SOME FACTORS REDUCING CARROT SEED YIELDS IN BRITISH COLUMBIA[1]

DAVID A. ARNOTT[2]

Field Crop Insect Section, Entomology Laboratory, Kamloops, B.C.

Commercial production of carrot seed in Canada is confined to British Columbia and most of it has for many years been grown at Grand Forks. In earlier years good yields were obtained, growers had little or no difficulty with pests or diseases, and returns were satisfactory. During the Second World War, when seed could not be imported, acreage was greatly increased to meet domestic needs. With the increase in acreage over a period of years, certain insects and diseases increased to such an extent that they caused serious damage to crops. Since the war, production has declined because of (1) the availability of imported seed at competitive prices and (2) the marked reduction in yields resulting from damage by insects, diseases, and some other factors. Although imported seed has to a considerable extent replaced home-grown seed it is considered that domestic production can still be profitable if satisfactory yields can be obtained. This paper deals with the chief factors in reduced yields in recent years.

Insect Pests

During 1947 and 1948 heavy infestations of a plant bug caused severe reductions in carrot seed yields at Grand Forks (Handford, 1949). At that time the insect was identified by the Taxonomic Unit, Ottawa, as *Lygus campestris* (L.), a European species recorded by Knight (1917, 1941) as widely distributed in North America and a pest of celery in Eastern Canada. (Brittain 1918) recorded this species as injurious to parsnip seed in Nova Scotia, and Matthewman (1941) reported damage by it to celery in Ontario. The bug is recorded by Alexander (1943) and by Whitcomb (1953) as a pest of celery in Massachusetts. Parshley (1919, 1921) refers to it as having been taken in the interior of British Columbia during 1917, but it had not been known as a crop pest in the province until 1947. In 1952 specimens of the bug from infested carrot seed fields at Grand Forks were identified by Mr. L. A. Kelton (in litt.), Entomology Division, Ottawa, as of a Nearctic species, *L. scutellatus* (Uhl.), the identity of which had been established by Wagner and Slater (1952). There is now much doubt that *L. campestris* occurs in North America. It is very likely that the earlier records concerned *scutellatus*. Strickland (1953) has recorded *scutellatus* from various localities of southern Alberta.

Subsequent study by the author showed that *L. scutellatus* is widely distributed in the southern interior of British Columbia, where it normally breeds on wild unbelliferous plants such as cow parsnip (*Heracleum lanatum* Michx.), water hemlock (*Cicuta douglasii* Coult. and Rose), and hemlock water parsnip (*Sium cicutaefolium* Schrank.). The bug was also found infesting seed plants of parsnip and dill at Grand Forks, but seed damage was negligible. Infestations have occurred annually in seed crops at Grand Forks since 1947 but none have been observed elsewhere except in one field at Armstrong in 1949 (Handford and Neilson, 1949). The insect has not been found damaging carrot root crops, the only case of infestation so far observed being a single adult taken in a field at Armstrong during 1953 by Dr. R. H. Handford, Officer-in-Charge of the Kamloops laboratory.

Experiments conducted by Handford (1949) demonstrated that *L. scutellatus* could be controlled with DDT and the seed yield doubled as a result. The outbreak subsided in 1949 and since then no significant damage has

1 Contribution No. 3343, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.

2 Associate Entomologist.

TABLE I.—Effects of Diseases on Germination and Yield of Carrot Seed, Grand Forks. B.C., 1952 and 1953.

Field	Percentage of growing plants affected by Blight	Black rot	Percentage of plants killed by root rots early in season	Germination %	Seed yield lb. per acre
Starchuck, 1952	6	3	trace	—	1674
Cutt, 1952	trace	trace	trace	85	764
Cutt, 1953	0	2	3	71	821
Moore, 1953[1]	2	3	8	78	780
Moore, 1952	10	4	8	—	695
Holobofl, 1953[1]	trace	5	9	80	634
Abrosimoff, 1952	trace	5	30	85	614
Semenoff, 1952	4	3	32	87	597
Big-Y, 1952	15	8	20	86	563
Peterson, 1952	trace	4	41	87	545
Kazakoff, 1952	77	trace	trace	85	527
Semenoff, 1953	trace	10	25	84	320
Wirischagin, 1952[2]	76	many	trace	86	242
Samsonoff, 1952[1]	2	25	3	88	110

[1]Part of crop damaged by wireworms.
[2]Crop severely infected with aster yellows virus.

been caused by this species in British Columbia. As the insect is a native species established on wild host plants throughout the southern interior of the Province, it is reasonable to assume that outbreaks may occur again.

