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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF MANITOBA

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ENTOMOLOGICAL SOCIETY OF MANITOBA

The Proceedings of the Entomological Society of Manitoba are published annually and include a record of the Society's activities and contributed papers of general and scientific interest to entomologists. Future contributors are requested to consult the "Style Manual for Biological Journals" (Am. Inst. Biol. Sci., Washington, 1960) for instructions on preparing manuscripts for publication and to include an Abstract of not more than 200 words for each contribution. Further information for authors may be obtained from the editor.

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ENTOMOLOGICAL SOCIETY OF MANITOBA

A society to foster the advancement, exchange and dissemination of entomological knowledge

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INTRODUCTION

The past year has been a successful one for the Manitoba Entomological Society. At our spring meeting we heard a very interesting review of the history of entomology in Manitoba, as outlined in these proceedings. The banquet at the Pembina Hotel was followed by a film on Aquatic life. Mr. Hunter, an artist with an interest in ecology, presented a very interesting series of slides showing close-ups of insects and flowers.

The fall meetings were held in the Norquay Building, a welcome change in locale. Following the banquet at the Montcalm Motor Hotel we were shown an interesting film on the Greater Winnipeg Floodway project.

It was an honor and a pleasure to be President of the Entomological Society of Manitoba in 1963. I would like to express my sincere appreciation to all those who have contributed to the success of the meetings during the past year.

Wm. G. H. Ives,
President.

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A HISTORY OF THE ENTOMOLOGICAL SOCIETY OF MANITOBA

W. R. Allen

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Introduction

I am still uncertain why we should concern ourselves with the History of this Society after less than two decades of existence. Gibbon considered that "History is little more than the register of crimes, follies and misfortunes of mankind". Possibly our follies have been few and we acknowledge no indictable crimes or convictions of guilt. Perhaps we should concur with Napoleon that, "History is but a fable agreed upon."

The Society emerged as a result of several meetings called by Professor A. V. Mitchner to discuss a policy for having the American Association of Economic Entomologists approve common names for our economic insects. As it took only ten entomologists meeting in Toronto in 1863 to form the first Entomological Society of Canada, it is not unreasonable that twice as many meeting in Manitoba would spawn an active Society.

Charter Meeting

This meeting took place in Winnipeg on March 23, 1945. The main impetus for the formation of this society was to draw into association groups of professional entomologists then in Winnipeg and Brandon. The founding President was Dr. B. N. Smallman. Eight members attended this meeting. There was much concern about establishing a constitution, for the charter members wished the meetings to be informal, informative and inexpensive. Fixed dues were not condoned, as levies were considered adequate for operation. Fortunately, this was true but we notice the frequent recurrence of the minute "loss of membership shall be automatic when a member neglects to pay the annual levy for two consecutive years." Indeed this indicates that there was grave question about the solvency of the members and the permancy of the venture.

The Formative Years (1945 - 1950)

This period was influenced by an important phase in the organization of Entomology in Canada. It was the period of post-war expansion in entomological research, fostered by increased financial support, which expanded staffs and facilities.

We posted to the masthead the following principles for the Society; (1) to foster the exchange of information on entomology; and (2) to further the dissemination of entomological knowledge. The first principal set the pattern for the early meetings. Each spring informal discussions on work being undertaken in Manitoba were held and each fall, review papers were presented by members or outside speakers. The Proceedings for this period reflects the expansion of research into fields of endeavour that were new for Western Canada. More detailed studies of life histories, ecology and behavior were developed, as well as work on ethology, insect nutrition and the use of insecticides for the control of field crop insects. Possibly, the rudimentary information prerequisite to studies on population dynamics and integrated control began to evolve. Indeed such programs likely influenced the young workers in this field and at least stimulated some thinking on research.

But the society also sought to exchange information with other workers. In 1948 the society acted as host to the International Great Plains Conference of Entomologists and the following year to the Entomological Society of Ontario. These meetings challenged the young society to effectively organize programs that provided both scientific interest and entertainment. The same attention to detail still distinguishes conventions arranged by the society. The re-instatement of a National Society was favored and promoted by our Society at this joint meeting with the Entomological Society of Ontario. The concern of the Society was that a truly National Society be established rather than amalgamation with the Ontario Society, as first proposed. The controversy was soon dispelled and the climate was conducive to the formation of National Society with associated Provincial Societies.

The Next Decade (1950 - 1960)

This period opened with the formation of the Entomological Society of Canada. The boyant spirit of our Society at that time was clearly expressed by President A.J. Thorsteinson on the occasion of our tenth anniversary when he stated "The foresight shown by those who were active in forming our organization now seem prophetic. The decade that has since elapsed, has been marked by such an increase in the complexity of entomological science, that there is an imperative need for interchange of knowledge, such as is provided by the regular meetings of our Society."

The outstanding feature of this decade was the impetous given to the dissemenation of entomological knowledge. The Committee on The Common Names of Insects functioned to provide acceptable names useful in teaching, extension or for publication. An Insecticides Committee provided lists of products available in Manitoba and sought means to unify insect control recommendations. This unification was only accomplished satisfactorily when the Government of Manitoba appointed an Extension Entomologist. The need for this appointment was realized as early as 1950 and a resolution was submitted to Government. However, this event was not accomplished until 1957, and resulted from leadership of Mr. W.A. Reeks. The brief presented emphatically pointed out that...." The system of disseminating information to growers or producers could be greatly improved if the Province of Manitoba were to obtain the services of a specialist in Extension Entomology". This objective was well and truly attained.

The Proceedings has slowly evolved under hands of several patient editors. The status and cost of the Proceedings has received considerable discussion through the years. However, recent improvements in format and content kindle the idea that it may serve as a record of regional research, as well as the activities of the Society.

The Society has been able to confer small honors on outstanding members. The efforts of our founder, Professor A. V. Mitchner, were recognized by life membership in 1950 and he was elected our first Honorary President in 1958. The distinction of life member was also conferred on Mr. J. B. Wallis, our distinguished amateur Entomologist. In 1960 he was elected an Honorary Member of the Entomological Society of Canada, our Society was pleased to initiate the proposal.

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A HISTORY OF AGRICULTURAL ENTOMOLOGY IN MANITOBA[1]

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The study of agricultural entomology in Manitoba was pioneered by a few serious amateurs, who made it an avocation. J. B. Wallis (1954), himself the leading member of this group, has described the activities of Heath, Hanhamm, Marmont, Dennis, Roberts, May and Brooks. These early men, being amateurs in a new country were primarily interested in collecting. Most of their collections, fortunately, are now preserved in the Department of Entomology and the Manitoba Museum. These fine men had unbounded enthusiasm and interests, They studied entomology because they wanted to, not just to make a living.

The next group of entomologists include the great names of J. B. Wallis and Norman Criddle.

J. B. Wallis, (Bird, 1958), a school teacher by profession, was not only a collector but a taxonomist in his own right. He started collecting when he came to Canada in 1893 and continued until shortly before his death in 1962. His scientific contributions in entomology were stimulated by his close friendship with Norman Criddle. He specialized in the taxonomy of Coleoptera, described new species and published a monograph on the genus Haliplus but he will probably be known best for his "Cicindelidae of Canada" which was published shortly before his death.

Norman Criddle (Bird, 1955, Criddle, 1957), started to study entomology as an avocation, became professional and the father of economic entomology in Western Canada. Born in England but raised on a pioneer farm at Aweme, near Treesbank, Man. Criddle became interested in natural history at an early age. He corresponded with James Fletcher, Dominion Botanist and Entomologist, who recognized his talent and employed him part time from 1900 to 1912 to paint illustrations of weeds and collect seeds. In 1913 he was appointed by the Division of Entomology as temporary Entomological Field Officer for Manitoba. In 1914 he was given full time employment and in 1915 a one room laboratory was built on his farm at Aweme (Gibson, 1933, 1939). But, it was while still an amateur that he made his first contribution in economic entomology, the famous "Criddle Mixture". This was the first grasshopper bait.

Criddle was supplied with summer assistants who in succession were, H. A. Robertson (1920-23), P. N. Vroom (1920-21), R. M. White (1922-31). In 1923 a larger laboratory was built on the farm, but it was still only operated in the summer, Criddle going to Ottawa in the winter.

In 1918 the teaching of entomology in Manitoba was commenced with the appointment of A. V. Mitchener (Bird, 1958) to the University. He trained many men who entered the federal service.

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[1] Contribution No. 141 Canada Dept. of Agriculture, Research Station Winnipeg.

The second Aweme laboratory was operated from 1923 to 1933 and was closed shortly after Criddle's death. Summer assistants during this period were R. M. White (1923-31), R. D. Bird (1924-26), R. H. Handford (1928-46). R. H. Painter (1932-37) was seconded from the Ottawa staff for the summer and autumn months to conduct grasshopper surveys.

In October 1933 R. D. Bird was appointed officer-in-charge and the laboratory was moved to the Federal Building, Brandon, Manitoba, where it could be maintained on a year round basis and where it remained until the C. D. A. Research Station was built in Winnipeg in 1957.

Norman Criddle's main studies were in the Orthoptera. Although he made a name for himself and the laboratory as an authority on the biology and control of this group he published widely in the fields of ornithology, botany and mammalogy. Due to the inheritance from Criddle and the major grasshopper outbreak that occurred in the 1930's all staff members were engaged in grasshopper investigations until 1942 when other lines of investigation on vegetable, and special crop insects were started. They carried out poison bait experiments and grasshopper surveys and forecasts. In collaboration with entomologists in Saskatchewan, Alberta and the U. S. A. grasshopper surveys and forecasts were developed to a standard that was uniform across the whole area. Grasshopper intensive study centers with resident observers were established at Lyleton and Arnaud and also survey study blocks in south-western Manitoba and the Red River Valley.

Herman W. Moore who joined the staff in 1934 carried out investigations on the grasshopper study center at Arnaud, Manitoba and participated in control experiments. He was transferred to the Saskatoon laboratory in 1944 to be responsible for grasshopper surveys. R. H. Handford became grasshopper coordinator for the prairie provinces in 1942 and held this position until 1946 when he was transferred to Kamloops, B. C., later to become head of the laboratory and now director of the Research Station. Moore now became grasshopper coordinator and the Saskatoon Laboratory the center of grasshopper research. In 1950 Moore died. L. G. Putnam, who had been on the Brandon staff in 1945 and 1946, went to Saskatoon from Lethbridge to replace him. R. H. Painter, who along with Handford came to Brandon from Aweme (Treesbank) Laboratory to conduct grasshopper surveys was transferred to the Lethbridge laboratory in 1937.

W. R. Allen joined the staff in 1935. His early work was on the grasshopper study center at Lyleton, Manitoba, for which work he obtained his masters degree. He became interested in chemical control and is now toxicologist at the Winnipeg Station. His most significant contribution has been in the control of the sugar beet root maggot with heptachlor impregnated fertilizer.

D. S. Smith who joined the staff in 1936 also worked on the grasshopper study center at Lyleton. After a period of service with the R. C. A. F. he returned to Brandon to work on grasshopper nutrition. In 1949 he was transferred to the Lethbridge laboratory where he continued his nutrition studies and was responsible for grasshopper surveys.

John McLintock was at the Brandon Laboratory in 1936 and 1937. He worked on mosquitoes.

