O.A.C.
Mr. D.L. Parks	Kemptville Agric. School
Dr. H.B. Peto	Ventura, California
Prof. C.W. Riley	Dept. of Agr. Economics, O.A.C.
Dr. R.W. Shuel	Dept. of Apiculture, O.A.C.
Mr. C.L. Stevenson	Plant Products Division, Dept. of Agr., Toronto
Mr. J. Stewart	Ailsa Craig, Ontario
Prof. N.J. Thomas	Dept. of Soils, O.A.C.
Mr. H.W. Wadley	Steele, Briggs Seed Co., Toronto
Mr. G.L. Warlow	Director of Publicity, O.A.C.
Mr. J.E. Winch	Dept. of Field Husb. O.A.C.

3. INTRODUCTION

The Third Annual meeting of the Legume Research Committee in Ontario was convened in the Faculty Lounge of the Ontario Agricultural College at 9:30 a.m. with Dr. J.R.Weir in the chair and Dr. D. MacDougall acting as secretary.

The chairman called the meeting to order and welcomed the committee members and guests. The secretary next read the minutes of the 1950 meeting. It was explained that the Executive Committee formed at the 1950 meeting had held six meetings throughout the year. During the year there were some changes in the personnel of the executive. After the resignation of Dr. Reek, Dr. MacLachlan became President of the O.A.C. and Dr. Weir was selected to succeed Dr. MacLachlan as chairman. Dr. Bibbey replaced Dr. MacLachlan as executive member representing botanical science. Prof. Downing was also added to the executive assuming the responsibility for studies on harvesting methods. Sub committees on greenhouse and land requirements were formed under Dr. Bibbey and Dr. Stinson and these committees have submitted reports to the President. A summary report of the committee activities was prepared and presented at the meetings of the Crop Improvement Association in Toronto in January.

4. APPROVAL OF MINUTES

The minutes were adopted on motion of Prof. Baker and seconded by Prof. Townsend. CARRIED.

The chairman next called on President MacLachlan. Dr. MacLachlan expressed his appreciation of the co-operation he had received while chairman of the committee and stated that the Legume Research Committee was a working example of what could be accomplished by the co-operative approach to a research problem Dr. MacLachlan wished the committee every success in its work.

5. SECRETARY-TREASURER'S REPORT

The secretary listed the accounts for 1950 as follows: W.F. Keith, $412.50; L.B. Mehlenbacher, $425.00; and D.G.Burke, $40.00.

6. APPOINTMENT OF PRESS RELEASE COMMITTEE

The chairman next appointed a committee to bring in a Press Release on Thursday. This consisted of Prof. Townsend as chairman with representatives from the Entomological and Agricultural Engineering groups.

REPORTS AND DISCUSSIONS

Reports on research activities during 1950 were presented as follows:

7. DEPARTMENT OF PHYSICS, O.A.C. - (presented by Mr. Smith)

In 1950, the Department of Physics again supervised meterological observations in the areas under study by other departments.

On June 6th, on the Keith field near Jarvis, the department set up the following instruments for the use of those working in that field:

Standard maximum thermometer
Standard minimum thermometer
Taylor recording wet and dry bulb thermometers
Campbell-Stokes sunshine recorder
Rain gauge
Sling psychrometers and small anemometers were also supplied.

This made available daily maximum and minimum temperatures, continuous records of temperature, relative humidity and sunlight, a record of precipitation and spot recordings of wind direction and velocity when desired.

Observations were concluded at this field on July 19th and the equipment was moved to the Luna field where similar observations were made from August 2nd to September 7th.

The data from these two fields has been compiled in suitable form and forwarded to those interested.

Another set of instruments was set up at the seed farm at Brampton for the use of the Department of Entomology. Observations were made there whenever insect studies were being conducted.

Dr. MacLachlan - Are the results obtained by the Physics Department on meteorological data being effectively utilized by the Legume Research Committee?

Mr. Smith - I have been surprised at the little use that has been made of the meteorological data. The Departments of Entomology and Apiculture have found the data useful and apparently feel that it is essential. Other Departments have shown little if any interest. This may be partially due to our lack of a permanent field which would provide year-to-year data.

The instruments, which have been purchased primarily for legume work, can be and are used for other field work such as the tree fruit pollination program in the Niagara peninsula. Thus, the expense of collecting the data is not as great as would first appear.

Although this information is not used extensively at the present, it may be more useful to the committee as the program progresses. Whether they are used or not, the data are available if needed.

8. DEPARTMENT OF CHEMISTRY, O.A.C. -(Presented by Dr. MacDougall)

During 1950, DDT determinations were carried out for the Entomology Department and boron determinations for the Botany Department. As a satisfactory stand of alsike was not obtained at the Kohler airport, no samples were collected for analysis. Studies on growing of alsike in the greenhouse in both sand and soil are underway.

9. DEPARTMENT OF SOILS, O.A.C. - (Presented by Prof. Heeg)

Plot work has been done since 1948 on Haldimand Clay Soil at the Kohler airport location. Studies have included the effect of phosphate, lime, borax and nitrogen applications on yield of alsike seed. No treatment has given a significant increase or decrease in yield over the check. In all cases the stand of plants has been poor, making it difficult to sample the plots adequately.

Haldimand Clay is a very heavy soil which easily reverts to poor physical properties. Where physical properties are bad, the effect of applications of nutrient elements is likely to be nullified because of restricted aeration. In addition, seedlings find it difficult to pierce the hard crust formed on such soil when the surface dries, resulting in a poor stand of plants. Plots in this area have therefore been discontinued.

When land of a loam texture is made available for long term experiments, new plots will be started, and efforts made to evaluate the effects of chemical and physical properties and agronomic approaches, in relation to stand of plants and yield of seed.

Dr. MacLachlan - Is there any correlation between the soil complexes of the Haldimand district and the fact that seed yield of alsike has fallen off rapidly during the past years?

Prof Heeg - There is little information on the soils of Haldimand County in the days of high yields of legume seed, making it difficult to report factual information on the difference then compared to the present.

However, certain surmises may be made. In those days much of the land may have been in sod, which would lead to a relatively good soil structure, providing conditions for good seed germination. Perhaps many alsike fields were self seeded, so that there was a minimum of cultivation to harm the structure of heavy soils.

Organic matter levels on these soils may have been higher then, leading to better structure than we have now, even with a like amount of cultivation. A large population of plants per acre would provide conditions for a good seed yield if insect conditions were not limiting.

In the present day, legumes are usually seeded with oats which follow corn in the rotation. After a corn crop, a soil will have a poorer structure than that prevailing at any other time in the rotation. This is particularly true of heavy clays low in organic matter, such as the Haldimand types. Such poor structure decreases germination because the clay surface bakes hard, making it difficult for the seedling to penetrate it. Most of the trouble we have had in this area has been due to poor seed catch. With an extremely thin and uneven stand of plants, good yield data cannot be obtained, no matter how perfect the statistical plot-plan might be.

Poor structure also limits the effectiveness of added nutrients. Lack of sufficient soil oxygen means limited absorption of such elements by the plant.

10. DEPARTMENT OF BACTERIOLOGY, O.A.C. - (presented by Mr. Jordan)

1. Determination of Ineffective trains of Root Nodule Bacteria - The object of the investigation was to study the nitrogen fixing ability of certain root nodule bacteria, in an effort to determine well defined limits between effective, ineffective and parasitic strains.

The Virtanen technique was used for the determination of nodular haemoglobin as an indication of nitrogen fixation. Field studies on alfalfa, alsike and vetch revealed that nitrogen fixation varied in different legumes throughout the growing season, and maximum concentrations of leghaemoglobin were obtained just prior to blossom formation: green house plants showed maximum concentrations at an earlier stage.

In both field and greenhouse experiments, reduced nitrogen fixation was found to be due to the presence of ineffective root nodule bacteria. Ineffective nitrogen fixation was accompanied by differences in colour, size and distribution of nodules, and changes in the bacteria.

In greenhouse experiments, both vetch and alfalfa plants showed the effects of ineffective strains of root nodule bacteria. The possibility that ineffective strains may become parasitic and visibly affect plant growth is born out by the isolation of a strain definitely parasitic on two varieties of alfalfa.

Investigations are proceeding to determine the importance and prevalence of ineffective root nodule bacteria, especially with respect to sweet clover.

2. Powdered Legume Inoculants - (presented by Prof. Garrard)

In order to satisfy the popular demand for powdered legume inoculants to replace the solid agar culture, experiments have been conducted on the efficiency of a humus type inoculant. This includes methods of manufacture, livability of the bacteria and efficiency of nitrogen fixation. To date, it has been shown that under certain conditions satisfactory livability has been obtained over a period of 4 months. The effects of these treatments on the ability of the bacteria to fix nitrogen has yet to be determined.

Dr: Weir - What is the longevity of powdered inoculum?

Prof. Garrard - There appears to be little information on this phase of the work. To date, our own experiments show good longevity up to 4 months.

Dr. Weir - What effect has the powdered inoculum on probable mutation rate?

Prof. Garrard - To our knowledge, this has not yet been determined. It is hoped that our own studies will supply information on effect of powdered inoculants on mutation rates.

Dr.Stinson - Are there any data available on the effect of treating legume seeds with fungicides and by inoculation?

Prof. Garrard - The reports of experiments using different dusts in conjunction with inoculation are not numerous, and are conflicting. It is the general opinion, however, that organic mercury dusts kill the bacteria on contact. Spergone, however, appears to be the only dust that allows some satisfactory nodulation. If treated seed is inoculated just prior to seeding, the reduction in nodulation will not be so severe. It appears that the ability of the root nodule bacteria to diffuse away from the zone of toxic concentration of a dust is an important factor influencing nodulation; therefore, the moisture content of the soil at the time of sowing influences to some extent the rate of nodulation.