Surveys made by the author at Grand Forks during 1951 and 1952 showed that many kinds of insects frequent carrot seed crops, most of them being harmless. Some are beneficial as crop pollinators or as predators of injurious species. However, several kinds that might be injurious were present in most fields. These included springtails, thrips, aphids, leafhoppers, wireworms, grasshoppers, and various plant bugs, including several other species of *Lygus* than *L. scutellatus*. Large numbers of springtails, thrips, and leafhoppers were found in some crops but they appeared to cause no serious damage. Populations of grasshoppers and plant bugs other than *L. scutellatus* have been very small and injury by them has been insignificant. Most crops are infested annually by small numbers of *Lygus elisus* Van. D., *L. lineolaris P.* de B., *L. atriflavus* Kgt., and *L. schulli* Kgt. In 1950 Dr. H. R. MacCarthy (unpublished), of the Kamloops laboratory, carried out an experiment at Grand Forks with adults of the *L. elisus-lineolaris* group by caging them on umbels in various stages of bloom and seed development. He found that 10 bugs feeding on umbels in the late-bloom stage for 10 days caused a marked reduction in seed yield but that at other stages of growth seed yield was not affected significantly.

Since the outbreak of *L. scutellatus* during 1947 and 1948, the only noticeable insect damage at Grand Forks has been caused by the Pacific Coast wireworm, *Limonius canus* Lec. Parts of one or two fields during each of the last three years have been infested. The wireworms attack roots soon after planting, so that many plants are killed early in the season or become so damaged that no bloom or seed develops.

Diseases

After the insect outbreaks of 1947 and 1948 crops generally improved but some growers still obtain yields much below average. In the absence of serious insect damage, observations were made to determine what other factors might be responsible. During 1948 Handford (1949) observed that in some fields many plants died within

a few weeks after planting, the roots having rotted completely. In 1950 Dr. MacCarthy (unpublished) observed that many plants in some fields showed symptoms of infection by a bacterial blight and that loss of plants from root rots ranged from 6 to 27 per cent. In 1951 the author observed similar infection of growing plants and that considerable plant loss resulted from root rots. In some badly infected fields, areas from 10 to 30 feet in diameter were devoid of plants and blank spaces of 2 to 20 feet along rows were common. Further study during 1952 and 1953 showed that diseases were the chief cause of marked reductions in yield.

Root rots are responsible for most of the plant loss from disease. Many infected roots rot completely soon after planting. Much of the loss is primarily due to black rot, caused by *Stemphylium radicinum* (Meier, Drechsl., and Eddy) Neerg. Roots may have only slight or incipient infection when planted in the field, but later rot so extensively that the roots wither and die before seed matures properly. Other rots are caused by *Sclerotinia sclerotiorum* (Lib.) de Bary, *Botrytis cinerea* Pers., and *Fusarium spp.* Bacterial rots, probably due mostly to *Erwinia carotovora* (L. R. Jones) Holland, also occur, and these frequently act as secondary rots following initial damage by the black rot organism. Fields surveyed by the author during 1952 and 1953 showed that root rots reduced some crop stands as much as 40 per cent.

Two other diseases that attack carrot seed crops are a bacterial blight, *Xanthomonas carotae* (Kendr.) Dowson, and yellows, caused by the aster yellows virus. The bacterial blight may affect the whole plant or only part, causing severe damage to plant tissues. Frequently complete or partial blasting of umbels by this blight destroys bloom and seed. Although blight has been common, it has not been severe enough at Grand Forks to seriously affect total crop yields.

Occurrence of the yellows disease is sporadic in some fields but in others it may be abundant, as in one field during 1952, when the entire crop developed a yellowish colour. The umbels were much smaller than normal. Many flowers became infertile due to imperfect formation. Yield from this field amounted to only 242 pounds of seed per acre compared with the average of 600 pounds. This disease is spread by a leafhopper during its feeding on plants and primary infection usually occurs the first year on steckling plants.