Following World War II there was a considerable increase in professional staff. H. P. Richardson was appointed in 1945; J. S. Kelleher and P. H. Westdal in 1946; W. Romanow and W. P. Stephen in 1947, and A. G. Robinson and T. V. Cole in 1948. Student assistants were also added to the staff: W. Chefurka 1945-47; P. Frith, now Mrs. W. Chefurka, 1946; T. Gajerski, 1946; S. Loschiavo 1946; B. Northcott, 1946-49; G. Thomas, 1946-48; J. Guppy 1949-50; D. McLean, 1950-51; W. Nakoneskny, 1955-56.

Richardson and Robinson worked on fruit insects. Robinson was transferred to the Vineland, Ontario Laboratory in 1952 and in 1953 left the service to join the Department of Entomology, University of Manitoba. Richardson was posted at the Morden Experimental Farm to work on the currant fruit fly and McDaniel mites on raspberries. In 1958 he joined the Winnipeg staff. W. Hanec assisted Richardson when Robinson left for Vineland in 1952 and like him, later joined the staff of the Department of Entomology.

W. Chefurka worked on grasshopper nutrition with Handford before leaving for graduate work in 1948. After he received his Ph. D. he joined the staff of the London, Ontario laboratory and is now in charge of the entomological section.

J. S. Kelleher worked with R. D. Bird on studies of the sweet clover weevil and carried out independent studies on biological control of the Colorado potato beetle and the life history of the radish maggot Hylemyia planipalpus. In 1958 he was transferred to the Belleville, Ontario laboratory to take charge of parasite importations.

P. H. Westdal worked first on vegetable insects has completed a number of publications on sunflower insects, including the life history and biological control of Phalonia hospes and Strauzia longipennis and pollination of sunflowers by various native insects and by honey bees. He is currently engaged with H. P. Richardson in studies on the six-spotted leafhopper dealing with ecology and control and transmission of the aster yellows virus.

W. Romanow is responsible for grasshopper surveys and forecasts, a project in which he has been continuously employed and has made noteworthy contributions. With R. D. Bird he is contributing to a study of the effects of land use on grasshopper abundance.

W. P. Stephen, who left the laboratory in 1952 to take a position at Oregon State College, started studies on alfalfa pollination by wild bees. These studies have been continued by T. V. Cole. A summer field station was established at Wanless, Manitoba, in 1952. Studies were carried out on the biology of leafcutter bees, Megachile spp., the establishment of Bombus terricola in artificial domiciles and management of alfalfa fields and adjacent land to produce maximum seed production on a permanent basis.

In 1957 the new C. D. A. Research Station in Winnipeg was completed and the Brandon staff was moved there, together with the Stored Products Insect laboratory from downtown Winnipeg. The combined staffs became the Entomological Laboratory of the Research Station with R. D. Bird as head.

The Stored Products Insect Laboratory was established at Winnipeg in 1932 by H. E. Gray and transferred to Ottawa in 1934, Seamens (1959). It was reestablished in Winnipeg in 1946 with B. N. Smallman in charge and F. L. Watters and B. Berck, chemist, as assistants. Their problems were connected with evaluation of the new insecticides, fumigants and with radio-frequency

sterilization. In 1951 Smallman was transferred to the London, Ontario Laboratory and Watters became officer-in-charge, Watters (1952). Watters' main contributions have been in the fields of effects of high frequency electric currents on insects, the hairy spider beetle and behaviour of the rusty grain beetle.

In 1948 a Stored Products Insect Unit was established in Ottawa with H. E. Gray as head, Gray (1953). This Unit was disbanded in 1956 and the remaining staff and positions transferred to Winnipeg which became the center of Stored Products Insect research in Canada.

S. R. Loschiavo, who had joined the Winnipeg Laboratory in 1949, was transferred to Ottawa in 1950, returned to Winnipeg in 1956. His work has been in the field of food preferences, biology and effect of sublethal dosages of fumigants. L. B. Smith joined the Stored Products Unit in 1955 and after graduate studies at Nottingham, England joined the Winnipeg staff in 1960. His work is in the field of population dynamics at low temperatures. E. A. R. Liscombe joined the Winnipeg staff in 1956 to work on problems connected with flour mills and insect surveys. R. N. Sinha, joined the staff in 1957 and has made a major contribution towards the understanding of hot spots in stored grain caused by insects and fungi.

In 1960, N. M. Chopra, chemist, was transferred to the entomological laboratory from the plant pathology laboratory within the C. D. A. Research Station, Winnipeg. He has been working on the degradation and movement of heptachlor in soil when used for the treatment of sugar beet root maggots.

R. D. Bird published on the Ecology of the Aspen Parkland in Western Canada and on the relationship of the red-winged blackbird to agriculture in collaboration with L. B. Smith.

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A HISTORY OF FOREST ENTOMOLOGY IN MANITOBA [1]

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Historical Beginnings

Scientific interest in the insects of the forests within the present boundaries of Manitoba has been traced by W. A. Reeks (1959) to the second quarter of the nineteenth century. The first recorded scientific collections are believed to be those of John Richardson (1797-1865), surgeon and naturalist of the Sir John Franklin expeditions, who on the second expedition (1825-1827) collected a large number of species at Lat. 54° and Cumberland House. According to Reeks, "Lat. 54° " probably refers to the present site of Norway House. This collection, and that of M. E. Bourgeau, who was with the Palliser expedition from 1857 to 1859, are believed to have been lodged in the British Museum of Natural History and may still exist there.

The earliest recorded collections of insects made in Manitoba under the auspices of the Canadian Government appear to be those by Professor Robert Bell (1841-1917), the distinguished Canadian scientist and explorer and ultimately the Director of the Geological Survey of Canada. Here again the collections were from the northern forested areas: Gods and Island lakes, Oxford House, Nelson House and along the Saskatchewan-Nelson River route from Cumberland House to Hudson's Bay. The collections, which are listed in the Reports of Explorations and Surveys, Geological Survey of Canada, published in 1880 and 1883, were identified by J. L. LeConte and are presumed by Reeks to have been deposited in the National Museum in Ottawa.

In 1887, James Fletcher was appointed Dominion Entomologist and Botanist, and thus became the first scientist employed full-time by the Canadian Government to serve the needs of the young nation in economic entomology. Working almost single-handed, he organized a system of insect reporting involving 400 observers across the Dominion. Most, if not all, of the several references to forest insects in Manitoba in his reports of the next 22 years must have been obtained in this way. [2]

The earliest of these is a reference in 1892 to attacks "by Lophyrus abietis Harr., the "spruce sawfly" on "Norway spruces in Winnipeg and western Ontario". This insect was again mentioned attacking "cultivated white spruces" in two or three places in Manitoba in 1905. The reports of 1893, 1904 and 1906 mentioned

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[1] Contribution No. 987, Forest Entomology and Pathology Branch, Department of Forestry, Ottawa, Canada.

[2] Canada Dept. Agr. Exptl. Farms Repts. 1887 et seq

insect damage to ash-leaved maples, apparently then, as now, a shade tree species of some importance. Manitoba's most notable pioneer in entomology, Norman Criddle, entered the reports in 1904 with an account of severe damage by leaf beetles in the poplar "bluffs" of southern Manitoba at the turn of the century. Although he did not specifically mention Manitoba, Fletcher referred to a sudden decrease in 1900 of infestations of tent caterpillars, which apparently had been reported at infestation levels " in all provinces ".

Pioneers of Professional Forest Entomology in Manitoba

According to Prebble [3] serious interest in forest entomology in Canada was first evident in 1909 following the appointment of C. G. Hewitt to succeed Fletcher as Dominion Entomologist. Hewitt immediately undertook a pioneering venture in biological control of forest insects in Canada -- the introduction from England of parasites of the larch sawfly, which was then making its first recorded appearance in Manitoba (Nairn et al, 1961). In December, 1911, Hewitt appointed J. M. Swaine as Assistant Entomologist in charge of forest insect work in the Dominion. It is of interest now that Swaine's first field assignment in this capacity must have been his visit to the Riding Mountain Forest Reserve in May, 1912. Hewitt [4] explained the purpose of this trip as follows: "In May, 1912, Mr. Swaine visited the Riding Mountain Forest Reserve in Manitoba. The primary object of his visit was to colonize a large collection of the cocoons of the larch sawfly, Nematus erichsonii, containing its parasite, Mesoleius tenthredinis. These cocoons had been collected in the English Lake District which I visited with that object, as mentioned in my last annual report. The weather conditions were not very favourable; nevertheless the parasitized cocoons were distributed by Mr. Swaine in two large tamarack swamps in the Riding Mountain east of Clear Lake". As Swaine's own favorite interest was in the bark beetles it is not surprising that his report of the trip referred particularly to the abundance of bark and woodboring beetles in fire-killed timber and slash. [5]

Full-time professional attention to entomology in Manitoba commenced in 1913 with the appointment of Norman Criddle as temporary Entomological Field Officer for Manitoba. The position was made permanent in 1914 and the first federal entomological laboratory was constructed on the Criddle property at Treesbank in 1915. Although Criddle's appointment was in the Division of Field Crop and Garden Insects of the Entomology Branch he maintained a broad general interest in forest and shade tree insect problems and reported regularly on conditions in southern Manitoba until his death in 1933. He was, for example, the sole Manitoba contributor on tree insects to the Insect Pest Review from its inception in 1923 until two years before his death. Of particular significance to present research on the larch sawfly was his collaboration with the Division of Forest Insects in the release of M. tenthredinis in the Spruce Woods Forest Reserve in 1913, and subsequent studies of its establishment and effectiveness there in the

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3 In Glen, Robt. Canad. Ent. 88: 350-363, 1956.

4 Can. Dept. Agr. Exptl. Farms Rept. for year ending March 31, 1913.

5 Rept. 16th Ann. Convention Manitoba Horticultural and Forestry Assn., 1913.

next 13 years. His records of larch sawfly infestation in the release area during that period have been used to advantage by Nairn et al (1961) in assessing the effects of defoliation by this pest on tamarack growth and survival.

Prior to the appointment of full-time forest entomology staff in 1937, research on forest insects in Manitoba was necessarily limited. This is reflected in the small number of technical papers published on forest insects prior to the establishment of the Winnipeg Laboratory. The first was an article by Swaine (1917), entitled "Shade Tree and Forest Insects in Manitoba", which reviewed the life history and applied control of the more injurious insects of the previous few years. Criddle (1918), in the following year published a paper describing the life history and natural control of the large aspen tortrix, Choristoneura conflictana (Wlk.), and later (Criddle, 1928) reviewed the introduction and establishment of M. tenthredinis. During the 1920's, R. D. Bird, presently Officer in Charge of the Winnipeg Entomology Laboratory of Research Branch, Canada Department of Agriculture, then commencing his career under Criddle at the Treesbank Laboratory, published several papers on insects attacking wild fruit trees (Bird, 1926a, 1926b, 1927a, 1927b, 1928) and described the life history and habits of the balsam-fir sawfly, Neodiprion abietis Harr. (Bird, 1929).