Dr. MacLachlan - To what extent are commercial legume cultures being utilized in Ontario ?

Prof. Garrard - We are not informed from any source the extent to which commerical legume cultures are being utilized in Ontario. To judge from letters, however, requesting information on various powdered inoculants, there must be numerous types available.

Mr. Busch - Does the crop have to be inoculated every year or is there a live-over of the organism?

Prof. Garrard - Root nodule bacteria will exist in the soil continuously, providing the specific legume is sown in proper rotation. If not, they die out fairly rapidly. In view of the slight cost of the cultures and the obvious advantage gained, we advise the inoculation of all legume seed, irrespective of previous crops or treatments.

Dr. McRostie - Are there many physiological forms of the legume organism? Are the differences between strains very marked?

Prof. Garrard - What differences that do exist are more morphological than physiological. The roote nodule bacteria possess a rather complex life cycle, but at certain stages they are morphologically similar. If, however, certain environmental factors are altered, considerable morphological variation may become apparent.

Dr. McRostie - Is it possible that the distribution of a pure strain from a single cell culture might result in a narrower application of its use, due to differences in strains of the legumes concerned?

Prof. Garrard - There is little available information to support this hypothesis. In view of the somewhat broad specificity of the Rhizobia and their ability to cross inoculate certain groups of legumes, it is doubtful whether single cell cultures would result in a narrower application of its use. It is hoped that our single cell studies will better answer this question.

Dr. Stinson - Does inoculation of seed offer reasonable assurance against parasitism by the strains referred to?

Mr. Jordan - Yes. A young legume plant is apparently only able to form a limited number of nodules at any one time. If these nodules are produced by efficient nodule bacteria, as would be the case if they were inoculated, then ineffective strains would be prevented from infecting the plant. In other words a kind of "pseudo-immunity" is built up in the plant against these foreign bacteria.

DEPARTMENT OF FIELD HUSBANDRY, O.A.C. - (presented by Mr. Fulkerson)

The Department of Field Husbandry, in co-operation with the Legume Research Committee, harvested over 1,100 samples of alsike clover, red clover, alfalfa and various grass species in 1950.

During the past two years experiments concerned with the burning of the old foliage from grasses early in the spring prior to the initiation of growth show that in most cases burning significantly decreases seed yields.

The practice of defoliating grasses and legumes with various dusts has proven that this will decrease seed yields in some forage species.

The opportunity to test the effect of virgin soil upon the seed yield of alsike was presented in 1950. In one of the three areas that were sampled, a significant increase in seed yield was obtained from the virgin area when compared with cultivated land surrounding it.

Considerable work was carried out upon testing new varieties of alfalfa for hay and seed yield.

The breeding program of grass and legume species made favourable advancement in 1950. Marked progress was noted in the alsike program where one polycross test has been completed.

In addition to these tests an extensive experiment has been instituted by this department. It is designed to determine the effect of rates of seeding upon the seed yields and in additon to determine the effect of association crops upon seed yields. It is hoped that these results may be forthcoming within two years.

Dr. Stinson - Has soil productivity been completely ruled out as a factor materially affecting legume seed yields?

Mr. Fulkerson - Soil fertility has not been ruled out as a factor affecting seed yields in legumes that I know of. In seed producing areas of the west at present it appears to be more of a lack of soil moisture rather than low soil fertility that might limit the growth of the legume crops and consequently seed yields.

Mr. Skinner - In the light of the history or pattern of seed production being relatively high in newer areas of production and then dropping off, what is the prospect for future production in those areas of production mentioned by Prof. Townsend as being located in Utah and California as well as in Alberta?

Mr. Fulkerson - Seed yields in the areas mentioned have definite y fallen off in the past. However, in Utah and California, the yields have been increased of late by the use of honeybees, In Alberta the yields in old areas continue to decline and it is believed they will not get larger unless the pollinators can be increased. Here again, honeybees appear to be the only answer for improving the situation at present.

Mr. Manson - Was the reduction in seed set in fertilized alfalfa the result of lygus activity or a genetical weakness?

Mr. Fulkerson - The reduction in seed set in alfalfa that had been fertilized was due to lygus, not an inherited weakness.

Mr. Chidley - Has the lygus bug been found in Ontario?

Mr. Fulkerson - Lygus has been found only in very small numbers in Ontario and it is not believed to be causing any trouble at present with alfalfa seed setting.

Dr. MacLachlan - Why does dusting alfalfa increase flower population?

Mr. Fulkerson - Dusting increases the flower population in alfalfa by controlling the lygus which feeds on and destroys the flowers.

Dr. MacLachlan - Was any reference made at Lethbridge to chemical spraying for tripping alfalfa flowers?

Mr. Fulkerson - No direct reference was made at conference meetings of spraying alfalfa to trip the flowers. However, in conversation some mention was made, but as I understand it, it was looked upon as being another mechanical means of tripping, which would have little if any effect upon the seed yield of alfalfa.

12. DEPARTMENT OF AGRICULTURAL ENGINEERING, O.A.C. - (presented by Prof. Webb)

1. Alsike Seed - Two hundred and fifty-five separate samplings of the rates of seed recovery were made, comparing three presently used methods of harvesting.

Complete laboratory analysis of the field data secured established the results reported in Table I following:

TABLE I

Average Rates of Seed Recovery and Comparative Efficiencies of Harvesting Alsike Seed by Three Common Methods of Threshing

Harvesting Method	Seed Recovery in lbs./acre	Percent Recovered of Total Seed Yield	Percent Efficiency of Separator Threshing
Windrowing Combining	258 lbs.	70.8%	123%
Separator Threshing	210 lbs.	66.7%	100%
Direct Combining	175 lbs.	49.3%	84%

Conclusions

None of the common methods of harvesting recover over three-quarters of the seed yield, under normal conditions.

Windrow pick-up combining compares favourably to stationary threshing with less arduous and irksome work.

Direct combining not only results in lowered recovery but frequently produces heated seed.

If and when seed yields are substantially improved, it will be profitable to develop harvesting methods that are more efficient than common windrow combining.

2. Red Clover Seed - Forty-eight plots were harvested, comparing seed recovery from the direct combining method of harvesting and five methods of windrow combining.

Conclusions

The maximum seed recovery under optimum conditions was 67% of the possible yield. Recovery was seriously reduced by weathering and handling of the windrows.

Appreciable deck losses took place, although ordinary methods of tailings examination gave little indication of this in the field. Considerable seed cracking also occurred.

Following severe and prolonged weathering, light windrows, and standing crop left for direct combining, showed less loss than did heavy windrows harvested at the same time. It is essential that windrows be combined as soon after cutting as crop conditions permit.

It is for the committee to decide what action should be taken with regard to an extensive program on the use of new harvesting equipment. Does the Committee think development work will gather 95% of the yield?

Dr. McRostie - Have you made an analysis of the reported 33 1/3% loss to see what the most important sources were?

Prof. Webb - Yes, to the extent that total losses of seed recovered by laboratory means from all material discharged, as threshed, showed through over losses from both combine decks as being .82% to 3.7% of the total computed seed yield. This indicates a very large part of the loss as being due to factors other than the ability of the combine to thresh out and save the seed once it reaches the cylinder.

Mr. Busch - How do you establish what 100% recovery is?

Prof. Webb - This is established by the Field Husbandry Department and we assume that this method is valid.

Dr. MacLachlan - Was the best seed lost?

Prof. Webb - We are not sure of that. The Agricultural Engineering Department had hoped to make cuttings of clover each week but the seed ripened at one time so it all had to be cut at once.

Prof. Morwick - What is the possibility of cutting when tough and then drying it in hay baler?

Prof. Webb - There is not too much information about this.

Mr. Mehlenbacher - A baler would lose a lot of seed.

Prof. Webb - There is great need for care in harvesting. The old time seed harvesters were very good. The best time to harvest is at night.

Dr. MacLachlan - Is there any type of harvester to pluck off seed heads?

Prof. Webb - There is no machine available for this. No commercial company has found it worth their while to develop a machine of this type.

Mr. Mehlenbacher - The main difficulty is the operator of the combine. Combine operators push the machines too much.

Prof. Webb - We did not crowd our machine.

Mr. Mehlenbacher - Not more than 25 per cent of the threshing machine operators know their job.

Prof. Webb - Losses were not due to lack of efficiency of the operator but were due to handling. The best results were obtained by the swather mounted on a tractor developed by the Agricultural Engineering Department. We use canvas to carry seed instead of rolling it or dragging it on the ground. The best time to do work is at 6 a.m. before dew is off. This study should be continued.

Dr. MacLachlan - What is the moisture content in the seed when harvested under these conditions?

Prof. Townsend - Seed is picked up by hay drier.

Dr. Weir - Would it be possible to set up a pilot plant on a small research basis in order to study harvesting methods?

Prof. Webb - Yes, it would be possible on the same basis that small plot threshers and combines have been used on many experimental farms. However, since the losses are obviously due to factors other than the ability of the combine to save the seed, it is questionable if the results would have much bearing on field scale operations.

The meeting adjourned at 12:00 noon for lunch and was reconvened at 1:30 p.m. Departmental reports were continued in the afternoon session.

13. DEPARTMENT OF BOTANY, O.A.C.

1. The Effect of Boron on Vegetative Growth and Seed Production of Alsike - (presented by Prof. Montgomery)

In attempting to find some causes of the sterility in alsike clover, studies were made by the Department of Botany on the effect of the element boron on the vegetative growth and seed production of alsike. A quantitative comparison was also made of the boron required for good plant growth with that required for good seed set.