The effects of the diseases on seed production are shown in Table 1. Crops with least infection produced the highest yields. The poorest yields were obtained from those crops severely infected with root rots. Although the diseases caused serious reductions in seed yields, they apparently had no adverse effect on germination, percentage germination of seed from badly infected crops being as high as that of seed from the least infected ones.

There are other factors that also tend to reduce yields. Low soil fertility, careless cultivation, and improper crop management, especially at planting and harvest, result in a certain amount of seed loss yearly, and no doubt these factors account for the variations within the infected and relatively uninfected crops.

Summary

Bacterial blight, black rot, several other species of root rot, and aster yellows virus damage carrot seed crops at Grand Forks, British Columbia. Black rot and the other root rots are responsible for most of the damage, and since 1948 these diseases have been the chief cause of serious reduction in seed yields. A native plant bug, *Lygus scutellatus* Uhler, caused severe reductions in yield during 1947 and 1948. It has not been a serious pest since that time but it is common and widely distributed throughout the southern interior of British Columbia, where it breeds on several wild species of Umbelliferae as

well as on seed crops of parsnip and dill; hence it may be assumed that outbreaks may occur again. Other species of *Lygus* have proved capable of reducing seed yields under caged conditions, but outbreaks have not occurred in carrot seed crops in British Columbia. Sporadic infestations of the Pacific Coast wireworm have occurred in some crops, but damage has not been serious. Other injurious insects infest carrot seed crops, but they have not caused serious damage at Grand Forks.

Acknowledgments

The author is indebted to Dr. R. H. Handford, Officer-in-Charge of the Kamloops laboratory, for data on the insect outbreaks of 1947 and 1948 and on control of the bug *L. scutellatus*. Data for 1950 on insect infestations, prevalence of disease, and damage done by bugs of the *L. lineolaris-elisus* group were kindly provided by Dr. H. R. MacCarthy of the Kamloops laboratory. For identification and appraisal of diseases attacking carrot seed crops, the author gratefully acknowledges the assistance of Mr. G. E. Woolliams, Associate Plant Pathologist, Plant Pathology Laboratory, Summerland, B.C. Wild host plants on which *L. scutellatus* breeds in the southern interior of British Columbia were kindly identified by Dr. T. M. C. Taylor, Head, Department of Botany, University of British Columbia, and Messrs. W. L. Pringle and A. McLean, Dominion Range Experiment Station, Experimental Farms Service, Kamloops, B.C.

References

Alexander, C. P.. Department of Entomology. *In* Annual report, 1942, 34-40. Massachusetts Agr. Expt. Sta. Bull. 398, 1943.

Brittain, W. H. Notes on *Lygus campestris* Linn. in Nova Scotia. Proc. Ent. Soc. Nova Scotia, 1918; 76-81. 1919.

Handford, R. H. *Lygus campestris* (L.): A new pest of carrot seed crops. Can. Ent. 81: 123-126. 1949.

Handford, R. H., and C. L. Neilson. Insects of the season 1949 in the interior of British Columbia. *In* The Canadian Insect Pest Review 28: 7-10. Canada Dept. Agr., Div. Ent. (processed). 1949.

Knight, H. H. A revision of the genus *Lygus* as it occurs in America north of Mexico, with biological data on species from New York. Cornell Univ. Agr. Expt. Sta. Bull. 391: 592-594. 1917.

Knight, H. H. The plant bugs, or Miridae, of Illinois. Illinois Nat. Hist. Surv. Bull. 22. 1941.

Matthewman, W. G. *In* The Canadian Insect Pest Review 19: 198. Canada Dept. Agr., Div. Ent. (processed). 1941.

Parshley, H. M. On some Hemiptera from Western Canada. Univ. Michigan, Occasional Paper Mus. Zool. No. 71. 1919.

Parshley H. M. A report on some Hemiptera from British Columbia. Proc. Ent. Soc. British Columbia (Syst. Ser.) 18: 13-24. 1919.

Strickland, E. H. An annotated list of the Hemiptera (S.L.) of Alberta. Can. Ent. 85: 193-214. 1953.

Wagner, E., and J. A. Slater. Concerning some Holarctic Miridae (Hemiptera, Heteroptera). Proc. Ent. Soc. Washington 54: 273-276. 1952.