Establishment of the Winnipeg Laboratory

In 1923, responsibility for investigations of insect problems of shelterbelts and the agricultural parkland area of southern Manitoba, Saskatchewan and Alberta was assigned to a newly established Laboratory of the Division of Forest Insects at Indian Head, Saskatchewan. J. J. deGryse was in charge from 1923-25; K. E. Stewart from 1925-39; and L. O. T. Peterson from 1939 to 1958. In 1954, jurisdiction for the agricultural areas of Manitoba and Saskatchewan was transferred to the Forest Biology Laboratory at Winnipeg, which was already responsible for the forested areas of these provinces. Staff of the disbanded Forest Insect Laboratory at Indian Head was transferred to Winnipeg, Calgary and Victoria except for Peterson who joined the Indian Head Forest Nursery Station in 1958 to continue studies of a number of shelterbelt and nursery pests. Major problems studied during the term of the Indian Head Laboratory included the forest tent caterpillar, scale insects, spruce spider mite, various defoliators of shelterbelts and ornamental trees and spruce seed insects.

Jurisdiction for forest insect investigations in the forested areas of the Prairie Provinces remained with Ottawa headquarters until the late 1930's. As a consequence this vast area continued to receive only cursory attention for more than a decade after the establishment of a regular program of forest insect investigations in the agricultural region. One or two brief references occur in published records to special investigations that undoubtedly reflect economic pressures more than scientific curiosity. An investigation of an eastern spruce bark beetle epidemic on white spruce in northern Manitoba and Saskatchewan in 1922 [6] can be taken to reflect concern about the additional threat of this insect to the post World War I lumber industry. Investigations carried out in 1926 and

[6] Insect Pest Review 1 (5): 15, 1923.

1927 by Ottawa officers of the Division of Forest Insects and the Dominion Forestry Branch [7] of spruce budworm damage east of Lake Winnipeg can be attributed to the interest of the pulp and paper industry, then commencing production at the Pine Falls mill. It may also be concluded that the transfer of control of natural resources from Dominion to Provincial government control in 1930 promoted provincial interest in the attention given to provincial forests by federal research and service agencies. The appearance of widespread severe outbreaks of the jack-pine budworm in northwestern Ontario in the mid-1930's, however, served to overcome the stultifying effects of economic depression and gave the final impetus to the establishment of a regional laboratory of the Forest Insect Investigations Unit of the Entomology Division of Winnipeg in 1937. This Laboratory was initially given jurisdiction for investigations in forested areas from Sault-Ste. Marie, Ontario, to the Saskatchewan-Alberta boundary. With the establishment of laboratories at Sault-Ste. Marie in 1944 and Calgary in 1948, and the disbandment of the Indian Head Laboratory the jurisdictional area has subsequently been revised to include both agricultural and forested areas within the boundaries of Manitoba and Saskatchewan.

The Laboratory was initially located for three years in temporary quarters of the Plant Inspection Division, Department of Agriculture, in the Dominion Public Building in downtown Winnipeg. Arrangements to construct a laboratory on the Fort Garry Campus of the University of Manitoba were completed in 1939 and the new quarters were occupied on June 10, 1940. Known initially as the Forest Insect Laboratory it subsequently was named Forest Biology Laboratory with the formation of the Forest Biology Division of Science Service, Department of Agriculture, in 1951. With the incorporation of this Division within the newly-formed federal Department of Forestry in October, 1960, the Laboratory became the Winnipeg Forest Entomology Laboratory of the Forest Entomology and Pathology Branch. The original Laboratory building, outgrown several years previously, was abandoned in January, 1961, when present quarters were occupied in the new Department of Forestry wing of the Department of Agriculture Research Station.

Officers in charge of the Winnipeg Laboratory have been H. H. Richmond, 1937-1945; R. R. Lejeune, 1945-1955; W. A. Reeks, 1955-1960; F. E. Webb, 1960-. Of the original staff of Richmond and four student assistants it is of interest that all but one made careers in forest biology. Richmond became officer-in-charge of the Victoria, B. C. Laboratory from 1945 to 1955 and is now Canada's pioneer consulting forest entomologist in private practice. R. R. Lejeune succeeded Richmond as officer-in-charge at both Winnipeg and Victoria, and still occupies the latter position. L. T. White went on to studies in forest pathology and is presently officer-in-charge of the Forest Pathology Laboratory at Maple, Ontario. D. N. Smith is now on the staff of the Victoria Laboratory.

The history of forest entomology in Manitoba has been marked by close co-operation between federal and provincial agencies. Throughout its history, the Winnipeg Laboratory has maintained a close and beneficial relationship with the Manitoba Forest Service and continues to rely on this agency for encouragement

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[7] Can. Dept. Agr., Minister's Repts. for years ending March 31, 1927, 1928.

and advice, and for active assistance in carrying out survey and research projects. In its turn, the Laboratory has made a contribution to the development of forest management policies and practices in this province by providing information and advice on problems in which insects are implicated, and has contributed in substantial measure to the general fund of basic research information on Canadian forest insects and some of the problems they create. The Laboratory, through W. A. Reeks, was influential in the creation of a Provincial Entomologist post for Manitoba in 1958.

The Winnipeg Laboratory has also had a close historical relationship with the University of Manitoba. Lectures in Forest Entomology were given by Laboratory staff members under Richmond, Lejeune and Reeks for nearly 20 years. The Entomology Department, under Mitchener and Thorsteinson has, in turn, had a profound influence on Laboratory work through the undergraduate and graduate training of many of the staff members. From time to time, collaborative research and assistance has been arranged between staff of the Laboratory and members of the Department.

Investigative Program of the Winnipeg Laboratory

The establishment of the Winnipeg Laboratory followed one year after the establishment of the Canadian Forest Insect Survey by deGryse in 1936.[8]. Handled from Ottawa in its first year, the Survey subsequently became represented at regional laboratories from coast to coast. The Indian Head unit was among the first to be established in 1940. Preparations for the establishment of a Winnipeg unit began in 1938 and in 1941 the unit was made responsible for surveys of forested areas from Heron Bay on Lake Superior to Alberta. In 1944, responsibility for surveys in western Ontario was transferred to Sault Ste. Marie, while forested areas of Alberta were added to Winnipeg jurisdiction until the establishment of the Calgary Laboratory in 1948. L. T. White was the first senior survey officer in 1941 followed by D. N. Smith, 1942-43; W. C. McGuffin, 1944-46; Ruth B. Barker, 1947-48; H. R. Wong, 1949-52; R. M. Prentice, 1953-61; and K. R. Elliott, 1962-.

Due to staff limitations and other stringencies the Winnipeg survey unit operated on a restricted basis until the end of World War II. Rapid staff expansion occurred in 1945, '46 and '47 with the addition of nine Forest Insect Ranger positions. Two more were added in 1955 with the addition of the agricultural region to Winnipeg jurisdiction, bringing the Ranger staff up to present establishment. This permitted the organization of field operations in 10 forest districts in the two provinces under a Supervising Chief Ranger. A measure of the resulting expansion in Survey work is provided in the records of samples received and handled each year: from less than 400 received annually from government and industrial cooperators in each of the first three years to more than 3,500 handled in each of the past three years. The detailed appraisals of forest insect conditions in Manitoba provided by the Winnipeg staff since 1941 have been incorporated in the published Annual Reports of the Forest Insect and Disease Survey. Research

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[8] Proc. 10th Intern. Congr. Entomol. Montreal (1956) 4: 219-232, 1958

work carried out within, and in association with the Survey organization has been described in a number of important publications including those by: Wong (1951, 1954, 1955); Lejeune and Hildahl (1954); Blais et al (1955); Prentice and Campbell (1959); Wong, Drouin and McLeod (1959); Hildahl and Reeks (1960); Nairn and Prentice (1960); Nairn et al (1962); Drouin et al (1963). The present establishment of the Manitoba-Saskatchewan unit consists of two Research Officers, 11 field rangers, two laboratory technicians, a stenographer and four seasonal assistants.

Development of Research Program

The research program of the Laboratory under Richmond was centered initially on an intensive study of the ecology, natural control, food preferences and damage caused by the jack-pine budworm in southeastern Manitoba and northwestern Ontario. These studies helped to define the ecological distinction between this species and the closely-related spruce budworm, which also appeared in outbreak form in the Spruce Woods Forest Reserve about 1939. Much emphasis was placed on the influence of staminate flowers and pollen production on outbreak severity and on the possibility of reducing the susceptibility of jack-pine forests by selective cutting to remove overmature trees bearing heavy crops of male flowers. Possibly the most intensive study yet carried out on this pest, this work unfortunately is not completely recorded in formal publication. Lejeune (1950) described the effect of staminate flowers on larval size and Lejeune and Black (1950) reviewed the results of studies from 1942 to 1948 of the relationship between abundance of male flowers and budworm infestation. Brief synopses of results of various aspects of studies during the 1940's are presented in four articles in the Bi-Monthly Progress Report (1 (2); 1 (4); 2 (6); 3 (2)).

Two other studies carried out under Richmond are worthy of mention. An account of the deterioration of fire-killed white spruce due to wood boring insects by Richmond and Lejeune (1945), based on investigations in northern Saskatchewan from 1942-44, formed the first scientific publication of the Laboratory and became especially pertinent in Manitoba following extensive blowdown damage in the Riding Mountain National Park in 1944. Detailed observations of the pine tortoise scale, Toumeyella numismaticum (Pettit and McDaniel), in the Sandilands Forest Reserve in 1937 and 1938 were summarized and published several years later by Rabkin and Lejeune (1954).

The concern of the Forest Insect Investigations Unit of the Canadian government about post-war planning is evident in Laboratory annual reports for the later war years. It is of interest now that proposals submitted from the Winnipeg Laboratory in 1943 recommended that Winnipeg become the regional headquarters for investigations in the three Prairie Provinces, with a total staff of 56 operating from two year-round laboratories in each province (Winnipeg and The Pas in Manitoba), and eight seasonal field laboratories (six in Manitoba). While somewhat over-ambitious in terms of laboratory quarters, the proposals have, in fact, been virtually realized in terms of total staff at the Winnipeg and Calgary laboratories.

Lejeune's appointment as officer-in-charge in 1945 came at a significant time in the development of forest entomology investigations in Manitoba and Canada generally. One indication of this was the formation in September of the Forest

Insect Control Board of the Federal Department of Reconstruction, comprised of representatives of the Departments of Reconstruction, Agriculture and Mines and Resources, the provinces, and the pulp and paper industry. In its seven years of existence, the Board was influential in increasing appropriations and staff for forest insect work under the Department of Agriculture and stimulated the interest of the province in this field. In 1947, D. M. Stephens, Deputy Minister of Mines and Resources for Manitoba, was appointed Prairie Resources representative and organized a Prairie Committee on Forest Entomology as an advisory body.

The first major increase in the research staff establishment of the Laboratory came in 1946 with the addition of four seasonal student assistant positions. Thus began a phase of recruitment and training for most of the present research staff. R. J. Heron, a student assistant in 1944 had been appointed full-time in 1945. H. R. Wong occupied a student position in 1945 and 1946 and received full-time appointment in 1947. J. A. Muldrew, W. J. Turnock, R. M. Prentice, G. L. Warren and W. G. H. Ives, respectively, occupied student positions during the period 1947 to 1950 and received appointments during the period 1949 to 1951. Several other professional staff members left for other career fields after relatively short periods of apponitment. Present staff members recruited from other than local student assistant ranks include C. H. Buckner, appointed in 1952, and L. D. Nairn, appointed in 1953. The transfer of G. A. Bradley from Indian Head in 1956 brought the research officer staff up to its present complement of 11 full-time positions. Technical supporting staff for research projects other than Forest Insect and Disease Survey presently consists of six Forest Research Technicians and 10 seasonal assistants. In 1961, R. M. Prentice was appointed National Coordinator of the Forest Insect and Disease Survey and was replaced at Winnipeg by K. R. Elliott, transferred from Sault Ste. Marie.

