A QUALITATIVE SURVEY OF DISEASES OF SOME SPECIALTY CROPS IN SASKATCHEWAN IN 1970 AND 1971: SUNFLOWER, SAFFLOWER, BUCKWHEAT, LENTIL, MUSTARDS, AND FIELD PEA

R.A.A.Morrall, D.L.McKenzie, L.J.Duczek, and P.R.Verma[1]

Abstract

This survey of diseases of sunflower (Helianthus annuus), safflower (Carthamus tinctorius), buckwheat (Fagopyrum esculentum), lentil (Lens culinaris), mustards (Brassica hirta 'Yellow' and B. juncea 'Oriental' and 'Brown'), and field pea (Pisum sativum var. arvense) was undertaken to identify potential disease problems on crops which could become more important in Saskatchewan. The two most widespread severe disorders were blight of field pea caused by Ascochyta pinodes, and herbicide damage of sunflower. Other noteworthy diseases recorded were alternaria leaf spot of safflower, aster yellows of buckwheat, a late root rot complex and alternaria black spot of the mustards, fusarium root rot of field pea, and sclerotinia stem rot of sunflower, lentil, the mustards, and field pea.

Introduction

In recent years there has been considerable interest in Saskatchewan in crop diversification because of a large oversupply of hard red spring wheat, and a consequent rural economic slump. While the main result has been larger acreages of coarse grains, such as barley, and oilseeds, such as rapeseed (Duczek and Morrall 1971), diversification has also led to increased acreages of several specialty crops (Table 1). With those such as sunflower and field pea, there has simply been renewed interest in a crop grown for a number of years on the prairies, while with others, such as lentil and buckwheat, the crops are relatively new to the province.

The diseases that affect these specialty crops seem to be well known in only some instances. Some idea of the extent of knowledge can be obtained by examining entries in sources such as Conners (1967), the USDA Index of plant diseases (1960) and the host–pathogen index of Review of Applied Mycology (C.M.I., 1968). There have been, at best, only sporadic records of diseases on the crops in Saskatchewan (Conners 1967). Clearly, if these crops are to become established in the province, cognizance must be taken of their diseases, and any serious threats to production should be identified so that attempts at control may be initiated.

[1] Authors' address, Department of Biology, University of Saskatchewan, Saskatoon; present address of L.J. Duczek, Department of Botany, University of Toronto, Toronto, Ontario.

Though acreages may be small in Saskatchewan (Table 1) compared with those of cereals and rapeseed, the crops are of great significance to individual growers. Moreover, it is conceivable that one or more of them could, with changing markets and requirements, show a dramatic increase in acreage such as occurred with rapeseed in the last 10 years. Interest on the part of plant breeders will be a factor in this connection. Another factor may be the extent of new irrigation farming in areas such as the Outlook district; irrigation will, of course, also be important with respect to crop pathology.

This paper is the report of a preliminary survey of the diseases of six specialty crops in Saskatchewan. The work was done over a 2-year period, in 1970 and 1971, but fieldwork was much more extensive in 1971. The crops included were buckwheat (Fagopyrum esculentum Moench), sunflower (Helianthus annuus L.), safflower (Carthamus tinctorius L.), lentil (Lens culinaris Medik.), field pea (Pisum sativum var. arvense L.) and the mustards Brassica hirta Moench 'Yellow', and B. juncea (L.) Coss 'Oriental' and 'Brown'.

Methods

The survey was, of necessity, qualitative. However, this was not considered to be a serious disadvantage since the main purpose was to identify diseases and form an initial impression of their present and potential importance. The numbers of fields of each crop that were visited are shown in Table 1. The approximate locations

Table 1. Estimates of acreage* of six specialty crops and rapeseed in Saskatchewan in the period 1945-1971, and number of fields of each specialty crop surveyed in 1970 and 1971

Crop	Acreage ('000)					No. of fields surveyed	
	Avg 1945-49	Avg 1963-67	1969	1970	1971	1970	1971
Rapeseed	40	480	1,000	2,200	2,750	NA†	NA
Mustards	0	60	180	120	175	1	18
Sunflower	0	10	0	3	65	4	25
Safflower	-**	-	-	40	24	5	7
Buckwheat	0	0	10	25	11	10	4
Field pea	7	2	2	2.5	2.5	2	12
Lentil	-	-	-	1.5	5.6	1	4

* Acreage data compiled from Canada Year Books, 1952-53, 1961, and 1970-71 and Saskatchewan Department of Agriculture Crop Reports, 25 November 1970 and 9 August, 4 October, and 22 November 1971.