In our experiments, it has been found that alsike will barely survive without the addition of boron to the nutrient medium. It will grow well in boron concentrations as low as 0.1 ppm without showing signs of boron deficiency. Concentrations greater than 1.0 ppm in the nutrient caused toxicity symptoms in vegetative parts.

Boron deficiency caused serious decrease in the weights of the plants and the weights of the flowering heads, in the number of flowers produced, and in the production of seeds. There was an optimum concentration of boron for plant growth, but in the toxicity range of our experiments no great decrease in vegetative growth occurred.

The greatest number of seeds were formed by those plants receiving the nutrient containing the higher ranges of boron, which would seem to indicate that in alsike clover higher concentrations are required for good seed production than for growth of stems and leaves.

From our experiments, it also seemed that as long as sufficient amounts of boron were present in either the pollen or pistil, good seed set occurred. That is, a deficiency of boron in pollen would be balanced by sufficient boron in the pistils, or vice versa. It was also apparent that high boron in both pollen and pistils was detrimental to seed production.

Prof. Ruhnke - Do not your results in these experiments throw considerable light on the variability of response by legumes in the field, receiving boron treatments as a fertilizer?

Prof. Montgomery - Yes. It would require a thorough working knowledge of the experimental effects of boron on plants and the effects in the field where so many variable factors enter. One must, therefore, be careful in interpreting boron deficiencies or excesses in the field.

Dr. McRostie - Did you find any difference between the boron in the pistil and that in the stamens of any individual floret?

Prof. Montgomery - It was impossible to make analysis of boron in pistils or pollen. But other workers have made such analyses and they find there are differences, and that both these contain higher concentrations than do some other parts, leaves for example.

Prof. Heeg - Was there any relationship found between calcium levels in the plant and boron deficiency or toxicity?

Prof. Montgomery - We have made no studies on this problem.

Dr. Weir - When is the greatest content of boron in the plant?

Prof. Montgomery - Just prior to flowering.

II. Root Rots of Forage Legumes - (presented by Mr. Busch)

A survey of root rots of forage legumes in South-western Ontario was conducted by the Department of Botany during the spring and early summer of 1950. The most serious trouble encountered was winter injury in the form of heaving; in many cases, 75 per cent or better of the clover was completely killed. In the fields examined, root rot, while present in trace amounts, was only severe in three: two in Essex County and one near Jarvis in Haldimand County.

Heaving presents a serious problem and may increase the amount of root rot present if it continues. An experiment was designed in the spring of 1950 to study the effects of combinations of various perennial plants with sweet clover on losses from winter heaving. The first results will be recorded in the spring of 1951.

Root rot was severe in two alsike fields in Haldimand County when examined in August. At the time of cutting no effects of the root rots were noticed. This establishes the possibility that root rots have contributed to the poor seed set encountered in this crop during recent years.

Dr. MacLachlan - Expand on statement in your report "It is felt that if root rots are present even slight heaving would greatly increase the amount of damage caused by these organisms" (beginning of 2nd paragraph, page 2).

Mr. Busch - Two possibilities exist:

(a) With the advantage of mechanical injury caused by winter injury, secondary or facultative parasites would be able to penetrate the roots and cause severe damage.

(b) Even with strong parasites the number of infected roots will be increased. A gradual build-up of inoculum could take place in the soil to the point where root rots would be important every year in Ontario.

Dr. MacLachlan - If disease incidence increased by winter injury, do you consider the pathogens in the category of weak parasite or perhaps saprophytes?

Mr. Busch - The pathogens are probably facultative parasites invading the roots through the wounds caused by winter injury.

1. THE DOMINION LABORATORY OF PLANT PATHOLOGY, HARROW, ONTARIO - (in the absence of Dr. L.W. Koch, this report was read by Dr. Macdougall)

Sweet Clover Failure in Southwestern Ontario

Further investigations of sweetclover failure in Southwestern Ontario during 1950 by W.G. Benedict of the Harrow laboratory have confirmed preliminary findings to the effect that there are 2 important and distinct disease problems involved. One of these occurs at the time of, or soon after emergence of seedings in the spring and often results in the partial or complete disappearance of seeding stands. Several different fungi appear to be responsible for this phase of the trouble.

The second, and perhaps more consistently damaging disease appears suddenly during the early spring in second-year stands. It is caused by the fungus Phytophthora cactorum and results in the wilting and death of affected plants. Fields that are attacked manifest a patchy appearance. Disease surveys of sweetclover during the summer in Essex and 20 other Ontario counties indicated Phytophthora rootrot to be particularly prevalent and damaging in Essex county. Where present, this disease frequently attacked 40 per cent of second-season stands with almost 100 per cent loss of plants in some affected fields.

Pathogenicity tests have indicated that the phytophthora fungus is probably not involved in the seedling trouble because sweetclover plants up to the age of 4 months manifested a distinct measure of resistance to infection by this fungus.

Stagonospora leafspot and rootrot was also found to occur in 10 percent of all fields in Gray and Huron counties with an average estimated loss of 2 per cent.

The specific relation of preceding crops to the sweetclover rootrot diseases and varietal resistance studies are now under intensive investigation.

15. DEPARTMENT OF APICULTURE, O.A.C. - (presented by Mr. M.V.Smith)

Extensive studies on the numbers and activities of pollinating insects on alsike, alfalfa and red clover were carried out during the 1950 season. Honeybees must be used for suitable cross-pollination of these crops.

On alsike, no relationship was found between DDT applications and honeybee populations in the present investigations. This is in direct contradiction to last year's findings and can only be explained on the basis of the entirely different weather conditions prevailing during the two seasons.

Alsike nectar concentration is not affected by DDT treatments.

Alsike clover is highly attractive to honeybees as a source of both nectar and pollen and will attract considerable numbers of honeybees, even when no colonies are situated near the field.

Alfalfa depends almost entirely on the honeybee for cross pollination. Honeybees are, however, extremely poor pollinators of alfalfa, tripping only .76% of the florets visited. Apparently young and inexperienced bees, comprising from 5 to 15% of the honeybee population, were responsible for most of the observed tripping of alfalfa florets.

Honeybees have not been found to work alfalfa for pollen, but confine their activities to nectar which they are usually able to obtain without tripping the blossom.

Honeybee activity is not affected by variations in the colour of alfalfa blossoms.

Somewhat less than 1 per cent of alfalfa blossoms trip spontaneously. Heavy rains increase self-tripping sometimes to as high as 30 per cent.

The cumulative number of florest tripped per day in alfalfa fields was found to increase as the honeybee populations increased.

Since the pollinating efficiency of the honeybee on alfalfa is so poor, very large honeybee populations must be maintained to secure a satisfactory seed set.

Experiments conducted with marked bees on red clover showed that bees tend to work into the wind. It was also found that the direction the colony is facing affects the dispersal of the foraging bees. Red clover is not particularly attractive to honeybees, and colonies should be placed right in the field for suitable pollination.

Prof. Baker - Are wild bees practically negligible?

Prof. Smith - Yes.

Prof. Townsend - There are five or six times as many wild pollinators on the campus as anywhere else.

Dr. Peto - Would you kindly elaborate on your remark about the placement of hives of bees in the field or on what side of the field of alfalfa.

Mr. Smith - Our marking experiments have indicated that -

(1) Bees tend to work into the wind more readily than with it.
(2) Greater populations were found in front of rather than behind colonies placed in legume fields for pollination.

We therefore, recommend that to obtain the maximum pollinating value of red clover and alfalfa colonies should be placed right in the field, preferably concentrated in the east end of the field and facing west. These are the recommendations in our area where prevailing winds are from the west.

Dr. McRostie - How are the bees marked?

Mr. Smith - This was studied experimentally last year. We used fluorescent compounds sprayed on blocks covered with felt, placed at the opening of the hive. The bees walked over the felt and the compound adhered to them. Bees could then be collected and identified as to which hive they belonged to.

Mr. Martin - Is there any evidence to indicate that honeybees tend to stay with one field of bloom as long as it is productive or do they vary their fields of work among various types of bloom available at any one time?

Mr. Smith - Honeybees do tend to remain on one crop as long as it is productive. Studies of the foraging habits of individual bees by Singh at Cornell and Ribbands at Rothamstead have clearly indicated this. Field observations carried out by this department have given similar evidence of the fixed habits of honeybees.

Dr. Weir - Which crop do honeybees prefer?

Mr. Smith - There is not too much definite information on this. Red clover is not too attractive to honeybees. Honeybees seem to prefer second cut.

Mr. Mehlenbacher - Does the wild bee population nest on the ground or in the bush? Better crops seem to be near bush.

Prof. Baker - The natural nesting place is in areas of rough land, fall timber, rail fences, undisturbed soil, etc.

Mr. Mehlenbacher - Wild bees - Would the population of leaf cutters be larger in bush areas. It is also a well established fact that leaf-cutter bees are very active and efficient as far are alfalfa pollination is concerned. However, our pollinator population studies have shown such a low proportion of leaf-cutter bees that it is quite unlikely that they would be of much value as pollinators in most parts of Southern Ontario.

Prof, Baker - Wild pollinators of alfalfa will be investigated.

Prof. Townsend - Work should be done on alfalfa. Only 15 per cent of bees visiting plants cause tripping. Honeybees are not sufficient. We would add more bees but the cost would be too much if the alfalfa price drops. Bumble bees will trip 100 per cent of florets visited.