In addition to recruiting and training new survey and research staffs, Lejeune was concerned with expansion of accommodations and facilities. The locale of field studies of the jack-pine budworm was shifted from East Hawk Lake, near Kenora, to a site in the Whiteshell Provincial Park in 1945 and the construction of the present Whiteshell Field Station on Red Rock Lake was commenced in 1948. The work of the Winnipeg Laboratory was seriously disrupted by the flood of 1950 which necessitated the refurbishing of the Laboratory quarters. A permanent Ranger Station on Clearwater Lake near The Pas was also constructed in 1950. Overcrowding in the original Winnipeg Laboratory necessitated the building of an office-insectary in 1951 and an office-workshop-garage in 1953.

In the process of recruiting and training new staff, Lejeune also directed a major reorientation of research programs. This was dictated partly by the reappearance of the larch sawfly in outbreak proportions in southern Manitoba in the late 1930's and in central Manitoba and Saskatchewan in the 1940's. Studies of the effects of pollen on jack-pine budworm survival and of the hybridization and host selection by the jack pine and spruce budworms were discontinued in 1948 due to absences of staff on educational leave. A new project on the spruce budworm in the Spruce Woods Forest Reserve was initiated in 1946 and continued until 1950. This study assayed the role of parasites and predators in an outbreak unique for its occurrence on pure white spruce in an isolated prairie forest. Attempts were made, without success, to colonize two additional species of parasites of the spruce budworm from other parts of Canada. Of particular interest was evidence

of competition and predation by an associated defoliator, the spruce coneworm, Dioryctria reniculella (Grt.). This work is referred to in the following issues of the Bi-Monthly Progress Report: 2 (4); 3 (1); 3 (4); 5 (6); 10 (3).

The larch sawfly has occupied the attention of Winnipeg research staff continuously since 1938 and has been the major project of the Laboratory since the late 1940's. In addition to mapping the expanding outbreak, the earliest work consisted of measuring parasitism by M. tenthredinis in the areas in which this parasite had been liberated a quarter of a century earlier. Results indicating that this was very low led to the discovery about 1945 of a high incidence of encapsulation of the parasite egg within the host. Detailed studies of this phenomenon from 1949 to 1951 have been reported in a widely-noted paper by Muldrew (1953). More recent studies of this phenomenon have revealed wide variation in the degree to which it occurs in larch sawfly populations elsewhere in North America and Europe (Muldrew, 1955). Current work is investigating the possibility that the effectiveness of this parasite in central Canada might be restored by the reintroduction of European strains less susceptible to encapsulation. Other work in the early 1940's involved relocation of native parasites from other parts of Canada and observations on cocoon predation by small mammals. The work was considerably intensified in 1946 when studies were commenced of the effects of flooding on sawfly survival. Continued until 1950, the results of this project were reported by Lejeune and Filuk in 1947 and by Lejeune, Fell and Burbidge in 1955. Tests were carried out of chemical control in 1946 and 1947, and of biological control using the fungus Beauveria sp. in 1948, but proved largely inconclusive. Extended annual surveys of infestation, parasitism and host condition in the two provinces were commenced by the Forest Insect Survey in 1948 and are still continuing. Studies of the history of larch sawfly outbreaks in central Canada and their effects on tamarack growth and survival, commenced in 1949, were taken over by Nairn in 1953 and were described in a paper by Nairn et al in 1961. In 1948, Lejeune investigated the reliability of curled shoot counts as quantitative indicators of infestation level. This idea was later used by Ives and Prentice (1958) in the development of a sequential survey technique now in general use.

Much of the present research program of the Winnipeg Laboratory dates from the early 1950's. In 1951 Warren commenced studies of Hylobius root weevils that were ultimately concentrated on the identification, life history, damage and root rot associations of H. warreni Wood (Warren, 1956a, b, 1958, 1960). Warren has now turned his attention to the problem of white grubs in forestry plantings -- their distribution, abundance, damage and chemical control. Basic research on larch sawfly was further intensified in 1951 with studies of the effects of starvation on survival and fecundity by Heron (1955), of the effects of moisture on the selection of cocooning sites by Ives (1955a) and with the commencement of broad ecological and population studies by Turnock (1955, 1957, 1960a, b). A review of the ecological life history of the insect based on Turnock's studies has received particular attention. In 1952 Ives commenced population studies and the development of sampling techniques for the present research program on this insect. These are described in a series of six papers by Ives (1954, 1955b, 1958, 1959, 1960, 1962) two in association with Turnock (Ives and Turnock, 1959; Turnock and Ives, 1962) and two in association with Prentice (Ives and

Prentice, 1958; 1959). In 1952 Buckner commenced an intensive investigation of the role of small mammals in the population ecology of the larch sawfly. This study has produced several papers on the relative effectiveness of the various species as natural control agents of the sawfly (Buckner 1955a, 1957a, 1958, 1959b), and on techniques for obtaining annual estimates of predation on study plots (Buckner, 1955b, 1959a). Particular attention has been paid to the metabolism and population behavior of shrews. The role of birds as sawfly predators has also been investigated by Buckner and Turnock and will be published shortly. Buckner's current work is largely concerned with the dynamics of small mammal populations.

Thesis projects published in the 1950's include an ecological study of the pitch nodule maker, Petrova albicapitana (Busck.) by Turnock (1953); Muldrew's study of natural immunity of the larch sawfly to parasitism by M. tenthredinis (1953); estimation of larch sawfly egg populations by Ives (1955b); a study of the life history and biology of the large aspen tortrix by Prentice (1955); and population studies of small mammals of southeastern Manitoba by Buckner (1957a, 1958). Review papers describing larch sawfly investigations were published by Lejeune (1951a, 1951b, 1955), Muldrew (1956), and Nairn et al (1961).

Systematic and taxonomic studies of forest insects have been represented in Manitoba by the work of Wong and Bradley. The former has been concerned since 1954 with biogeographical-taxonomic studies of the genus Pristiphora in the Holarctic region. Since his transfer to the Winnipeg Laboratory in 1956, Bradley has continued to publish a series of taxonomic papers on the genus Cinara in Canada (Bradley, 1956a; 1956b; 1959; 1960; 1962; 1963; Bradley and Wighton, 1959; MacGillivray and Bradley, 1961; Robinson and Bradley, 1962).

Basic research on the spruce and jack-pine budworms in recent years has been confined to a nutritional study by Heron designed mainly to discover the characteristics of the hosts that elicit feeding responses in the larvae. This work was largely terminated in 1962 and this officer has returned his attention to physiological studies of the larch sawfly.

The term of W. A. Reeks as Officer-in-Charge, from 1955 to 1960, is notable for a considerably accelerated pace of research productivity in terms of publication. Most of the research staff recruited in the late 1930's and early 1940's had then completed post-graduate training and were well advanced in project work. In 1955 alone, a total of 11 publications appeared in scientific journals, compared with a total of 14 published by the Laboratory up to that time. An additional 37 formal papers were published from 1956 until 1960. A large number of these papers relate to the developmental phase of the larch sawfly project. Related studies of the larch sawfly by Ives, Turnock, Nairn and Buckner were more closely integrated, under the leadership of Reeks, by the application, commencing in 1955, of the life-table approach to a comprehensive study of the population dynamics of this insect. Major attention was directed toward the development and application of appropriate sampling techniques and instrumentation for the measurement of sawfly populations and population regulating factors on three initial plots in southeastern Manitoba. These techniques have now been largely described in publications referred to above.

Transfer to the Department of Forestry in 1960 and occupation of new laboratory quarters in 1962 have been major events in the history of the Winnipeg

Laboratory under present leadership. Certain developments may also be reported for research direction and organization during this period. A review of progress of larch sawfly investigations in 1960-61 has been followed by an enlargement of the life-table plot system and by increased emphasis on bioclimatological effects and on biomathematical interpretation of the population dynamics data. This long-term collaborative project may now be considered to have passed from the developmental phase to the more interesting and challenging interpretive phase, with the ultimate aim of mathematical simulation of the biological systems under measurement. Increased interest in biological control possibilities has also been generated by the receipt of substantial shipments of foreign parasites of the larch sawfly and initially successful colonization of one species. Investigation of white grub biology, populations and control have been expanded in anticipation of increased importance of this insect problem with the planned expansion of reforestation programs in the Manitoba-Saskatchewan region.

Future Prospects

The transfer of federal government work in forest entomology and pathology from the Department of Agriculture to the Department of Forestry should prove to be of considerable significance in the future development of forest entomology in Manitoba and Canada generally. This opens the way for a consolidation of research effort and resources, and for a closer integration of experimental approach and research philosophy between forestry research elements formerly operating independantly from separate government departments. Equally important, consolidation should improve the opportunities to develop future research programs on a problem rather than on a discipline basis - to accelerate the pace at which forestry research follows other research fields in converting from the individual to the team approach. The Winnipeg establishment has experience in this approach through the larch sawfly project and is one of the first in Canada in which the various units of the new Department have been brought together under one roof. It may be reasonable to expect, therefore, that the advantages of integrating forest entomology surveys and research with other forestry research will be evident at least as early in Manitoba as in other parts of Canada.

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PESTICIDE LEGISLATION IN MANITOBA

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On May 6, 1963, the Manitoba legislature assented to Bill No. 51, an act to control and regulate the distribution and use of pesticides and called the Pesticide Control Act. On May 28, 1963, the Manitoba regulation No. 42 under the Pesticide Control Act was filed setting forth that the new Act would control and regulate the distribution and use of insecticides only. It set forth the licencing procedure for all persons selling insecticides in the province, established a $10.00 licence fee for pesticide dealers, and set forth a procedure to be followed by licenced dealers in the sale of specific insecticides, namely, aldrin, dieldrin, heptachlor, endrin and DDT. The Pesticide Control Act and regulation 42 controls the distribution and use of insecticides to be used by farmers on field crops or livestock. The Act provides for the testing of field crops, livestock, livestock products for the presence of an insecticide residue, the destruction of contaminated products and penalties for violation of the Act. The Act also has provision for the power to ban or prohibit the use of an insecticide in Manitoba. Recently the Manitoba Government introduced a regulation placing a ban on the insecticides aldrin and dieldrin for use on cereal crops, oil seed crops, pastureland, road allowances, drainage ditches, rights-of-way used for public purposes or for public utilities or wasteland.

Testing facilities for conducting insecticide residue tests by the province is a joint Federal and Provincial program. Tests are carried out in the laboratory of the Food and Drug Directorate, Department of National Health and Welfare in Winnipeg. The Food and Drug Directorate is providing the space, most of the technical equipment and technical assistance. The Manitoba Department of Agriculture and Conservation is providing a graduate chemist and assistant to do the provincial testing work, and providing some of the equipment and all the chemicals that are used. Although an insecticide residue testing program was introduced into Manitoba about a year and a half ago, most of the first year was spent training personnel and developing analytical procedures, so that most of the tests conducted on agricultural products in our province have taken place over the past six months. The introduction into our province of the pesticide control act and insecticide residue testing program was done to protect the good reputation of our agricultural industry in Manitoba and the public health of all who might use our agricultural products through the safe use of insecticides.