Whitcomb, W. D. The biology and control of *Lygus campestris* L. on celery. Univ. Massachusetts Agr. Expt. Sta. Bull. 473: 1-15. 1953.

House Fly Maggots Infesting a Child's Bed

In October 1952, a public health inspector brought in from North Vancouver, some very small maggots which had been removed from the surface and from inside the fabric of a mattress of a child's bed.

The inspector said that a similar infestation had occurred earlier that season on an expensive mattress recently purchased with a new bed. The owners had contacted the store from which the bed had been purchased and they and the manager of the store and the health inspector, had shredded the mattress and found many maggots and puparia inside the stuffing. The store then replaced the mattress and shortly afterwards, more maggots were found in the new one. As usual in such cases, the people concerned considered they had done the right thing

by drenching the mattress, the bed and the room, with insecticide. However, the inspector saved six maggots to bring to me. Three of these died shortly afterwards, but three pupated and between November 14 and November 18, three flies emerged which I identified as *Musca domestica* Linn. the common house fly. The flies were scarcely half the size of normal house flies so I sent one to Mr. G. E. Shewell, Division of Entomology, Ottawa, who confirmed my identification.

The inspector said that the house where the infestation occurred was right on the sea shore, belonged to people of some substance, was extremely clean and well kept and that the housewife declared that the baby's bed was always covered with a rubber sheet under the normal bed clothes. Probably the rubber sheet leaked and the mattress became soaked with urine, and when it was hung out to dry, the flies laid eggs upon it; certainly a diet of urine was famine rations because the maggots were half starved and stunted and the flies were the smallest I have ever seen of this species.

Amongst a long list of substances on which or in which house fly maggots can develop Hewitt* records "substances contaminated or mixed with excremental products, such as bedding from piggeries and from rabbits and guinea pigs, paper and textile fabrics which have been contaminated, as cotton and woollen garments, sacking, rotten flock-beds, straw mattresses, cess pools, etc.", but he does not mention urine-soaked material specifically, *i.e.*, material contaminated with urine only. (There *is* a recent reference to house flies developing on urine alone but I cannot locate it at this time.—*G. J. Spencer, University of British Columbia.*

* Hewitt C. Gordon, 1910. The House Fly. Manchester University Press.

SOME UNUSUAL RECORDS OF BEETLES IN VANCOUVER

G. J. SPENCER

Department of Zoology, University of British Columbia.

Two blocks from my house in West Point Grey are several rhododendron bushes whose lower leaves have been ragged for years. On May 20, 1952, I examined them at night with a flashlight, swept the bushes thoroughly and recovered a few specimens of *Brachyrhinus singularis* L. the clay-coloured weevil which injures laurel hedges so extensively in Vancouver, but more specimens of a weevil identified for me as *Strophosoma melanogrammus* Forst, an insect slightly smaller than the clay-coloured weevil. In his Catalogue of the Coleoptera of North America Leng lists one species (16641) in this genus, *S. coryli* (Fab.); I do not know when Forst named this second species. Andison (Proc. B.C. Ent. Soc. 38, 1942) mentions that Kaven in Germany found *B. singularis* attacking rhododendron, but this instance of *S. melanogrammus* would seem to be a new record for this species on this host.

Another unusual record is of a small bettle *Barypeithes pellucidus* Boh., No. 16672 in Leng's Catalogue, the only species in this genus, listed as "introduced" from Old France and recorded from New England and New York. This beetle was sent in to me from Burnaby where it was found in tunnels of one of our native death watch beetles *Coelosthetus* which was burrowing freely in timbers of an old house, heavily attacked by dry rot. Chunks of wood were sent to me (25.V.1953) and I recovered the beetles from the tunnels. This was the second time that I have taken this beetle from tunnels of *Coelosthetus*; but the first time I mistook them for strawberry root weevils that had merely sheltered in the wood and, unfortunately I discarded them. The insects which are slightly smaller than the strawberry root weevil, have a shining black head with very dark brown thorax, dark brown elytra and tan-coloured legs and antennae. It may be that this beetle is a predator on some stage of *Coelosthetus*; its occurrence in the death watch tunnels seems to be hardly accidental.

A third rather unusual beetle record is of a small Nitidulid, *Meligethes nigrescens* Stephens, not mentioned in Leng's Catalogue. Specimens of this insect were brought to me in April, 1953, from a neighbouring golf course