** - = No record.

† NA = not applicable.

of fields are illustrated in Figure 1. Visits were made either between July and October 1970 or between August and September 1971. The majority of visits were deliberate, in response to information about field locations received from agricultural representatives. However, some fields were found by accident in connection with other work (Duczek and Morrall 1971), or during vacation trips. Because of this, and also because of limitations of time, it was impossible to attempt quantitative assessments of the diseases observed, based on systematic sampling in several parts of each field. Furthermore, several of the visits were made late in the season when swathing or combining of the crops were complete. At those times the recognition of diseases depended upon the examination of stubble, or thin strips of standing crop at the edges of fields or near power poles. Nevertheless, wherever feasible, observations in fields were based on an examination of plants in two separate parts, or while walking up to about 400 meters through the crop. In this latter case, particular attention was paid to covering both low and higher areas when the topography was clearly uneven. During the survey many specimens were taken to the laboratory for microscopic examination, isolation work, or both, to aid in the identification of pathogens. All isolations were made on potato dextrose agar (PDA).

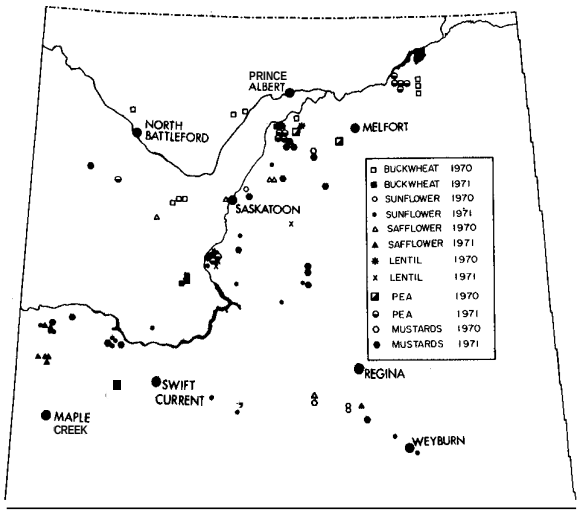

Figure 1. Map of southern and central Saskatchewan showing the approximate locations of the fields surveyed.

Results and discussion

Table 2 presents a summary of diseases encountered in the survey and the numbers of fields in which they were found. New Canadian and Saskatchewan records are indicated with asterisks. The remainder of the text consists of an elaboration of, and comment on, information in Table 2.

Table 2. Diseases of specialty crops in Saskatchewan in 1970 and 1971

Crop	Disease and principal causal pathogen(s)	Number and percentage of fields examined where disease was found			
		1970		1971	
		(No.)	(%)	(No.)	(%)
Sunflower	Herbicide injury	0	0	22	88
	Hail damage	0	0	3	12
	Basal stem rot (Sclerotinia sclerotiorum)	1	25	6	24
	Head rot (*Rhizopus sp., S. sclerotiorum, *Mucor spinosus)	0	0	8	32
	Root rot (Fusarium spp., Rhiwctonia sp., etc.)	1	25	18	72
	Leaf spots	0	0	16	64
Safflower	Leaf spot (Alternaria carthami)	2	40	7	100
	Rust (Puccinia carthami)	0	0	2	29
	Root rot (**Fusarium spp.)	3	60	2	29
Buckwheat	**Aster yellows (Mycoplasma)	3	30	3	75
	*Stem rot (Botrytis cinerea)	3	30	1	25
	Root rot (Fusarium spp. & Botrytis sp.)	5	50	3	75
Lentil	* sclerotinia stem rot (Sclerotinia sclerotiorum)	1	100	1	25
	*Botrytis stem rot (Botrytis sp.)	0	0	1	25
	Root rot (Fusarium spp., Rhizoctonia sp.)	0	0	3	75
Mustard ('Yellow')	Late root rot complex (Fusarium spp., Rhizoctonia sp.)	0	0	12	86
	Black spot (Alternaria spp.)	0	0	9	64
	Aster yellows (Mycoplasma)	0	0	5	36
	sclerotinia stem rot (Sclerotinia sclerotiorum)	1	100	3	21
	Ring spot (Mycosphaerella brassicicola [Duby] Oud.)	0	0	1	7
Mustard ('Brown' and 'Oriental')	Late root rot complex (Fusarium spp., Rhizoctonia sp.)			3	75
	white rust (Albugo cruciferarum S.F. Gray)			2	50
	Black spot (Alternaria spp.)			2	50
	Aster yellows (Mycoplasma)			1	25
	Sclerotinia stem rot (Sclerotinia sclerotiorum)			1	25
	Downy mildew (Peronospora parasitica [Pers. ex Fr.] Fr.)			1	25
Field pea	Ascochyta blight (dscochyta pinodes)	2	100	10	84
	Bacterial blight (Pseudomonas pisi)	0	0	2	17
	Sclerotinia stem rot (Sclerotinia sclerotiorum)	1	50	7	58
	Root/foot rot (Fusarium spp., Rhizoctonia sp., Botrytis sp.)	0	0	8	67
	Powdery mildew (Erysiphe polygoni)	1	50	0	0
	Downy mildew (**Peronospora viciae [Berk.] Casp.)	0	0	1	8