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REGULATIONS AS THEY AFFECT AGRICULTURAL USE OF INSECTICIDES AND PESTICIDES

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The Minister of National Health and Welfare, Miss Judy LaMarsh, in reporting to the Special Committee on Foods and Drugs made this statement, "The responsibility for the safe use of pesticides is shared by manufacturer, by those who sell and use the materials and by Government. As the problems become more complex, the role of Government becomes increasingly important".

This should not necessarily mean that more and more restrictive legislation needs to be passed, however, this is the normal and actual development at the present time. In speaking of regulations we must be aware that this includes all government levels, from the municipality with its by-laws to the Food and Drug Act backed by the Criminal Code. Perhaps you are not aware that there are at least 25 separate Provincial Acts dealing with the control of Pesticides.

In considering Federal legislation, we should turn first to the Pest Control Products Act administered by the Plant Products Division of the Department of Agriculture. This Act requires that certain data be submitted by the Pesticide manufacturer in his application for registration of a pesticide. The submission is considered by several federal departments who serve as advisors to the Plant Products Division:

Public Safety by the Department of National Health and Welfare;
Technical Problems by the Department of Agriculture as part of its research program;
Effect on Wildlife by the Department of Northern Affairs and Natural Resources;
Effect on Fish by the Department of Fisheries;

In addition, the Department of National Health and Welfare is concerned about the effect of the use of Insecticides and Pesticides on people, as stated by Dr. C. A. Morrell, Director of the Food and Drug Directorate, "The only regulatory authority over pesticides vested in our Department is that provided by the Food and Drug Act. Section 4 (a) of this Act states 'No person shall sell an article of food that has in or upon it any poisonous or harmful substance'." It should be noted that no authority is given to regulate the sale or use of pesticides and in fact food that is not sold or offered for sale is not controlled under this legislation.

Dr. R. A. Chapman, Assistant Director, Food and Drug Directorate, states "Our experience has indicated that almost all instances of excessive residues are the result of improper use of the pesticide". We believe that on the basis of the submission and our own research that if a pesticide is used in the manner prescribed then a violation of the Food and Drug Act is not likely to occur.

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REGULATIONS AS THEY AFFECT AGRICULTURAL USE OF INSECTICIDES

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The use of insecticides has received a great deal of publicity during the past two years as a result of Rachel Carson's book "Silent Spring". The public are now very aware of unforeseen difficulties which could possibly occur and a few people in the country have taken an alarmest attitude. The purpose of this speech is to point out the importance and usefulness of Insecticides and to point out the safety measures and Government regulations which are employed to ensure safe usage of insecticides.

Uses

First of all, are insecticides important. There are presently 200,000,000 people living in Canada and the United States, compared to approximately 1,000,000 inhabitants who dwelt here at the time when Columbus discovered America. The population of Canada and the United States is expected to increase to 400,000,000 people by the turn of the century. With this in mind, a land which supported 1,000,000 inhabitants in 1492 now supports 200,000,000 inhabitants with surplus food for export. We must ensure that we will have sufficient food to support the 400,000,000 inhabitants expected by the year 2,000.

There are 2,500 types of insect and disease pests which attack Canadian crops. Pesticides are the backbone of pest control, although cultural and biological methods are helpful. Although steps are being made in improved biological methods of insect control, it is quite certain that pesticides will continue to be the main tool in insect control in the future.

Insecticides also have played an important role in control of diseases which are spread by insects such as Malaria and Encephalitis. Vast areas of the forests of New Brunswick would have been destroyed by the spruce budworm had it not been for an extensive spray programme which was carried out in that Province for several years. The most obvious use of insecticides is probably in the field of human comfort. Household insects such as cockroaches, ants, silverfish, bed bugs, etc. have been practically eliminated by the use of insecticides. There is an increasing demand for the use of insecticides in spraying Resort areas for control of mosquitoes and black flies. Undoubtedly this demand will increase as people journey further into the Northland in search of natural resources and recreation.

Hazards

In view of this inevitable increase in the use of insecticides, the hazards of use must be always kept in mind. First of all, there is the hazard to the people working in factories which manufacture insecticides. These are the people who are subject to the greatest concentration of the poisons and must use the greatest precautions. Then there is the hazard to the user, the farmer and the back yard gardener. Hazards to people actually using the products can be overcome by careful use as indicated in the manufacturer's directions. The most difficult

hazard to control is the hazard of insecticide residues in feed stocks. There is also the hazard of people consuming insecticides purposely in order to commit suicide or the hazard of insecticides inadvertently falling into the hands of children. Control of these hazards, of course, is a matter of common sense. The fifth hazard in the use of pesticides is the widespread use of insecticides for control programmes in large areas such as forests. In such cases the insecticides can get into streams and poison fish or can be harmful to birds and wildlife which live in the area which is sprayed.

All of these hazards must be considered and coped with by the people who are manufacturing and applying the pesticides.

Regulations

As you know the principal Act governing pesticides in Canada is the Federal Pest Control Products Act. The Act provides that those who wish to market pesticides in Canada must do the following:

1. Research the product to the point of confirming beyond a reasonable doubt that the product will be beneficial and safe to use.
2. Register the product annually and when requested reconfirm effectiveness, safety and the adequacy of labelling.
3. Label with information
    (a) on method of safe and efficient use
    (b) on hazards of misuse
    (c) on steps to minimize consequences of misuse

Under the P. C. P. Act great reliance has been placed on the labelling and on the common sense and good judgement of the Canadian Public. Some of the most toxic of chemicals have been used effectively and safely for several years. In spite of the highly hazardous nature of a few pesticides they have caused a relatively small number of serious accidents. This, I think, speaks well for the effectiveness of the Act and for the excellent job of publicity and extension which has been carried on between Government and industry.

The Province of Manitoba has a pesticide law further regulating some aspects of insecticide use.

The product registration under the P. C. P. Act is but one step in the development of the product. Then come the Provincial and Regional advisory committees on pest control who are the link with provincial extension services which in turn provide information direct to the farming public.

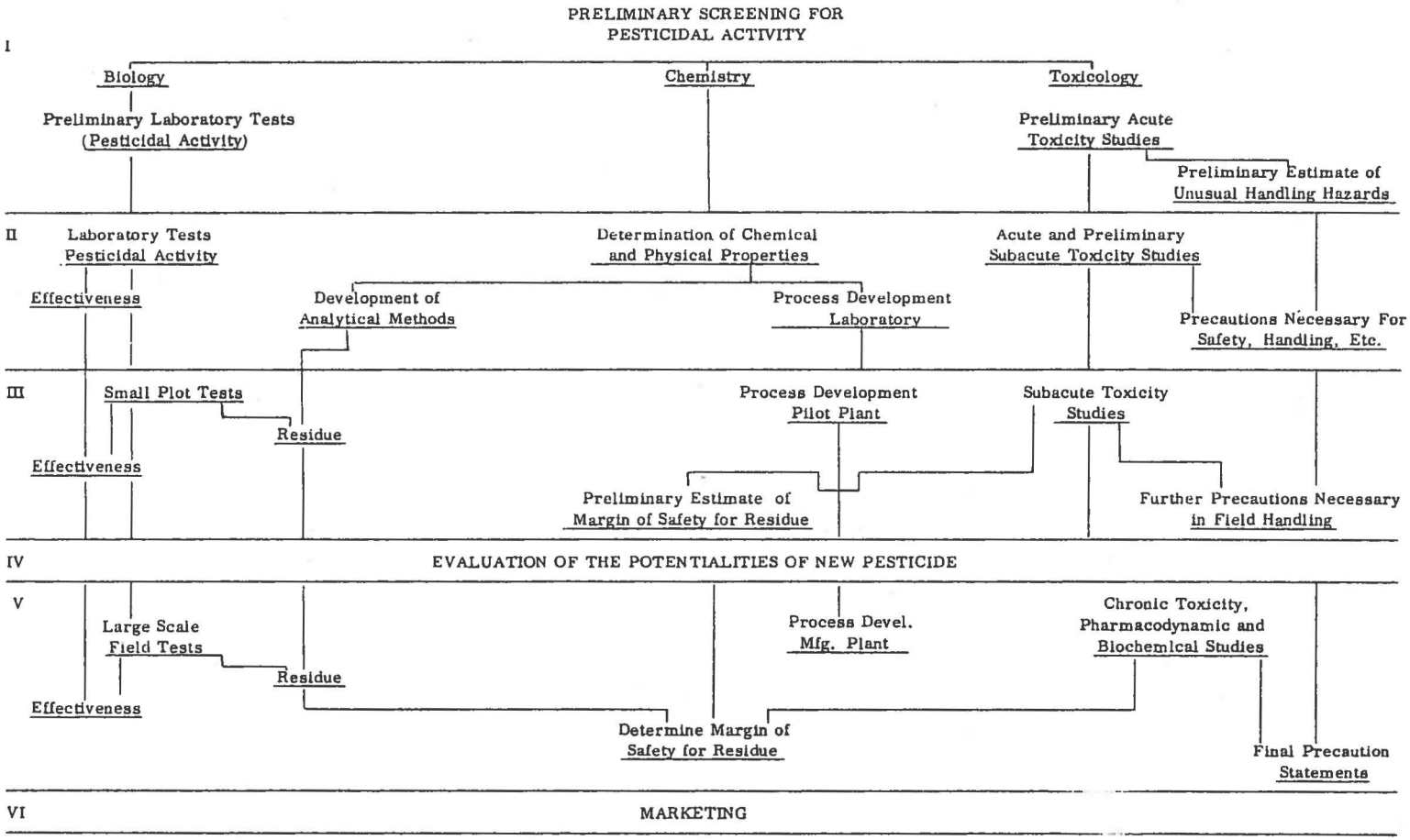
Each year these committees review existing information on pesticides and revise their recommendations accordingly. Constant liaison is maintained between research and extension to ensure that the user gets the advantage of the most effective, most economical and safest method of pest control.

The National Committee on Pesticide Use in Agriculture

This committee was formed to meet the need for national co-ordination and exchange of information. It is broken down into four separate groups in order that each phase of insect control could be properly considered.

(a) Livestock Insecticide Section
(b) Fruit Insecticide Section
(c) Vegetable Insecticide Section
(d) Cereal and Forage Insecticide Section

TABLE I. STAGES IN THE DEVELOPMENT OF A NEW PESTICIDE



Objectives of N. C. P. U. A.

1. To define problems and co-ordinate and stimulate research in the use of pesticides.
2. To summarize all available information and make it available to research, extension and industry.
3. To promote uniform principles to be used in drafting local recommendations for insect control.

Members from the Canadian Agricultural Chemical Association are an important part of this committee.

Summary

The use of pesticides must be continued and increased if we are to maintain increased crop production and continue to control diseases which are spread by insects. Continued use of pesticides will require the greatest degree of co-operation between industry and Government in future to ensure safe, efficient, knowledgeable use of these materials.