Mr. Mehlenbacher - Is there any mechanical method of tripping?

Prof. Townsend - If blossoms are tripped, pollination takes place. Cross pollination would not take place.

Dr. Weir - The self tripping strains of alfalfa do not produce satisfactorily. Selection of seed from the same field year after year does not make for effective seed setting.

Prof. Townsend - Seed yields are very low in self pollinated fields. Sometimes up to 30 per cent self tripping may be caused by heavy rain. From studies, yields are very low from self tripping.

Dr. Bibbey - Would it be possible to use a self tripping variety, then honeybees to cross pollinate?

Dr. Weir - Self tripping variety is not too popular.

Prof. Baker - Should the alfalfa program be started with bees? We should start a study with wild pollinators, learn their habits, etc.

Mr. Parks - More investigation should be made in seed setting in alfalfa.

Dr. McRostie - Have you made any comparisons of the relative length of the corolla tubes in the flowers of first cutting versus second cutting?

Mr. Smith - We have not made any actual studies of the relative length of the corolla tubes in the flowers of first and second cutting red clover. We have always found more bees on the second cutting, but have attributed this to the fact that there was less competition from other bloom at that time. Corolla length may be a factor - although comparisons of corolla length of different strains of red clover at Ottawa showed little difference as far as bee activity or seed yield was concerned.

Mr. Parks - Have you investigated the possible variation of nectar content of different strains or varieties of red clover?

Mr. Smith - We have not to date carried out any extensive comparison of nectar content or concentration of the various varieties of red clover. Some work on red clover nectar - as influenced by nutritional factors - is being conducted at Ottawa, but I do not know whether this included varietal studies.

With the addition of Dr. R.W. Shuel to our staff, we have a plant physiologist who has done considerable work on nectar secretion studies, and it is hoped that we can enlarge upon this phase of the work in our legume research.

16. DEPARTMENT OF ENTOMOLOGY, O.A.C. - (presented by Prof. Musgrave)

Transient Repellancy and Mortality of DDT and Dusts on Pollination

Extensive and carefully designed field experiments with small plots and large areas have been conducted using DDT sprays and dusts at heavy and standard rates of spplication. The effect on hive bees and wild pollinators was recorded by a counting method and many of the results were analyzed statistically. It is considered likely that DDT sprays and dusts would cause only slight and unimportant transient repellency and mortality to visiting pollinators if applied at the recommended rates, provided there is no drift of spray or dust directly into hive entrances. Recommended rates: 2 lbs. of 50 per cent DDT wettable powder spray per acre; 30-35 lbs. of 3 per cent DDT dust per acre.

The bibliography which formed part of the report for 1949 was published in the s cientific press and was well received.

Work on the use of fluorescein as a marking material was continued. It was found that a crop could be dusted with fluorescein and that bees picked up this dust and carried it to the hive, where affected bees could be caught and detected. This work has been published.

Miss Salkeld's graduate work described histological changes in honeybee ventriculus associated with the administration of certain poisons. This work has been published.

A few simple experiments with the new systemic insecticide (bis dimethylamino phosphorus) anhydride were conducted, as it might prove to be a material suitable for use on seed crops. Indications from laboratory tests are that it is poisonous to the honey bee. However, it might be found harmless to bees in the field, and should therefore not yet be rejected. It is a poisonous substance.

Mr. Smith - On what crop did you find the high proportion (50 per cent) of wild pollination at Brampton?

Prof. Musgrave - Alsike.

Mr. Smith - If I recall correctly, there were occasions when dead bees were apparent near the entrances of some of the hives you used. Yet you said bee mortality was negligible. Would you elaborate on this?

Prof. Musgrave - Yes, I am aware that dead bees were to be seen at the entrance of one hive. We placed a sheet of white canvas in front of it, the better to see such dead bees and we have some record of the numbers. The maximum was 50 on the canvas. This was early in the season, shortly after the hive had been sited and half the experimental area had received one treatment. There were two and one-half subsequent treatments.

Clearly, one must be cautious in ascribing these deaths to DDT, for the normal death rate for any hive is difficult to determine and deaths may be due to senility, disease, skunks or other spraying in progress on some other crop that the bees are working.

It seemed reasonable to assess the mortality from the gross effect on the hives placed near experimental areas. There were five such hives and examination, towards the end of the season, showed them to be in a very healthy condition. Mr. Adie, an independent observer, examined one and declared it to be in fine condition. These observations, coupled with the figures on seed yield and associated with the ideas I have just outlined, were used as the basis for the statement that bee mortality was negligible.

Should this surprise us? Well, it is worth reiterating a remark I made in last year's report. DDT is said to have a negative temperature coefficient at low doses (such as a bee might pick up from a dusted crop). That is, it is the more effective, the lower the temperature. Bees only work at the higher summer temperatures. One other point:- bees in many cases do avoid a crop for a few hours after treatment (a slight transient repellency) and it may be that this behaviour is a kind of defence mechanism.

Mr. Busch - Is there any difference between wild pollinators and honeybees to susceptibility to DDT?

Prof. Musgrave - We note that the amount of wild pollinators working in three experiments and in only one of these did the analysis of the results indicate that wild pollinators were repelled more than honeybees.

No figures on wild pollinator mortality were obtained. This would have been very difficult to determine anyway.

17. WESTERN ONTARIO EXPERIMENTAL FARM, RIDGETOWN - (presented by Mr. Neilson)

In 1949 alfalfa was dusted with DDT on commencement of bloom when dusted and the results were almost negligible. The crop was very poor and the cold weather probably nullified any effects of the dusting. There was very little seed on the dusted area. The dusting may have been too late.

18. DEPARTMENT OF ENTOMOLOGY, O.A.C. - (presented by Dr. Heming)

Alsike Seed Production

The results of work conducted in 1950 raise a question pertaining to earlier recommendations for the timing of spray applications. Only insignificant numbers of the Tychius beetles were in Alsike at the previously recommended time, nor did a substantial increase in numbers occur for another 9 or 10 days. A population assay by insect net sweeps would provide more accurate timing data than the degree of bud and blossom development.

Unless spittlebugs are present in large numbers, a properly timed single treatment is, perhaps, all that is necessary under our conditions.

Alsike seed yield increases varying from 83 to 289 percent were obtained following the application of one or two DDT sprays (1 lb. actual DDT per acre) 10 days or two weeks after the appearance of the first open blossoms.

Seed losses due to harvesting machinery and techniques were found to approach 50 per cent.

Red Clover Seed Production

Results to date do not warrant the making of any insecticidal recommendations to control the insects injurious to seed production. A more intensive study of the biology of the insect population is necessary.

19. DOMINION ENTOMOLOGICAL LABORATORY, CHATHAM, ONT. - (presented by Mr. Arnott)

During the 1950 season, weevil infestation in the Keith field was quite moderate and no appreciable infestation occurred in the alsike until considerable bloom had developed in mid-June. Once infestation started, it developed rapidly and was affected little by changes in mean daily temperature or rainfall. It would appear that the amount and stage of bloom throughout the crop season have a greater influence on the development and progress of weevil infestation than the meteorological factors noted.

Early treatments, applied June 2 and 5, before considerable bloom and infestation developed, were not effective in controlling the weevil, either at the time of application or by residual action of the DDT.

Single treatments, applied on June 13 and 19, were highly effective in reducing infestation at the time of application or within a period from 3 to 9 days after application. Beyond this time, their effectiveness was greatly reduced. Once infestation starts and progresses rapidly, the effectiveness of treatments is overcome by successively large increases in weevil populations. Such increases are the chief factors limiting the amount of weevil control which may be expected from insecticidal treatments.

Since the maximum effectiveness of a single DDT treatment is limited to so short a time during crop infestation, further increase of its control value, especially in severely infested fields would likely involve two or more treatments applied at shorter intervals.

Seed development in alsike clover appears to be affected mostly by insects which directly attack the seed or feed on other floral parts associated with ovule development. Most of the seed loss from insect damage is caused by the Tychius weevil, the greater proportion resulting from adult feeding. Comparatively little seed loss was observed as a result of damage by the weevils Hypera meles Fab. and H. nigrirostris Fab. Seed damage by other insects was found to be insignificant.

Treatment of alsike clover with DDT, at the rate of 2 pounds of 50 percent wettable powder per acre, was quite effective in protecting alsike clover seed from insect damage and was highly effective in reducing Tychius weevil damage in a crop moderately infested with these insects.

Apparent loss of seed from infertility varied in amounts from 10 percent to 18 percent. However, obscure insect damage which prevented ovule development would tend to exaggerate infertility and the amount observed may be greater than actually occurs.

Post-harvest treatment of alsike clover fields by means of ploughing, cultipacking, discing or the combination of these cultures and the application of lindane, at the rate of 4 ounces per acre, followed by discing, is an effective method of reducing weevil infestation in the soil. The combined use of the insecticide lindane and discing gave the greatest amount of weevil control, infestation in the soil being reduced 73.5 percent by this treatment.

Treatments should be applied as soon after crop harvest as possible. The earlier their application the greater is their effectiveness. Post-harvest treatment of fields may not fully protect alsike crops from weevil attack but the cultural procedures are good farm practices and at the same time, afford a significant amount of weevil control.

Prof. Musgrave - Was it known if treatment of a crop with DDT inhibited Tychius migration?

Mr. Arnott - Yes. Treatment of alsike clover with DDT does not inhibit the migration of Tychius weevils into the crop from hibernation sites outside the field. In previous studies by Dr. Pielou and Mr. Arnott, it was shown that weevil populations build up in both treated and untreated alsike during the crop season. The initial kill of weevils at, or shortly after, the time when DDT is applied, prevents the normal build-up of seasonal infestation and the degree of control secured depends upon the speed and magnitude of weevil migration into the crop following treatment.