* New Canadian record.

** New Saskatchewan record.

Sunflower

There was a striking increase in sunflower acreage in Saskatchewan from 1970 to 1971 (Table 1). The majority of fields in 1971 were on dry land in the southern part of the province, but a few in the Outlook district, 60 miles south of Saskatoon, were on irrigated land (Fig. 1). The most prominent damage was caused by herbicide drift which was found in 88% of the fields inspected in 1971. Rough visual estimates of the percentages of plants affected by drift were made in each field, although no account was taken of severity, which is known to vary from plant to plant due to genetic factors. Of 22 fields in which damage was observed 10 were estimated to have only a trace, 3 were estimated to have 1% of the plants affected, 2 estimated to have 5% affected, 4 estimated to have 10% affected, and one each estimated to have respectively 25%, 30%, and 90% affected. The field with 90% was one where it was known that cereals nearby had been sprayed by airplane early in the growing season. It is difficult to relate these estimates of damage to yield losses because of the variable severity on individual plants. The most severely affected plants clearly produced no seed, but less severe damage was manifest by slight malformation of leaves and probably only slight yield reduction. However, it was clear that substantial yield losses were incurred in some fields due to herbicide drift. In view of the frequency of this damage, herbicide drift may be one of the major problems of sunflower production in Saskatchewan. Control will depend not only on greater care in spraying operations by farmers, but also, perhaps, on the development of lines with greater tolerance to herbicides.

Sclerotinia basal stem rot caused by Sclerotinia sclerotiorum (Lib.) de Bary was round in both 1970 and 1971. A single heavy infection found in 1970 in a small irrigated field has been reported elsewhere (Duczek and Morrall 1971). In 1971 infections were found in both irrigated and dryland fields; rough visual estimates were that two fields had about 1% infection and four had only traces. S. sclerotiorum is undoubtedly a potential threat to sunflower production in Saskatchewan, especially on irrigated land, but the presence of the disease depends on local inoculum, which had not had time to build up in the areas where sunflower was grown in 1970–71. As indicated in Table 1, sunflower is relatively new to Saskatchewan and the crop is not yet grown in areas where Sclerotinia is common on other crops (Duczek and Morrall 1971).

It was of interest that where head rot of sunflower (McDonald 1967) was found, S. sclerotiorum was associated with the condition only in one plant. Usually the decayed heads yielded Rhizopus sp. on isolation and contained abundant sporangia of Rhizopus in vivo. One representative Rhizopus culture was identified as R. arrhizus Fischer. Isolation from a rotten head in one field yielded Mucor spinosus van Teigh. In all, head rot was found in 32% of fields surveyed in 1971 but never in greater than trace amounts. However, the latter part of July and August prior to the survey was relatively hot and dry in most of south-central Saskatchewan and these conditions would not have favored the disease.