Proc. Entomol. Soc. Manitoba Vol. 19 (1963)

SUITABILITY OF CLIMATIC AREAS OF CANADA FOR INFESTATION OF SOME MAJOR STORED GRAIN INSECTS ON FARMS [1]

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Abstract

The relationship between the mean monthly temperatures in 500-bushel wheat bulks and the mean monthly air temperatures at 106 geographical locations in Canada was established theoretically. Monthly mean temperatures of 20 C or higher in unheated bulks were considered minimum for the development of most stored grain insects. From these relationships the number of months when such grain bulks would have temperatures suitable for the development of storage insects were calculated for the grain-growing areas. In Western Canada, the southern half of the grain-growing area was considered vulnerable to infestation of storage insects. While the entire grain-growing area in Eastern Canada was predicted to be vulnerable to some storage insects, only a small area where the average grain temperature exceeds 20 C for 5-7 months, extending south of a line in southern Ontario passing near Sarnia, London, Guelph, Peterborough, Brockville, and Cornwall was considered to be favourable for the development of the major storage insects such as Sitophilus granarius and S. oryzae. A small area in the vicinity of Chatham, Ontario alone is potentially suitable for the development of almost all major storage insects including Rhizopertha dominica and Trogoderma granarium. Analyses of the past records of infestation of stored grain by insects confirmed these predictions.

Over 150 species of insects have been found associated with stored products in Canada during the last 100 years. Many of these occurred occasionally and were not able to establish themselves. The main reason for their failure lies in the climate. Insect pests introduced accidentally with foodstuff imported from the warmer areas of the world usually die due to the severity of the winter. The surviving populations of some cold-hardy species also perish because the temperatures at which they can breed effectively are of short duration. Consequently, less than 300 species are presently considered as grain pests.

The acreage devoted to the three main field crops, wheat, oats, and barley, in Canada in 1961, was approximately 24, 11.5 and 9 million, respectively (Canada Bureau of Statistics, 1962). Most of this was in Alberta, Saskatchewan, and Manitoba, which have a widely variable continental climate. Thus, it is to be expected that the distribution of storage insects in unheated granaries on the farms would be influenced by the temperatures.

This paper outlines the climatic areas in which temperatures within small grain bulks are suitable for the development of storage insects.

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[1] Contribution No. 153 from the Research Station, Canada Dept. of Agriculture, Winnipeg, Manitoba.

The suitability of an area for the development of several major species of insects was estimated by counting the number of months for which the average temperature was 20 C (68 F) (Howe and Lingren, 1957). A monthly average temperature exceeding 20 C was considered necessary to allow the major species to multiply sufficiently to become a pest. Their minimum breeding temperatures in the laboratory are: Sitophilus oryzae (L.) - 15.2 C; Rhizopertha dominica (F.) - 18.2 C (Birch, 1944-; Cryptolestes ferrugineus Steph. - 17 C (Ashby, 1961); C. turcicus (Grouv.) - 17 C (Lefkovitch, 1962); Tribolium castaneum (Herbst) - 22 C (Howe, 1956b); Oryzaephilus surinamensis (L.) - 20 C (Howe, 1956a).

Wooden granaries of variable size and shape with a capacity of about 1,000 bu. are commonly used to store grain on farms in the Prairie Provinces. In order to simulate the conditions of grain storage, two 10 ft x 11 ft bins with wooden walls and concrete floor, were constructed under the same roof in Winnipeg, Manitoba; 500 bushels of wheat, 6 ft deep with about 14% moisture content, were stored in each bin in 1959. During 1959 - 1963, grain temperatures were measured at weekly and monthly intervals with copper-constantan thermocouples placed in 125 fixed locations at the surface, 1, 2, 3, and 4 ft levels. The mean value of temperature at 5 levels for each month was calculated for the 4-year period. The 6 monthly means were converted to plus or minus figures by subtracting them from the 30-year normal mean monthly air temperature recorded by the Meteorological Station, Winnipeg (Canada Department of Transport, Winnipeg, 1962). The theoretical grain temperatures for each month at the same levels in identical granaries located in other parts of the country were then calculated from the normal mean monthly temperatures at these locations (Canada Dept. of Transport, Meteorological Div., 1947; 1954). Four climatic zones within the grain growing areas of the Prairie Provinces were delineated on the basis of the number of months for which the average grain temperature at the 2 ft level was 20 C or higher (Fig. 1). The rise of grain temperature above 20 C for 4, 3, 2 or 1-months would determine whether an area is potentially liable to infestation. While a 3-month area is favourable for development of cold hardy storage insects, the most severe problem concerning these pests is expected to occur in 4-month areas. Two to 1-month areas are unfavourable for rapid multiplication of such insects.

Although many storage insects can survive and complete their life cycle in dry conditions, the optimum humidity for a great majority of them is rarely below 70% R. H. The moisture content corresponding to 70% R. H. for wheat at 20 C is 14%. In the Prairie Provinces, wheat is usually stored in farm granaries at 12.5 to 15.5% moisture content. Since changes in the condition of the external air have no influence on the atmosphere inside a grain bulk, the amount of moisture in the intergranular air spaces (which amount to 40-45% of the total volume) is determined by the moisture content of the grain. No great change from the initial storage moisture content, about 14.1%, was observed in the 4-year study of the two 500 bushel wheat bulks in Winnipeg. However, the moisture in the grain near the 2- and 3-ft levels increased approximately by 1.5% during the winter as the grain aged. This is why grain temperatures at the 2 ft level were used in preparing climatic maps. Insect infestations in small grain bulks on farms are usually found within the first 2 ft of the surface.

The prediction of the distribution of insects on a climatic basis is seriously limited because storage insects vary greatly in their ability to survive low grain temperatures in winter, to increase rapidly in higher grain temperature in summer, and to heat grain in unheated granaries. The rates of increase at various combinations of temperature and moisture for many common stored grain insects are not known. Therefore, the climatic zones dividing the grain growing areas of the Western and Eastern Canada, proposed in this paper, only reflect in a very general way the probable degrees of infestation by such insects.

Climatic areas potentially favourable or unfavourable to the development of stored products insects in small unheated farm granaries in each province are given in Table 1. In Western Canada, areas with less than 3 favourable months (Fig. 1) are not likely to be vulnerable to infestation by any stored-grain insect. The 3 and 4 month areas would be unsuitable for outbreaks of the major cosmopolitan pests, such as Sitophilus, Trogoderma and Rhizopertha (Howe, 1958), but Cryptolestes ferrugineus and Tribolium castaneum could cause trouble in certain years in these areas.

TABLE 1

Geographical Locations Potentially Favourable for Development of Storage Insects

Figures (from L. to R.) indicate the number of months grain temperature remains 20 C or above at 1, 3, and 5 ft depths in a 500-bushel wheat bulk.

A. Manitoba

Portage la Prairie	4-4-3	Gimli	3-3-3
Morden	4-4-3	Swan Lake	3-2-3
Morris	4-3-3	Minnedosa	3-2-2
Winnipeg	4-3-3	Moose Horn Bay	3-2-2
Dauphin	4-3-3	Ninga	3-2-2
Pierson	4-2-2	Birtle	2-2-2
Brandon	4-2-2	Swan River	2-2-2
Virden	4-2-2	Russell	2-2-2
Pinawa	4-2-2		

B. Saskatchewan

Pennant	4-4-3	Lintlaw	3-1-1
Maple Creek	4-4-3	Kamsack	2-3-2
Swift Current	4-3-3	Shaunavon	2-2-3
Midale	4-3-3	Dafoe	2-2-2
Aneroid	4-2-3	Strasburg	2-2-2
Assiniboia	4-2-2	Grenfell	2-2-2
Moose Jaw	4-2-2	Macklin	2-2-2
Estevan	3-3-3	Scott	2-2-2
Alsask	3-3-3	Melfort	2-2-2

B. Saskatchewan

Anglia	3-2-2	Whitewood	2-2-2
Outlook	3-2-2	Prince Albert	2-2-2
Davidson	3-2-2	Humboldt	2-2-1
Rosthern	3-2-2	Hubbard	2-1-1
Yorkton	3-2-2	Waseca	2-1-0
Regina	3-2-2	Quill Lake	2-1-0
Battleford	3-2-2	Loon Lake	2-1-0
Saskatoon	3-2-2	St. Walburg	2-1-0

C. Alberta

Medicine Hat	4-4-3	Strathmore	2-2-2
Manyberries	4-4-3	Edmonton	2-2-2
Lethbridge	3-4-4	Alix	2-2-1
Raymond	3-4-4	Ranfurly	2-2-1
Cardston	2-4-4	Wetaskiwin	2-2-1
Foremost	3-4-3	Coronation	2-1-1
Brooks	4-3-3	Viking	2-1-0
Bassano	4-3-3	High River	2-1-0
Pincher Creek	2-4-3	Elk Point	2-1-0
Calgary	2-3-3	Sion	2-1-0
Olds	3-2-1	Athabaska	2-1-0
Lloydminster	3-1-0	Beaverlodge	2-1-0
Hanna	2-2-2		

D. Ontario

Chatham	6-6-7	Kitchener	5-5-4
Leamington	5-5-6	Stratford	5-5-4
St. Catharines	5-5-6	Peterborough	5-5-4
Wallaceburg	5-5-6	Barrie	5-5-3
Simcoe	5-5-5	Owen Sound	5-4-4
Windsor	5-5-5	Woodstock	4-5-4
Brucefield	5-5-4	Georgetown	4-5-4
Collingwood	5-5-4	Almonte	4-4-4
Kingston	5-5-4	Mount Forest	4-4-4
Brockville	5-5-4	Alton	4-4-4
Brantford	5-5-4	Pembroke	3-4-4

E. Quebec, New Brunswick, and Prince Edward Island

Montreal, Que.	4-5-4-	Charlottetown, P.E.I.	4-4-4
Napierville, Que.	4-5-4	Joliette, Que.	4-4-3
Sherbrooke, Que.	4-4-4	Quebec City, Que.	4-4-3
Grand Falls, N.B.	4-4-4		

Climatic areas potentially favourable for the development of storage insects in Ontario, Quebec, and New Brunswick have been determined by the same method used for the prediction of similar areas in the Western Canada. The grain growing areas of Ontario are restricted to the southern part of the province which is tempered climatically by the proximity of the Great Lakes. Winter temperatures are less severe than those of the Prairie Provinces. In Quebec, the agricultural areas are also confined mainly to more southerly regions bordering the Ottawa and St. Lawrence Rivers. The climate in these regions is similar to that of the adjoining areas of Ontario, although slightly more extreme because of the lesser influence of the Great Lakes. Oats is the most important stored cereal in Ontario, Quebec, and Prince Edward Island because of its popular use as a feed grain. In 1961, approximately 1.6, 1.0 and 0.55 million acres were devoted to oats, mixed grain, and barley respectively in Ontario. In the same year, 1.3, 0.18, and 0.1 million acres of oats were grown in Quebec, New Brunswick, and Prince Edward Island respectively. The grain bulks in a small area in the vicinity of Chatham, Ontario, offer the most favourable conditions for the development of all major stored grain insects such as Sitophilus spp., Tribolium spp., Rhizopertha dominica (F.) Trogoderma granarium Everts. This is the only area in Canada where an average grain temperature in a small unheated granary exceeds 20 C for 6,6, 6, and 7 months respectively at 1, 2, 3 and 5 foot depths (Table 1, D). Under these conditions, the khapra beetle, the lesser grain borers, and granary weevils can be potentially very serious pests (Howe and Lindgren, 1957). The area where the average grain temperature exceeds 20 C for 5 months extends below a line in southern Ontario passing near Sarnia, London, Guelph, Peterborough, Brockville, and Cornwall (Fig. 2). Grain stored in this area is also potentially liable to infestations by the major storage insects, especially Sitophilus spp. but because of the adverse effect of competition (Birch, 1953) only 1 or 2 species of the Sitophilus - Rhizopertha - Trogoderma group is expected to do well in this area. On the basis of their intrinsic rates of increase, Howe (1958) showed that cooler and damper environment suits Sitophilus, a warmer and drier environment suits Rhizopertha dominica and the hottest and the driest environment is best for Trogoderma granarium Everts. Howe argued that the importance of T. granarium is reduced by the pressure of these other species (of somewhat similar temperature requirement) in the more humid environments and its chances of gaining a foothold is greatest in dry regions. Since the areas for which the average grain temperature was 20 C or more for 5 and 6 months are unusually humid due to the proximity of Lake Huron, Lake Erie, and Lake Ontario, Sitophilus species are expected to cause most severe infestations in farm granaries, although the other species can cause some trouble.