Prof. Goble - Is there any evidence that DDT prevents feeding of Tychius to a greater degree than the control (kill) of the weevil? The seed increase on DDT plots might indicate this.

Mr. Arnott - No special observations have been made to determine whether or not DDT prevents feeding of Tychius weevils. From records of weevil infestation in alsike clover treated with DDT, it has been assumed that the weevils continue to feed normally until they are killed by the insecticide.

Prof. Baker - Has the condition or attractiveness of the crop anything to do with the movement of Tychius?

Mr. Arnott - We have no facts or figures. There were lots of Tychius around the field, but not in the alsike - then they moved in all at once.

Prof. Townsend - We should be able to have some way of knowing when to put on spray.

Mr. Arnott - As soon as the alsike begins to show brown heads, weevils appear. Attention should be paid to brown heads as well as to fresh heads.

Mr. Mehlenbacher - Would you spray as soon as first brown florets show?

Prof. Townsend - That could be a tentative recommendation.

Prof. Musgrave - Does DDT prevent development of new weevils or feeding of weevils?

Mr. Arnott - DDT will be effective for some time after use, but if the population increases, the insecticide cannot kill the weevils fast enough.

Prof. Baker - Should two or three treatments be tried to keep down further populations.

Dr. Heming - Dr. Pielou did not find this successful.

The meeting was adjourned at 4:30 p.m. and recovened at 9:30 a.m. on Thursday, February 8th.

The chairman called on Mr. Fulkerson to present a report on the Alfalfa conference held in Lethbridge in the summer of 1950.

20. ALFALFA IMPROVEMENT CONFERENCE, LETHBRIDGE, 1950 - (presented by Mr. Fulkerson)

The Twelfth Alfalfa Improvement Conference held at Lethbridge, Alberta, on July 31st to August 2nd, 1950 was attended by R.S. Fulkerson of the Field Husbandry Department. During the three days of this Conference, many papers were presented by active workers in the various fields of alfalfa research.

One day was spent on the diseases attacking alfalfa in the United States and Canada. Papers were presented on breeding for resistance to the various diseases as well as discussions on cultural practices to control their spread. Several papers were also given on the progress of alfalfa breeding for insect resistance, yielding ability, longevity of stand and other characters. A general round-up of the progress in alfalfa improvement in the United States and Canada was also presented.

Considerable time was spent on insects in relation to seed-setting in alfalfa. Excellent papers were given on tripping and pollinating insects. The importance of wild pollinators to good seed-setting was pointed out. Several reports on the use of honey bees were made. This practice is becoming fairly common in some alfalfa seed producing areas in the Western United States. It was also shown to be just as important to control injurious insects by using good cultural practices, as well as the proper use of insecticides, if maximum seed yields are to be obtained.

Dr. Stinson - Has soil productivity been completely ruled out as a factor materially affecting legume seed yields?

Mr. Fulkerson - Soil fertility has not been ruled out as a factor affecting seed yields in legumes that I know of. In seed producing areas of the west at present, it appears to be more of a lack of soil moisture rather than low soil fertility that might limit the growth of the legume crops and consequently seed yields.

Mr. Skinner - In the light of the history or pattern of seed production being relatively high in newer areas of production and then dropping off, what is the prospect for future production in those areas of production mentioned by Prof. Townsend as being located in Utah and California as well as in Alberta?

Mr. Fulkerson - Seed yields in the areas mentioned have definitely fallen off in the past. However, in Utah and California, the yields have been increased of late by the use of honey bees. In Alberta the yields in old areas continue to decline and it is believed they will not get larger unless the pollinators can be increased. Here again, honey bees appear to be the only answer for improving the situation at present.

Dr. MacLachlan - Was any reference made at Lethbridge to chemical spraying for tripping alfalfa flowers?

Mr. Fulkerson - No direct reference was made at conference meetings of spraying alfalfa to trip the flowers. However, in conversation some mention was looked upon as being another mechanical means of tripping which would have little if any effect upon the seed yield of alfalfa.

Dr. MacLachlan - The alsike programme is now costing over $20,000 per year at the College. It is evident that one of the best ways to invest this money is to send men out to get the results of other research programmes.

Mr. Martin - I wish to express our appreciation of the work which the Legume Research Committee is doing. The general public have no idea what work is being done. I hope this work will be continued. We also appreciate the review of the work which the Committee allowed to be presented at the Crop Improvement Association meetings.

Dr. MacLachlan - Perhaps the Crop Improvement meetings next year there will be a better opportunity to feature what the committee is doing.

Mr. Martin - This will be done if possible.

21. SIXTH ANNUAL POLLINATION CONFERENCE HELD AT THE UNIVERSITY OF ARIZONA, TUCSON, OCTOBER 24, 25 AND 26, 1950. - (presented by Prof. Townsend)

The following is a brief summary of the Pollination Conference held at Arizona as well as information gleaned from visiting various Experimental Stations on the West Coast:

Upwards of two hundred attended this Conference. Those present were mainly seed producers and beekeepers, with a large representation from research entomologists and apiculturists and forage men.

All phases of pollination and seed yield were covered with the greatest amount of time being placed on alfalfa seed production.

It was definitely shown that the production of legume seeds is a multiple factor problem involving harmful insect control, pollination, irrigation, soil management and proper harvesting procedures. In alfalfa seed production it was definitely shown that since 1947 when these various methods were improved the seed yields in the fields where improved methods were applied have gradually risen from 300-400 pounds to the acre to 1200-1500 pounds to the acre. Insecticides are applied to all fields. They are only put on when the bees are not flying in the field and only two insecticides, namely, DDT and toxaphene, are using during bloom periods. For best results honeybees are used for pollination purposes, and it was definitely shown that these must be used in the proper concentration if results are to be expected, namely, one colony per acre for ladino, and five to seven colonies per acre for alfalfa. Irrigation is a must, and by proper use of irrigation the seed yields can be considerably increased. By improper harvesting procedures, seed yields have been reduced by at least 50 per cent. Steps are being taken to improve these methods, and some have introduced the use of vacuum harvesters with very good results. Those who are still using the combine find that it must be used under proper conditions to obtain satisfactory seed yields.

Conclusions

1. The production of alfalfa and ladino seed has been solved at least for the Western States, and there is every indication that similar practices should solve the problem here. Considerable still remains to be done in reducing the cost of this production, especially from a pollination and harvesting point of view.

2. There is every indication that similar practices will produce seed from red clover and others.

3. The following listed practices are necessary. If any one is left out it will seriously interfere with production and sometimes nullify the effect of others:

(a) Harmful insect control (using sprays relatively non-toxic to honeybees, e.g. DDT and toxaphene).

(b) Provision for sufficient pollinators (honeybees) located in the field.

(c) Suitable harvesting equipment (there is no suitable machinery on the market at the present time that does not require considerable adjustment).

(d) Irrigation.

(e) Suitable cultural practices (to control insects not controlled by sprays).

Recommendations

1. That the best recommendations should all be put together and tried on a fairly large scale, not only to determine if the practices followed in the West will work here but if not, then to determine just where they are falling down.

2. That extensive work be started as soon as possible in an attempt to develop new harvesting equipment for legume seed production, possibly of the vacuum type. It is quite evident that the harvesting equipment now in use is far from satisfactory and will leave most of the seed on the field.

22. CANADIAN SEED TRADE ASSOCIATION - Mr. H.W. Wadley.

The Chairman next called on Mr. H.W. Wadley, President of the Canadian Seed Trade Association, to address the meeting.

Mr. Wadley brought greetings from the Seed Trade Association and stressed the importance of the seed industry and promised the wholehearted support of the Seed Trade for the type of research being undertaken.

23. POLLINATION PROBLEMS IN CALIFORNIA - Dr. Howard Peto.

Dr. Howard Peto of Ventura, California, next addressed the meeting.

Our company carried on operations in both Colorado and California. In general, the problems and methods of solving them are identical with those in Ontario. The general public does not realize the need for pollinating insects.

In pollination studies, bees have been used for vine crops - watermelon and cucumbers. In Mexico, the cucumber crop was a failure due to lack of bees. With hybrid cucumbers and hybrid watermelons, they are using five hives of honeybees per acre.

The effect of differences in seed setting across large fields has also been determined. Starting at the hive, tests were taken across the fields running at a 45-degree angle from the hives. On a 19-acre field, with 5 hives per acre, there was no significant difference in the seed set in any part of the field.

The problem of competing crops such as fruit trees, beans, wild sage, etc., must also be kept in mind.

In most cases, bee pollination is about eight times as effective as hand pollination.

Everyone in California is using bees and they are very scarce. Dusting is killing off some insects. The wild bee population is very low and there are no bumble bees.

An exchange of information with workers in Ontario would undoubtedly be of value to both parties.

24. THE CHAIRMAN NEXT CALLED ON PROF. TOWNSEND, CHAIRMAN OF THE COMMITTEE ON PRESS RELEASES.

Prof. Townsend read tentative releases from Entomology, Agricultural Engineering and Apiculture.

re: Release from Entomology

Mr. Parks - What type of sprayer would be satisfactory for the recommendations made? Would a potato duster be satisfactory?

Dr. MacLachlan - The time to spray should be set out.