Other sunflower diseases found relatively frequently in 1971 (Table 2) were a rather nondescript root rot complex and several types of leaf spotting. The etiology of these remains obscure and further work seems warranted. The root rot was usually manifest as brownish stem discoloration, necrotic leaves, and decayed roots, the affected plants being generally scattered throughout a field but occasionally occurring in patches. Such patches were sometimes full of weeds. In some cases the diseased patches were around the perimeter of the field, and in one they were at the bottom of gullies in a hilly field. Affected plants in the patches ranged up to 50%, but elsewhere in the fields, or in fields with only scattered affected plants, the disease was usually only in trace amounts. Isolations from the bases of the stems and the roots of affected plants yielded a variety of fungi and some bacteria but not in a consistent pattern. Nevertheless, the most common isolates were species of Fusarium and Rhizoctonia, which were sometimes associated together and sometimes alone. Hence, these organisms may be etiologic agents of the disease although the limitations of using only PDA to make isolations must be recognized. Drought may also be a factor since the disease was never found in irrigated fields. Verticillium spp. were not isolated from any diseased plants.

The leaf spotting referred to above varied from small black polygonal spots to large spreading brown lesions, and even yellowish lesions in a few cases. Isolation yielded a variety of organisms, but again with no consistent pattern; Fusarium spp., Alternaria alternata (Fries) Keisslers, Rhizopus spp., and even Helminthosporium sativum P.K. & B. [Bipolaris sorokiniana (Sacc. in Sorok.) Shoem., stat. perf. Cochliobolus sativus (Ito & Kurib.) Drechs, ex Dastur] were among the organisms obtained. Many of the isolates were perhaps growing saprophytically on moribund tissue. In most of the fields where leaf spots were seen, infections were in trace amounts, but in four it was estimated visually that 5–10% of the plants were affected, although plants that were affected usually had many spots on each leaf. These facts suggest that much of the spotting may have been physiological or even genetic.

Three well-known sunflower diseases on the prairies (McDonald 1967), leaf mottle (Verticillium albo-atrum Reinke & Berth.), rust (Puccinia helianthi Schu.), and downy

mildew (Plasmopara halstedii [Farl.] Berl. & de Toni) were not encountered during this survey. While it is possible that they were overlooked due to inadequate sampling techniques or inexperience on the part of the observers, it seems more likely that they were absent or very rare. All three depend on local sources of inoculum, which would have been absent in those parts of Saskatchewan where sunflower was grown, except where wild sunflower occurred. However, these diseases will probably appear if sunflower continues to be grown in the same areas and inoculum has time to build up and if climatic conditions are favorable.

Safflower

The survey for diseases of safflower was limited to a few fields in both years (Table 1) and unfortunately most of the fields examined in 1971 were in one limited area in the southwest of the province (Fig. 1). No severe diseases were found either year. The most frequent was alternaria leaf spot caused by Alternaria carthami Chowdhury (Table 2), which varied in intensity from trace to moderate; even with moderate infections not all plants in the field had lesions. This disease and rust caused by Puccinia carthami Cda., which was found in only trace amounts in two fields in 1971, are two of the potentially more destructive diseases of safflower in Saskatchewan. With climatic conditions favorable to their spread and sufficient primary inoculum (for example, seed-borne teliospores of the safflower rust fungus), they could be responsible for substantial yield reductions. The only other disease found in the survey was a root rot, causing necrosis of above-ground plant parts, that was present in trace amounts in about half of the fields. Isolations from such plants consistently yielded Fusarium spp.

Buckwheat

Fewer fields of buckwheat were surveyed in 1971 than in 1970, but this was less a reflection of the decline in acreage (Table 1) than of chance in finding fields. Fields examined in 1971 were in quite different areas from those seen in 1970 (Fig. 1). Only three diseases were found (Table 2) and these were in trace and slight amounts. Aster yellows would probably have been detected in more fields in 1970 if some had not already been swathed or combined when examined. In both 1970 and 1971 some aster yellows infections were estimated at 1% of the plants in the field. The same applied with botrytis stem rot, a disease which has been reported in Manitoba to be seed borne and a potential problem (J.T. Mills, personal communication). Representative isolates were identified as belonging to both Group A and Group B of Botrytis cinerea Pers. (Morgan, 1971). It appeared that Botrytis infected the stems late in the growing season, giving rise to grayish discoloration and wilting of the plant above the infected zone. Moist conditions in late summer might be expected to result in the disease becoming a serious problem through large-scale infection. The majority of fields visited also contained traces of plants suffering from a root/basal stem rot. Isolates from discolored tissue invariably consisted of Fusarium spp. and also occasionally Botrytis sp.