On climatic grounds, Tribolium, Oryzaephilus and Cryptolestes are likely to be important pests of the grain growing areas of Ontario, Quebec, New Brunswick, and Prince Edward Island. Selected meterorological stations in these provinces are listed in order of suitability of the areas they represent for the development of storage insects (Table 1 D-E).

Predictions of the distribution of storage insects on a climatic basis can be tested by means of insect distribution data compiled from the past records of infestations and outbreaks. Such records for most areas are unavailable. However, some idea of the validity of the predictions can be obtained from the following examples.

The insects which commonly occur in farm-stored grain in the Prairie Provinces are mainly the rusty grain beetle, foreign grain bettle, several species of flour beetles and fungus beetles (Lathridius and Crypotophagus), saw-toothed grain beetle, spider beetles, psocids, Cepalonomia, and meal moths. Infestations of the rusty grain beetle and 1 or more of the other insects have been reported to the Stored Products Insect Laboratory, Winnipeg, from various locations in Manitoba and Saskatchewan. In 1954-58, no infestation was reported from the area where a monthly average of 20 C is reached for only 2 months. Thirty four and 66 per cent of the yearly infestation reports originated from the areas in which 20 C developmental minimum was reached for 3 and 4 months, respectively. In 1963, 43 and 55% of 76 reports received came from the 3 and 4-month areas, respectively. Saskatchewan: In 1953-57, 6, 66, and 31% of the reports originated from areas where a monthly average of 20 C is reached for 2, 3, and 4 months, respectively. No report was received from the 1-month area.

These fragmentary records indicate that in the Prairie Provinces most infestations of stored grain insects are confined to the climatic zones where the average monthly temperature of 20 C is reached for at least 3 months.

Stirrett and Arnott (1933) reported the following insects from farm granaries in southern Ontario - rice weevil, granary weevil, saw-toothed grain beetle, red-flour beetle, rusty grain beetle, flat-grain beetle, foreign grain beetle, cadelle, meal worms, psocids, two-banded fungus beetle, and Typhaea fumata L. A severe outbreak of the granary and rice weevil, red-flour beetle, and saw-toothed beetle occurred in an area south of a line from Sarnia to Stratford and Hamilton during 1930-32. The worst infestations were reported in the vicintiy of Chatham, Essex and Kent Counties, although reports were received from other parts of the province as well. This report confirms the prediction made earlier that the most favourable area for the development of major storage insects such as the granary weevil in the Eastern Canada is a climatic zone where a monthly average of 20 C reaches for 5 and 6 months.

Such predictions of distribution of storage insects on climatic basis may be profitably used in future programs for the prevention and control of infestations in the following way.

(1) Survey patterns can be planned and modified by emphasizing the areas most vulnerable to infestation.

(2) Extension work by the provincial authorities on insect control and grain storing practices can be intensified in the most vulnerable areas and relaxed in less vulnerable areas.

(3) Some of the quarantine regulations affecting the storage insects may be re-examined, since many of the harmful insects have little chance of becoming established in most grain storage areas of the country.

(4) Attempts can be made to eradicate or keep permanently in check certain key insect pests in some unique areas of the country such as the areas of southern Ontario bordering Lake St. Clair, Lake Erie, and Lake Ontario.

FIGURE 1

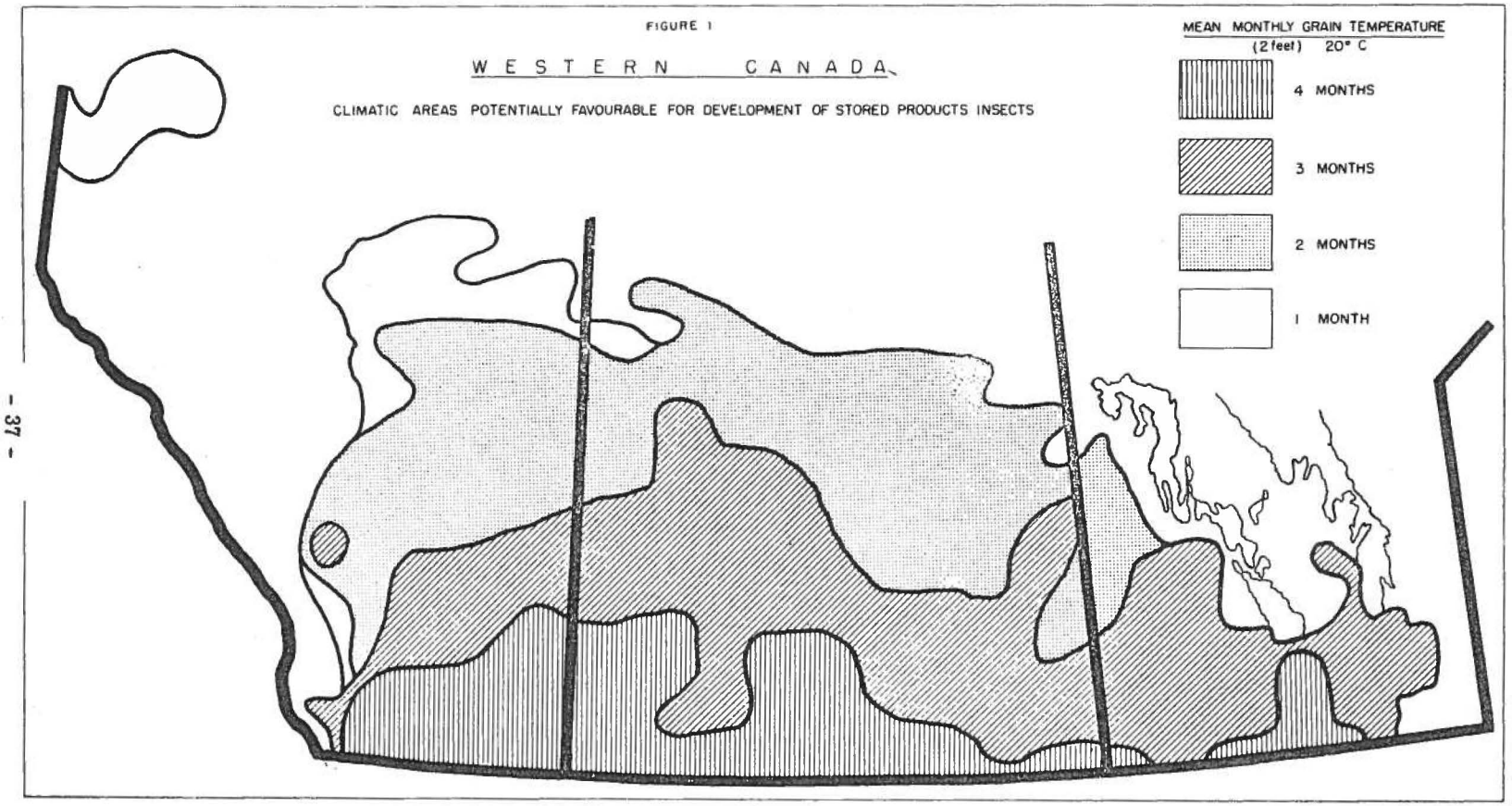
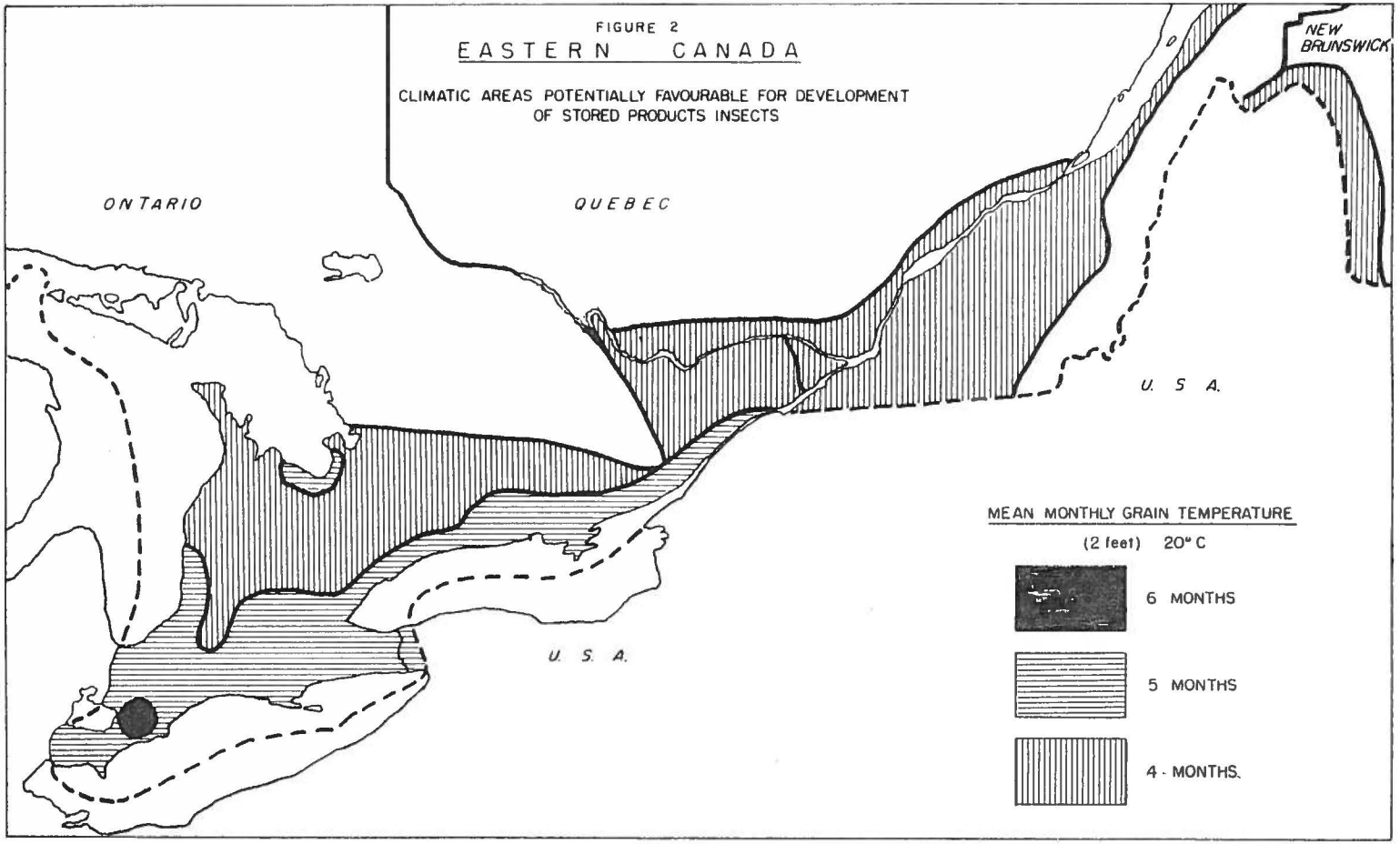