Prof. Baker - This release is not an extension bulletin, but a report on last year's results. However, it should be stated that when to spray cannot be predicted at this time. It will be necessary to watch the insects this spring. Spraying should probably be done about the mid-bloom stage. Warnings will have to be sent out through the Agricultural Representatives as to when to spray. In 1949, the optimum time was June 10 - 13 in the pre-bloom stage, while in 1950, the spray was best applied at the half-bloom stage.

re: Release from Agricultural Engineering

Prof. Webb - The speed of combining cannot be definitely laid down. The operator must be the judge. Present combining is usually done too quickly.

re: Release from Apiculture

Prof. Townsend - Bees should be on the side of the field away from the wind. Usually it is best to place bees in the east end of the field and distribute them in the field.

It was moved by Prof. Baker, seconded by Prof. Webb, that a press release be put out as a release of the committee as a whole, with the three reports presented being given specific attention. CARRIED.

The press release as finally sent out is included in the appendix (II) of this report.

Mr. Chairman next called on Prof. Riley to present a progress report from the Department of Agricultural Economics.

25. DEPARTMENT OF AGRICULTURAL ECONOMICS, O.A.C. - presented by Prof. Riley)

During January, 1951, the Department of Agricultural Economics, O.A.C., was asked to co-operate with the Legume Research Committee. The specific assignment was to provide information which would indicate the location and extent of seed production in Ontario of sweet clover, red clover, alsike and alfalfa.

Currently known sources of data were examined to determine whether they were sufficiently accurate and adequate for the purpose. Of these, the Dominion of Canada Census of 1941 provided the most promising source of data. From it the following information was obtained.

The acreage of the four crops varied considerably from county to county, that for alfalfa from 0 to 2719 acres; for alsike from 0 to 3473 acres; for red clover from 1 to 4288 acres, and sweet clover from 0 to 1096 acres per county. Of the 54 counties in Ontario having 100 acres or more of one of the above seed crops, 38 produced alfalfa, 23 alsike, 44 red clover and 20 sweet clover. There was also a wide variation in yield per acre from county to county. Including only those counties which produced 100 acres or more, the yield in pounds per acre varied for alfalfa from 28.7 to 142.6 lbs.; for alsike from 60.7 to 210.2 lbs.; for red clover from 34.3 to 135.1 lbs., and for sweet clover from 110.8 to 321.5 lbs. per acre. The provincial average yield per acre for the four crops was as follows: alfalfa 52 lbs., alsike 130 lbs., red clover 62 lbs., and sweet clover 212 lbs.

Allowing for limitations of the above information it would still appear that yields of seed from these crops are very low.

The meeting adjourned at 12 noon for lunch and reconvened at 1:30 p.m.

A bibliography of papers published on work done under the sponsorship of the Legume Research Committee was circulated. This bibliography is included in the appendix of this paper.

PROPOSED PROGRAMMES FOR 1951

26. ENTOMOLOGY - 1951 PROGRAMME - (presented by Prof. Baker)

A year ago it was suggested that the work on control of insects injurious to alsike seed production might be concluded in 1950. Because of discrepancies in Tychius adult migration and blossom development as compared with 1949 and 1950 and the interesting results of preliminary cultural control studies, it is felt that the work on alsike must be continued for at least another season. For two years, work has been carried on on the repellency of DDT to honeybees under Prof. Musgrave. This programme has been carried to a satisfactory conclusion, and it is proposed that it now be discontinued. It may have to be reopened later if other insecticides enter the picture. The following is the proposed programme for 1951:

Alsike

Mr. Arnott, unfortunately, is leaving the Chatham Laboratory for a Western Canadian laboratory. The student assistant who worked with Mr. Arnott on the project in 1950 will be available for 1951. He will work with such help as can be provided from the student assistants working under Dr. Heming, especially on factors influencing the movement of Tychius into alsike, the timing of such movement, and the seasonal injury caused by this insect.

Further work on spray timing based on population determinations and blossom development will be conducted.

If time permits, some preliminary investigations on certain other insecticides may be undertaken.

Repeat, and perhaps extend, the experiment on the post-harvest control of Tychius in infested soil.

Experiment on a field rather than on a plot basis, using 3 colonies of bees per acre to ensure maximum pollination. The field would be treated using the 1951 recommended spray programme with an adequate field check area.

Red Clover

A survey of the insect fauna of red clover will be made. This should be as comprehensive a study throughout the growing season as time and personnel will permit.

Alfalfa

A study of the distribution of the wild insect pollinators of alfalfa will be conducted.

27. APICULTURE I - 1951 PROGRAMME - (presented by Mr. Smith)

It is recommended that the following projects be undertaken during the coming season:

1. Further pollinator population and tripping studies be carried out on alfalfa. For this work, it is requested that the half-acre alfalfa plot at O.A.C. be made available. It is also requested that the Physics Department set up a weather shelter to record temperatures and humidities in this plot.

2. Experiments to determine the best method of utilizing honeybees for red clover pollination be continued. For this project, it is recommended that the 7-acre red clover field at the Arkell farm be made available.

3. Competition between various clovers for honeybee pollinators be investigated. For this purpose, randomized plots of different clovers were set out in the spring of 1950 on the Fleming farm near Arkell. However, the catch did not appear too satisfactory, and if these plots are not suitable for this study, it is requested that the Fleming field be abandoned, and new plots be seeded by the Field Husbandry Department on land at the College made available by the Animal Husbandry Department.

4. Optimum honeybee populations be provided for moderate sized fields of red clover, alsike and alfalfa for seed production. For this project it is requested that:

(a) 6 acres of red clover at Brampton be made available and 24 colonies of bees be rented to pollinate this field.

(b) Arrangements be made with farmers to procure fields of alsike and alfalfa and that sufficient bees be rented to pollinate these fields.

(c) Square yard seed yield figures be taken on these fields by the Field Husbandry Department and seed be harvested using the best techniques available, by the Agricultural Engineering Department.

Estimated Expenditures for 1951

2 student assistants	$ 1500.00
Rental of bees	250.00
Travelling	500.00
Equipment and supplies	150.00
Total --	$ 2350.00

APICULTURE II - 1951 PROGRAMME - (presented by Dr. Shuel)

It is possible that the physical condition of the soil may have a direct effect on nectar secretion, apart from the indirect effects exerted via the conditioning of plant growth. Experiments now in progress are designed to test the effect on nectar secretion of soil aeration, soil water content, and soil temperature. These experiments are expected to involve some 2000 to 3000 individual determinations. Data from these studies will be available by the end of March.

Snapdragons grown in the Horticulture greenhouse are being used in this study. Although this plant may seem to have little connection with legume research studies, it is felt that the problem is sufficiently basic that information obtained from working with one plant can be applied to experiments with another.

Mr. J.A. Shivas of the Soils Department is co-operating in this project.

Future Work

The direction which will be followed in greenhouse and field studies later in the year will be determined largely by the outcome of the present investigations. If promising leads are obtained, the present investigations will be continued and extended. An alternative or, possibly, an additional line of investigation would be a study of the relation of organic nutrition to nectar secretion - C/N ratio determinations and other work of a similar nature.

Expenses

Student assistance for 5 months	$ 800.00
Travel, equipment, miscellaneous	200.00
	$1000.00

28. BOTANY I - 1951 PROGRAMME - (Presented by Mr. Busch)

Observations in 1950 showed a high incidence of root rots in post-harvest surveys of alsike fields. It is therefore suggested that this project concentrate on alsike in 1951.

It is proposed to establish permanent quadrats or bisects in alsike fields of different ages and on different soil types and to study this crop in relation to the root rotting organisms that may be present or be introduced. An attempt will be made to follow disease (root rots, etc.) development and to determine its effects on seed production.

The isolation and testing of organisms associated with sweet clover, alfalfa, and alsike roots will be continued. To

date, trouble has been experienced in testing the pathogenicity of these isolates. Reliable techniques will have to be developed since this is a phase of the work that is fundamental in a proper assessment of the root rot survey.

A certain amount of equipment, greenhouse space, access to farmers' alsike fields, about one-half acre of land, and a half-time summer student assistant will be required for this project in 1951.

BOTANY II - 1951 PROGRAMME - (presented by Dr. Bibbey)

A study of the physiology and ontogency of alsike clover in relation to a number of environmental factors - photoperiod, temperature, nutrition, etc. This work will be closely correlated with the cytological and pathological studies being made in the Botany Department.

Assistance 1951	1 graduate student
Equipment	Use of infra red micro-analyser being developed by the Department of Physics. Use of Light Panel in the Botany Department.
Special Equipment	Equipment for measuring meteorological factors, soil moisture and soil temperatures.
Space	Approximately 100 square feet of greenhouse bench. Approximately one-quarter acre of field space.
Chemical Analysis	Not over 75 samples.

29. BACTERIOLOGY - 1951 PROGRAMME - (presented by Prof. Garrard)

1. Efficiency of Root Nodule Bacteria

To determine the prevalence and importance of ineffective strains of root nodule bacteria on wild and cultivated sweet clover. Single cell technique and nutritional studies will be used to attempt to determine the reasons for the development of ineffective and perhaps parasitic strains of root nodule bacteria.

2. Powdered Legume Inoculants

Continuation of work of the previous year, and to determine the nitrogen fixing ability of root nodule bacteria in powdered inoculants made and stored under different conditions.

3. Requirements

Equipment	- supplies and travel (approx.)	$ 200.00
Personnel	- one third year student for summer	725.00
	- one graduate student for year	1500.00
		$2425.00

30. CHEMISTRY - 1951 PROGRAMME - (presented by Dr. MacDougall)

The Chemistry Department will continue to run chemical analyses as required by other departments.