Lentil

There is no mention of lentil in Conners' book (1967); hence, the only published Canadian record of a disease on this crop is one of Sclerotinia sclerotiorum in an earlier paper from our laboratory (Duczek and Morrall 1971). Very few fields of lentil were surveyed as the crop is not easy to find. Three of the four fields in 1971 were on irrigated land. Few diseases were found (Table 2) and those were in only trace to slight amounts; however, the presence of two stem rots should be noted since both have the potential to become serious on irrigated land if inoculum builds up. The botrytis stem rot was characterized by grayish lesions covered with abundant conidia and conidiophores of Botrytis sp. On isolation the fungus proved to sporulate very poorly in culture and it was not possible to identify it to species. However, its cultural characteristics were quite distinct from those of the B. cinerea cultures obtained from buckwheat, As on other crops referred to in this paper, traces of root rot were found in some lentil fields, and isolations from the roots gave Fusarium spp. and in one case Rhizoctonia sp.

Mustards (Yellow, Brown, and Oriental)

The diseases of the various mustards grown on the prairies are well known, and they have been included in several surveys by Petrie and Vanterpool (1965, 1966, 1968). Furthermore, in 1970 and 1971 comprehensive and quantitative surveys of Brassica diseases in Saskatchewan were done by Petrie (personal communication). These will be published in future. Hence, no discussion of mustard diseases will be attempted here. Indeed, the only reason for including the diseases of these species in Table 2 of this paper is that many of the fields visited were in parts of the province not included in Petrie's surveys because cruciferous crops are not common there (Fig. 1).

Field pea

Field pea has been grown in Saskatchewan for many years but the acreage has remained more or less constant (Table 1). New uses for peas currently being investigated in the College of Agriculture, University of Saskatchewan, could lead to an expansion of the acreage. To date, the crop has been grown primarily in two rather limited areas in north-central Saskatchewan where rainfall is adequate; however, the implementation of irrigation in the Outlook district has recently resulted in some fields there too (Pig. 1). Among the 14 fields surveyed

(Table 1), 5 in 1971 consisted of mixed stands with other crops; 3 with oats, 1 with barley, and 1 with rapeseed.

Clearly the most serious disease of field pea was ascochyta blight, which was found in all but two fields. It is noteworthy that the only fields in which it was not found were two in the Outlook district in which bacterial blight caused by Pseudomonas pisi Sackett was found. In all cases the two blight diseases were confirmed by making isolations from diseased leaves, stems, and pods. The isolates of Ascochyta were identified as A. pfnodes L.K. Jones. Although only visual estimates were made, the severity of both blight diseases was clearly considerable. In most cases 100% of the plants in the field had lesions, especially on the leaves. With ascochyta blight usually the lower leaves, stems, and pods were most severely diseased, and in several of the fields they were completely covered by lesions. Amounts of disease on the upper portions of the shoots ranged from slight to severe. It was clear that the loss of photosynthetic surface from ascochyta blight must have caused considerable yield reductions, although these could not be quantified. In addition, in fields where pod lesions were severe, it is likely that a large proportion of the seed would be infected by the fungus. Especially if pea acreage increases in Saskatchewan in the future, ascochyta blight will require considerable attention from pathologists and growers.

Another potentially serious problem in pea production is sclerotinia stem rot, which was found in about 50% of the fields in this survey. Where present it was in trace or slight amounts (meaning that it was probably present on 1% or less of the plants). However, field peas are mainly being grown in areas where another host of Sclerotinia sclerotiorum, rapeseed, is widely grown. In view of the ability of the sclerotia of this fungus to survive in soil more than 1 year (McDonald 1967, Morrall unpublished), inoculum could build up and lead to serious infestations and losses in future years, if climatic conditions were favorable. The only other significant disease of pea that was found was root rot caused mainly by Fusarium spp. but sometimes by Rhizoctonia sp. Isolation in one case also gave Botryis sp. Infections of root rot, when present, were in trace amounts in all except one field where a severely diseased patch occurred at a low-lying end of the field. A contributing factor in this case appeared to be temporary waterlogging of the soil at an earlier date.

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