WESTERN CANADA
CLIMATIC AREAS POTENTIALLY FAVOURABLE FOR DEVELOPMENT OF STORED PRODUCTS INSECTS
MEAN MONTHLY GRAIN TEMPERATURE
(2 feet) 20° C
4 MONTHS
3 MONTHS
2 MONTHS
1 MONTH

FIGURE 2

EASTERN CANADA

CLIMATIC AREAS POTENTIALLY FAVOURABLE FOR DEVELOPMENT OF STORED PRODUCTS INSECTS



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PLANT GROWTH DILUTION AND THE DECLINE OF INSECTICIDE RESIDUES FROM ALFALFA IN MANITOBA [1]

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Introduction

By 1961 it was not established that effective nonpersistent insecticides would be available for grasshopper control in forage crops. Accordingly, the decline of insecticide deposits from the early season crop of alfalfa and the effect of growth dilution in decreasing residues was examined under Manitoba conditions.

This paper reports the degradation of residues of the persistent insecticides Dieldrin and Chlordane in comparison with Guthion. The results for Guthion are compared with data from Iowa reported by Dahm et al. (1959).

Climatic conditions in June 1961 were unusual; precipitation was the lowest on record, the mean temperature has only been exceeded by 0.2 degrees previously and it was the sunniest month (370.4 hours, 76% of total possible) in Winnipeg history.

Materials and Methods

Duplicate randomized blocks were set up in a field of alfalfa near Winnipeg. Plots 13 x 120 ft. in size were arranged so that each was separated by 23 ft. to avoid spray drift. The insecticides used were emulsion concentrates of Dieldrin, Chlordane and Guthion that contained 2, 4 and 1.8 pounds, respectively, of actual insecticide per imperial gallon. The sprays were applied May 31 with a self-propelled plot sprayer at 45 pounds pressure that delivered 14.5 to 16 gallons per acre. The rates of actual insecticide applied were calculated from the amounts of spray delivered to the duplicate plots provided for each treatment. Dieldrin Chlordane and Guthion were applied at 1, 2, 8.8 and 14.0 ounces actual insecticide per acre when the crop was 4-6 inches high. The first samples of Alfalfa were collected for analysis within six hours after spraying, the remainder 1, 3, 9 and 27 days later.

Plant growth between these intervals was determined by cutting and weighing the plants on 4-square foot areas at 15 locations spaced throughout the length of each plot. Samples for analysis were prepared by taking plants from each location, mixing and drawing composite samples of 1300 grams. These were frozen and retained for analyses.

Dieldrin residues were determined by the Pesticide Residue Laboratory of the Manitoba Department of Agriculture and Conservation, using G.L.C. - electron capture. Velsicol Chemical Corporation, Chicago used the method of Ordas, Smith and Meyer (1956) for Chlordane. Guthion was determined by Chemagro Corporation, Kansas City, by a specific method (1961).

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[1] Contribution No. 156 Canada Department of Agriculture Research Station, Winnipeg, Manitoba.

The procedures followed in Iowa were described by Dahm et al. (1959) but it is appropriate to point out that they applied Guthion at 16 oz. actual in 10 gallons of spray to alfalfa 18 inches high on July 16th. The intervals they used for residue sampling and measurement of plant growth are shown in Table 1.

Results and Discussion

Table 1 shows the increase in forage weight per unit area, the residues reported for the intervals after spraying, the percentage reduction from the initial deposits, the percentage reduction attributed to growth dilution and the remainder attributed to other causes. The effect of growth dilution was calculated on the assumption that the initial residue is only diminished by plant accretion and therefore represents the maximum effect of this factor. The initial insecticide residue was therefore divided by the forage weight increase. The figures were first calculated for each plot but the data were combined for tabulation as this did not affect the results.

Table 1. Decline of insecticide residues on alfalfa, after one spray application.

Insecticide OZ/A	Days after spray	Forage weight increase	Residue (p. p. m.)	Reduction of initial deposits %		
				actual	growth dilution	remainder
Dieldrin	0	1.0	1.85			
1.2	1	-	0.99	46.5		
	3	1.63	0.73	60.5	38.6	21.9
	9	1.96	0.17	90.8	48.9	41.9
	27	2.89	0.065	96.5	65.4	31.1
Chlordane	0	1.0	1.32			
8.8	1	-	0.75	43.2		
	3	1.69	0.42	68.2	41.0	27.2
	9	2.22	0.39	70.5	54.9	15.6
	27	2.81	0.16	87.9	64.4	23.5
Guthion [1]	0	1.0	72.7			
(Manitoba)	1	-	54.0	25.7		
14.0	3	1.67	21.2	70.8	40.2	30.6
	9	1.86	4.0	94.5	46.2	48.3
	27	2.84	0.6	99.2	64.8	34.4
Guthion [2]						
(Iowa)	0	-	69.4			
16.0	1	1.0	51.6	25.6		
	3	1.09	23.5	66.1	9.0	57.1
	7	1.41	8.1	88.3	29.3	59.0
	14	1.52	1.4	97.9	34.5	63.4
	21	1.47	0.2	99.7	32.0	67.4
	28	1.09	0.1	99.9	8.3	91.5

[1] Rainfall 0.05 and 0.09 inches recorded 1 and 9 days after spraying.

[2] Rainfall 0.42, 0.10, 0.65, 0.10 and 0.12 inches recorded 5, 11, 12, 14, and 28 days after spraying.

In Manitoba forage weight continued to increase on the treated plots for 27 days after spraying, increasing 2.8 to 2.9 times. In Iowa this weight increased only 1.5 times during the first 14 days, then declined to 1.1 times the initial weight.

Mean temperatures (degrees F.) for the four weekly periods after spraying were: -

Manitoba	69	67	65	68
Iowa	81	76	73	78

Rainfall recorded for the duration of the sampling intervals is shown in Table 1.

Dieldrin and Chlordane lost a larger proportion of the initial deposit in the first day than Guthion. However, Guthion residues were less persistent than Dieldrin and Chlordane residues, when plant growth dilution was essentially the same. Furthermore, the residues of Dieldrin and Chlordane remaining after 27 days, probably were sufficient to contaminate animal products if the forage was fed to cattle. Guthion residues declined in Manitoba and Iowa at similar rates. Growth dilution was more important to this loss in Manitoba, when early season growth was rapid. But also Guthion residues were dissipated more rapidly by other causes than Dieldrin or Chlordane residues. In Iowa other factors such as higher temperatures and greater rainfall were more important than growth dilution in the loss of Guthion residues from a well established crop. The slightly higher overall loss shown for Iowa, probably resulted from the marked loss of foliage during the fourth week.

Acknowledgement

The author wishes to thank Mr. B. Berck for assistance in planning this investigation. Chemical analyses were completed by Velsicol Chemical Corporation, Chicago; Chemagro Corporation, Kansas City; and the Pesticide Residue Laboratory of the Manitoba Department of Agriculture and Conservation, Winnipeg.

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APPENDIX I

EXECUTIVE

1962-63	1963-64
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L. B. Smith Canada Agriculture Research Station, Box 6200 Winnipeg 1, Manitoba.	W. G. H. Ives Forest Entomology Laboratory Box 6300 Winnipeg 1, Manitoba.
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APPENDIX II

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APPENDIX III

FINANCIAL STATEMENT AS OF NOVEMBER 20, 1963

Receipts	
Balance on hand (C/A previous statement April 9/63)	$ 64.00
Fees	372.00
Cheque - Received but not withdrawn	8.00
Sale of Proceedings	18.25
U. S. Exchange 1.07 + .07	1.14
	$ 463.39
Savings Account 5917	445.52
Interest on Savings Account	14.27
	$ 459.79
	$ 923.18
Expenditures	
Fees to the Entomol. Soc. of Canada	$ 286.00
Typing of Proceedings	140.00
Reprints	28.58
Postage	22.31
Banquet - Gratuities	5.00
University of Manitoba (Coffee)	3.10
University of Manitoba (Film rental)	1.50
Telegram (Re - Loan of Linnaeus film)	3.48
Outstanding cheque	8.00
Bank (Service charge)	.30
	$ 498.27
	$ 424.91
Bank Balance	
Savings Account $459.79 - $ 59.00* =	$ 400.79
Current Account	24.12
	$ 424.91

*Transferred to Current Account

Submitted by W. Romanow, Treasurer.
Audited by A. G. Robinson and P. H. Westdal.

APPENDIX IV

ADDITIONS TO THE LIBRARY

OF THE ENTOMOLOGICAL SOCIETY OF MANITOBA

1. Acta entomologica Musei nationalis Pragae. Vols. 31-35,1957-63.
2. Annals of the Entomological Society of Quebec. Vol. 1, 1956; Vols. 5-7, 1959-62.
3. Gembloux, Belgium, Laboratoire de zoologie générale institut agronomique de l'état. (Reprints from Jean Leclercq.)
4. Liege, Belgium. Universite. Institut Leon Fredericq, Biochimie. (Reprint material.)
5. Nebraska. Agricultural Experiment Station. Quarterly, 1963.
6. Nebraska. University. College of Agriculture. (Reprint material, 1963.)
7. Pest infestation research. (Great Britain. Agricultural Research Council. Report of the Pest Infestation Laboratory, Slough, England). 1962.
8. Polska akademia nauk. Instytut zoologiczny. Warsaw, Poland. Annales zoologici. Vol. 20, nos. 17-22, 1962-63; vol. 21, Nos. 1-19, 1963.
9. Polska akademia nauk. Instytut zoologiczny. Warsaw, Poland. Fragmenta faunistica. Vol. 10, Nos. 17-29, 1962-63.
10. Polska zwiazek entomologiczny. Warsaw, Poland. Klucze do oznaczania owadow Polski (Keys to the designation of insects in Poland). Ser. 29-42, 1963.
11. Proceedings of the Entomological Society of British Columbia. Vol. 60, 1963.
12. Redia; giornale di entomologia. (Florence, Italy. Stazione di entomologia agraria) Vol. 47, 1962.
13. Studi sassaresi; Annuli della Facolta di agraria dell'Universita di Sassari. Sez. 3, Vol. 10, 1962.
14. Zastita bilja; Plant protection. (Savenzni institut zastitu bilja, Belgrade, Yugoslavia) Nos. 69-71, 1962-63.