With regard to the nutritional aspects of the seed setting problem, it would appear that two courses are open. One would be a thorough survey of the nutritional status of clover from different sections of the province. The other would be a fundamental nutritional study under greenhouse conditions. In view of the analytical results already obtained and the part which destructive insects, inadequate pollination, and harvesting methods appear to play in obtaining better seed yields, there does not appear to be a nutritional deficiency involved in the poor seed yields now being obtained. Therefore, we feel that it would not be feasible to undertake either of the above-mentioned projects until such time as it is definitely shown that control of the other factors mentioned will not solve the problem.

31 SOILS - 1951 PROGRAMME - (presented by Prof. Heeg)

Contingent on the acquisition of suitable land for the specific use of the Soils Department over a long term period, the following soil studies in relation to legume problems are recommended.

1. Nutritional studies involving the major nutrient elements N, P and K and their relation to legume growth and seed production.

2. The effect of additions of calcitic and dolomitic lime in the presence of adequate amounts of N, P and K to be studied relative to their effects on growth and seed yield.

3. On application of adequate amounts of N, P and K, the effects of the minor elements, especially B, Mn, Zn, Cu, Fe and Co to be studied relative to their effects on the microbiological flora, legume growth and seed yield.

(a) Particular emphasis to be given boron. Observations would indicate a lack of boron in subsurface soil horizons. Experiments designed to incorporate boron into these horizons will be planned.

(b) Exploratory single plot experiments to be tried with various arrangements of minor elements as soil applications.

(c) Sprays of minor elements in various combinations to be used to determine relative effectiveness of spray versus soil application.

4. Over the years of experiments, periodical chemical and physical determinations are to be made, particularly nitrogen, organic matter, replaceable cations, non-capillary pore space and water stable aggregation. These determinations to be related to seed catch, growth and seed production.

5. Studies are to be made on various cropping rotations and their effect on soil structure, germination and plant stand, and subsequent yield of hay and grain.

6. It is recommended that all plots be sprayed for insect and disease control in an effort to minimize any variations due to such cases.

32. AGRICULTURAL ENGINEERING - 1951 PROGRAMME - (presented by Prof. Webb)

1. Recommendations

1. Replicate work of 1950 with indicated machine changes.
2. Extend the tests to include ladino, alfalfa and grasses.
3. Separate any tests of new equipment from the basic harvesting methods investigation.
4. Use only available commercial machines in (1) and (2).
5. Complete these investigations in 1951.

2. Estimates for 1951 - (Basic Legume Harvesting only)

1. Equipment and Personnel

Modifications to commercial machines	$1000.00
New commercial machines required	1000.00
To personnel and travelling (based on 1950)	2000.00
	$4000.00

3. Land and Crops - should be contracted for in appropriate localities of availability. Draw up an itinerary based on ripening dates of crops; also request College area for new machine testing.

4. Personnel, to the extent of 2 machine-operators will be required from May 1st to December 1st, their duty to be both development of new machines (under Ag. Eng.) and carrying out basic harvesting tests (for Legume Committee).

5. Emphasis to be placed on development, testing and release of information to both farm and industry.

6. If the committee recommends the development of improved harvesting machines, it is hoped that such appropriation will be added to the funds (for development) of the Agricultural Engineering Department and separated from the Legume Research budget in order to limit the size of any one public account.

7. New machines and improvements to existing machines must be perfected and proven before their inclusion in the comparative tests of harvesting methods, and should not be considered in assessing commercial results.

33. FIELD HUSBANDRY - 1951 PROGRAMME - (presented by Mr. Fulkerson)

1. Plant Breeding

Considerable emphasis has been and will continue to be placed upon this phase of our forage programme. In all species we are selecting for leafy, high-yielding, disease resistant types. Polycross nurseries are used to pick high combiners. In the breeding work, seed-setting is given special consideration since any variety that might be developed must be reproduced economically.

2. Agronomy

(a) A study of the effect of combinations of grasses and legumes for seed production.

(b) A study of the effect of rates of seeding of legumes in pure stands and in simple mixtures on seed settings.

(c) A study of the effect of first versus second cut on seed setting in red clover and alfalfa.

3. Requirements

(a) Land - In order to keep abreast with alfalfa improvement and breeding work in other forage crops, additional land is an essential. Breeding work on several species will have to be curtailed if a suitable testing area is not made available. For 1951, a uniform land area of at least four acres in size is required in close proximity to the campus.

(b) Personnel - This requirement will depend somewhat on the amount of work we are asked to do for other departments. However, if requirements are similar to those of 1950, the following amount of help will be needed:

1 graduate student	$1200
1 third year student	730
1 laborer	720

(c) Equipment

1 small fanning mill, motor and screens	$200
2 sets of dial scales	300

(d) Expenses

Wages	$2650
Equipment	500
Travelling	500

34. AGRICULTURAL ECONOMICS - 1951 PROGRAMME - (presented by Prof. Riley)

The Federal Plant Products Division are making available certain information which they have collected, regarding the production of legume seed crops. This information promises much greater accuracy than that given in the progress report. As a first step, it is planned to analyze and summarize the material provided. The results will determine what further steps may be necessary to obtain a complete and accurate answer to the problem. Only when these results are obtained, will it be possible to determine what further steps, if any, it may be necessary to take in order to obtain a sufficiently complete answer to the problem.

The above proposals for 1951 were all approved by the Committee as a whole.

35. ELECTION OF OFFICERS FOR 1951

The chairman handed the meeting over to Dr. MacLachlan for the purpose of election of officers for 1951.

Dr. MacLachlan thanked the executive for their efforts and called for nominations for chairman. It was moved by Mr. Manson, and seconded by Prof. Garrard that Dr. Weir be chairman of the Legume Research Committee for 1951. Prof. Baker moved that nominations close. This was seconded by Prof. Thomas. The motion carried unanimously.

Dr. MacLachlan next called for nominations for secretary. It was moved by Prof. Goble, seconded by Dr. McRostie, that Dr. MacDougall be secretary for 1951. Prof. Morwick moved that nominations close. This was seconded by Prof. Townsend. The motion carried unanimously.

31. REVIEW OF MEMBERSHIP

Dr. Weir resumed the chairmanship of the meeting and the membership of the Committee was reviewed. It was agreed that a representative of the Canadian Seed Trade and the Secretary of the Ontario Crop Improvement Association should be included as Committee members. The executive and committee members for 1951 are included in the appendix of this report.

There being no further business, the chairman thanked those assembled for their assistance in making the 1951 meeting a success. He then declared the meeting adjourned at 4:30 p.m.

APPENDIX

APPENDIX I

BIBLIOGRAPHY OF PAPERS PUBLISHED ON WORK SPONSORED BY THE LEGUME RESEARCH COMMITTEE.

Pielou, D.P.: "The effect of insecticide applications on the insect fauna and seed yield of alsike clover in Southern Ontario". The Canadian Entomologist 82:141. (1950).

Musgrave, A.J. and Salkeld, E.H.: "A bibliography of honey bee toxicology". The Canadian Entomologist 82:177. (1950).

Salkeld, E.H.: "Changes in the histology of the honey bee ventriculus associated with the ingestion of certain insecticides" Nature 166:608. (1950).

Salkeld, E.H.: "A toxicological and histophysiological study of certain new insecticides as stomach poisons to the honey bee". The Canadian Entomologist (in press).

Musgrave, A.J.: "Some results of an investigation of the repellant effects of DDT to the honey bee". Annual Report, Entomological Society of Ontario, 1950.

Garrard, E.H., and Jordan, D.C.: "Does parasitism exist among the nodule bacteria" A.I.C. Review (in press).

APPENDIX II

PRESS RELEASE

LEGUME RESEARCH COMMITTEE IN ONTARIO MAKES RECOMMENDATION

Lack of honeybees, the presence of injurious insects, and faulty harvesting methods are among the main factors causing poor yields of forage legume crops in Ontario.

These conclusions have been reached by the Legume Research Committee in Ontario after three years of intensive investigation of some of the major factors affecting production of forage legume seeds. The Committee, comprised of Provincial and Federal research workers concerned with forage legumes, met on February 7th and 8th to review progress made in studies during 1950. These studies on red clover, alfalfa and sweet clover extended the earlier work on alsike, and now permit the release of more extensive recommendations.

The importance of honeybees in pollination was stressed in the recommendations of the Department of Apiculture, O.A.C. Investigations carried out by this department have shown conclusively that honeybees must be used to obtain adequate cross pollination of alsike, alfalfa, red clover and other legumes. Recommendations for the use of honeybee pollinators on the various forage legumes differ in some respects and are as follows:

Alsike

This crop is highly attractive to honeybees. Three colonies per acre either beside or within ½ mile of the field should provide adequate pollination.

Alfalfa

Although honeybees were the only insects found in any numbers on alfalfa, they are extremely poor pollinators of this crop. Therefore, to ensure satisfactory pollination, large honeybee populations - at least five colonies per acre - must be used. Colonies should be placed in groups right in the field.

Red Clover

Honeybees do not find red clover particularly attractive as long as other clovers are in bloom. For this reason, it is easier to maintain honeybees in fields that bloom in late summer rather than earlier in the season. For early blooming red clover (June and July) use five colonies per acre. For late bloom, three colonies per acre should be sufficient. Colonies

should be placed right in the field.

Other Legumes

For white dutch and the sweet clovers, use the same recommendations as for alsike. For ladino clover, one colony per acre placed beside the field should be sufficient.

General Recommendations

To obtain the maximum pollination value from honeybee colonies, it would be well to observe the following practices:

(1) Do not move honeybee colonies into the field until roughly 15% of the blossoms are open.

(2) Concentrate colonies in the end of the field opposite to the direction of the prevailing winds.

(3) If the honeybees do not appear to be working in the field for which they were intended, arrange to have the original colonies replaced with other colonies from a different area. The exchanging of colonies every week or so has been found to greatly increase alfalfa pollination.

Control of injurious insects in alsike production was emphasized by the Department of Entomology, O.A.C. and the Dominion Entomological Laboratory, Chatham. The insecticide DDT when applied to clovers in flower, has been thought to reduce pollination by repelling honeybees and other pollinating insects. The results of two years work show that DDT is responsible, at most, for only a slight temporary interference with the activities of pollinators. This is not considered of any economic importance.

Investigations were continued on the injurious insects of alsike. This additional work confirmed that the injury caused by the European Clover Seed Weevil was the most serious and that control by DDT treatments definitely increased seed yield. Control experiments included spray and dust applications of DDT, and various post-harvest treatments.

Observations early in the 1950 season on the movement of weevils from overwintering quarters and on blossom development, made it necessary to change the timing of insecticide applications from that recommended from previous work. Until more is known about those factors responsible for weevil migration into the crop, insecticide application dates cannot be stated definitely.

In 1950, best results were obtained by applying the first treatment when the alsike was in half-bloom, and the second, ten days later. These dates were approximately June 13th and June 23rd in the Norfolk-Haldimand area. These may or may not be the correct dates for 1951. If the weevils should move into the crop earlier this year than last, thus requiring a treatment before the half-bloom stage, radio and press warnings will be released. If a period of very cool weather occurs between treatments, the second should be delayed somewhat.

Sprays or dusts may be used, but in our experience better results can be secured with sprays. Recommendations for 1951 are as follows:

Sprays - DDT 50% wettable powder - 2 lbs.
Water -80 gals.

A power boom sprayer with a pressure of at least 125 lbs. should be used, and the spray should be applied at the rate of 80 gallons per acre. If less water is used, the equivalent rate of DDT must be maintained. Low pressure weed sprayers may be satisfactory, but they have not been tested with alsike under Ontario conditions.

Dusts - DDT 3% dust - 30-35 lbs. per acre.

Conventional potato dusters are satisfactory. Uniform coverage is essential.

Caution 1. Forage treated with DDT should not be fed to livestock.

2. Except in cool and cloudy weather, when bees are not active during the day, insecticides should be applied in early morning or evening.

The importance of proper harvesting methods was stressed by the Department of Agricultural Engineering, O.A.C. Investigations were conducted on two crops - first cut alsike and second cut red clover. Seed losses range from 30% to 70% of the total yield. Recovery was seriously reduced by weathering and handling. Appreciable threshing losses took place, although ordinary methods of tailings examination gave little indication of this in the field. Considerable seed cracking also occurred.

Under favourable weather conditions, swathing followed by pick up combining is recommended. This method gave higher yields than other conventional methods, including direct combining; and mowing, cocking, and stationery threshing. Following severe and prolonged weathering, light windrows will show less loss than heavy windrows harvested at the same time. The results

from windrowing with the conventional side delivery rake were consistently poor in both good and bad weather. The threshing action of the side delivery rake can cause considerable seed loss; this machine forms a windrow which does not dry as well as might be desired and does not feed uniformly into a combine.

It is essential to reduce the speed of ground travel to first gear to avoid overloading the separating and cleaning capacity of the combine. Good practices of combine operation are absolutely imperative. To minimize losses, pick up combining should be done as soon after windrowing as crop conditions permit.

It is evident that considerable work must be carried out in developing better equipment for the harvesting of legume seeds. This will be still more important if the actual seed yields are increased by improved methods of production. It will probably mean the development of new types of harvesting equipment.

Addtional information may be obtained from the departments making the above recommendations.

APPENDIX III

LEGUME RESEARCH COMMITTEE-1950

Executive Committee

Dr. J.R. Weir	Chairman (Jun-Dec)	Dept. of Field Husb., O.A.C.
Dr. D. MacDougall	Secretary	Dept. of Chemistry, O.A.C.
Prof. A.W. Baker		Dept. of Entomology, O.A.C.
Dr. R.O. Bibbey		Dept. of Botany, O.A.C.
Prof. C.G.E. Downing		Dept. of Agr. Eng., O.A.C.
Prof. E.H. Garrard		Dept. of Bact., O.A.C.
Dr. J.D. MacLachlan	Chairman (Jan-Jun)	President, O.A.C.
Dr. W.R. Reek	(Jan-Aug)	President, O.A.C.
Prof. G.N. Ruhnke		Director of Research, O.A.C.
Dr. F.A. Stinson		Dept. of Soils, O.A.C.
Prof. G.F. Townsend		Dept. of Apiculture, O.A.C.

Committee Members

Prof. E.G. Webb	Dept. of Agr. Eng. O.A.C.
Mr. M.W. Smith	Dept. of Apiculture, O.A.C.
Mr. F.H.S. Newbould	Dept. of Bact., O.A.C.
Prof. F.H. Montgomery	Dept. of Botany, O.A.C.
Prof. R.T. Riddell	Dept. of Botany, O.A.C.
Dr. R.S. Brown	Dept. of Chemistry, O.A.C.
Prof. H.W. Goble	Dept. of Entomology, O.A.C.
Dr. W.E. Heming	Dept. of Entomology, O.A.C.
Prof. A.H. Musgrave	Dept. of Entomology, O.A.C.
Dr. G.P. McRostie	Dept. of Field Husb., O.A.C.
Mr. R.S. Fulkerson	Dept. of Field Husb., O.A.C.
Prof. R.C. Moffatt	Dept. of Physics, O.A.C.
Mr. J.G. Smith	Dept. of Physics, O.A.C.
Prof. F.J. Heeg	Dept. of Soils, O.A.C.
Prof. F.F. Morwick	Dept. of Soils, O.A.C.
Mr. G.F. Manson	(Dominion Entomological Lab.
Mr. O.A. Arnott	(Chatham, Ontario.
Dr. L.W. Koch	Dominion Laboratory of Plant Pathology, Harrow, Ont.
Dr. D.P. Pielou	Dominion Entomological Lab. Belleville, Ont.
Mr. C.A. Jamieson	Dominion Apiculturist, C.E.F., Ottawa, Ont.
Dr. T.M. Stevenson	Dominion Agrostologist, C.E.F., Ottawa, Ont.
Mr. H.L. Seaman	Division of Entomology, Dept. of Agr., Ottawa, Ont.
Mr. A.G. Skinner	Agricultural Representative, Ont. Dept. of Agr. Cayuga, Ont.
Mr. L.B. Mahlenbacher	Cayuga, Ont.

APPENDIX IV

LEGUME RESEARCH COMMITTEE-1951

Executive Committee

Dr. J.R. Weir	Chairman	Dept. of Field Husb., O.A.C.
Dr. D. MacDougall	Secretary	Dept. of Chemistry, O.A.C.
Prof. A.W. Baker		Dept. of Entomology, O.A.C.
Dr. R.O. Bibbey		Dept. of Botany, O.A.C.
Prof. C.G.E. Downing		Dept. of Agr. Eng., O.A.C.
Prof. E.H. Garrard		Dept. of Bacteriology, O.A.C.
Dr. J.D. MacLachlan		President, O.A.C.
Prof. G.N. Ruhnke		Director of Research, O.A.C. Head, Department of Soils, O.A.C.

Committee Members

Prof. M.W. Drummond	Dept. of Agr. Economics, O.A.C.
Prof. S.H. Lane	Dept. of Agr. Economics, O.A.C.
Prof. C.W. Riley	Dept. of Agr. Economics, O.A.C.
Prof. E.G. Webb	Dept. of Agr. Engineering, O.A.C.
Dr. R. Shuel	Dept. of Apiculture, O.A.C.
Mr. M.W. Smith	Dept. of Apiculture, O.A.C.
Mr. D.C. Jordan	Dept. of Bacteriology, O.A.C.
Mr. L.V. Busch	Dept. of Botany, O.A.C.
Prof. R.T. Riddell	Dept. of Botany, O.A.C.
Dr. R.S. Brown	Dept. of Chemistry, O.A.C.
Prof. H.W. Goble	Dept. of Entomology, O.A.C.
Dr. W.E. Heming	Dept. of Entomology, O.A.C.
Prof. A.H. Musgrave	Dept. of Entomology, O.A.C.
Dr. G.P. McRostie	Dept. of Field Husb., O.A.C.
Mr. R.S. Fulkerson	Dept. of Field Husb., O.A.C.
Prof. R.C. Moffatt	Dept. of Physics, O.A.C.
Mr. J.G. Smith	Dept. of Physics, O.A.C.
Prof. T.J. Heeg	Dept. of Soils, O.A.C.
Prof. F.F. Morwick	Dept. of Soils, O.A.C.
Mr. G.F. Manson	Dominion Entomological Laboratory, Chatham, Ontario.
Dr. L.W. Koch	Dominion Laboratory of Plant Pathology, Harrow, Ont.
Mr. C.A. Jamieson	Dominion Apiculturist, C.E.F. Ottawa, Ont.
Dr. T.M. Stevenson	Dominion Agrostologist, C.E.F. Ottawa, Ont.
Mr. H.L. Seamans	Division of Entomology, Dept. of Agriculture, Ottawa, Ont.
Mr. A.G. Skinner	Agricultural Representative, Ont. Dept. of Agr., Cayuga, Ont.
Mr. L.B. Mehlenbacher	Cayuga, Ont.

Mr. H.W. Wadley	President, Canadian Seed Trade Association, Toronto, Ont.
Mr. A.H. Martin	Secretary, Ontario Crop Improvement Association, Toronto, Ontario.