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**DISTRIBUTION AND INCIDENCE
OF SUGAR BEET DISEASES
IN THE WIND RIVER AND BIG
HORN RIVER BASINS
OF NORTHWEST WYOMING**

**Distribution and Incidence of Sugar Beet Diseases
in the Wind River and Big Horn River Basins
of Northwest Wyoming**

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Introduction and Acknowledgements

Information in this publication was obtained through surveys of 129 sugar beet fields contracted by Holly Sugar Corp., over a three-year period (1992-1994). Fields were located in Fremont, Hot Springs, Washakie, Big Horn, and Park counties. Although other diseases may occur, this publication provides information on diseases that would be expected to occur during most years as well as their distribution and importance to this irrigated region of the state. Additional information for each of the three survey years is available upon request.

Financial support for this study was provided by the Washakie Beet Growers, Holly Sugar Corp., and the University of Wyoming.

Appreciation is expressed to Chick Duncan, Dave Mischke, Ron Tharp, Bob Stauffer, John Mills (agriculturalists), and Dr. Jim Gerick (plant pathologist) with Holly Sugar Corp. who assisted in the survey and disease identification. Thanks to Celeste Havener (research associate), David Craig (graduate student), Bridgette Fishburn, Kathleen Brown, Roy Martens, and Melissa Gray (undergraduate students/research assistants) for assisting in the field surveys and laboratory isolations. Appreciation is expressed to each grower and owner of the 129 sugar beet fields that were surveyed. Special appreciation is expressed to Kathy Johnston for graphics and manuscript preparation and Randy Anderson for layout. Distribution maps were prepared by Snowy Range Graphics in Laramie.

Survey and Laboratory Procedures

A total of 129 sugar beet fields were surveyed for diseases in five counties during 1992-94 (**Figure 1**). The number of fields surveyed for each of the three years was: 36 in 1992, 42 in 1993, and 51 in 1994. The total beet acreage contracted by Holly Sugar, as well as percent acreage surveyed for each year, was: 26,142 (7.3 percent), 25,143 (8.8 percent), and 24,801 (10.8 percent), respectively. Fields randomly selected by Holly Sugar Corp. agriculturalists in Fremont, Hot Springs, Washakie, Big Horn, and Park counties were visited three times during mid-May to mid-September of each year (a total of 387 field visits). Six undergraduate and graduate students from the College of Agriculture assisted in the surveys.

During the first visit, seedling stand and seedling injury were determined in 3-foot sections of rows selected randomly in fields. There was an average of one site for each two acres of sugar beets. Injured seedlings were collected for laboratory observation. After washing thoroughly, isolations were made from roots in general and selective culture media (potato dextrose agar and corn meal agar plus antibiotics selective for *Pythium* and *Phytophthora*) in the plant pathology laboratory in Laramie and incubated at 72 degrees Fahrenheit. Isolations were observed for fungal pathogens after two weeks, and identifications were made for spores using a compound microscope at 40-200 magnifications. Plugs of fungal mycelia, suspected of being water molds (*Aphanomyces*, *Pythium*, and *Phytophthora*), were placed in sterile water with 3- to 5-day-old sugar beet seedlings and incubated for five days to induce sporulation of the aquatic spore stage. Plugs and seedlings were then observed under the compound microscope for identifiable spore structures. When seedling disease or insect injury was present, fields were rated for damage on a scale of one to six (1 = 0 percent injury, 2 = 1 percent, 3 = 5 percent, 4 = 20 percent, 5 = 40 percent, and 6 = 60 percent or greater).

During the mid- and late-season visits, plants were observed for leaf, crown, and root diseases and insect injury. Initially, diseased plants were collected and taken to the laboratory for positive identification. Isolation techniques were similar to those described for seedlings. After disease diagnoses were made in 1993 and 1994, estimates of the percent of the fields diseased were made. Fields were rated as follows: trace (<1 percent plants affected), slight (2-5 percent), moderate (6-15 percent), severe (16-30 percent), and very severe (>31 percent). When BCTV was present, the percent infections in 500 plants were determined in randomly selected rows in the field. In 1992, two plants showing symptoms of an unknown virus were collected during the second visit and mailed to the ELISA Laboratory located at the Irrigated Agricultural Research and Extension Center in Prosser, Washington, for positive identification.

In 1994, soil was collected during the first visit for sugar beet (cyst) nematode (*Heterodera schachtii*) analysis. Soil was collected from the upper 2 to 4 inches at 25 random locations within a one acre sampling site, representative of the entire field. Soil from each field was bulked and placed in a plastic bag (approximately one quart of

soil) and stored at 50 degrees Fahrenheit until processing. Soil was removed from bags and the clods were broken and sieved to remove rocks and large debris. The soil was then air-dried, and thoroughly mixed in a soil tumbler. After mixing, cysts of *H. schachtii*, along with the organic fraction, were recovered by water flotation with an automatic elutriator from a 200-cubic-centimeter (cc) (approximately one-half pint) subsample of soil. Cysts and the organic fraction were collected on a paper filter, placed under the stereo-microscope set at 35 magnifications, and cysts were separated and counted by hand. Cysts (dead, mature female nematodes) were placed in a glass tissue grinder containing distilled water and crushed to release the eggs. One milliliter (ml) of the egg suspension was then placed on a nematode counting slide and the number of “viable” (healthy) eggs (including first- and second-stage juveniles) determined. From the average number of eggs obtained from 4 ml of egg suspension, the total number of eggs in a 200 cc of soil was calculated.

This survey did not address the presence or absence of beet necrotic yellow vein virus (rhizomania) or the closely related Tx7 Virus.

Summary of Results (1992-94)

Sixteen diseases and four insect parasites of sugar beets were identified during the three survey years (1992-94) (Table 1). Of the 16 diseases, 13 were caused by fungi, one by a nematode, and two by viruses. Diseases were found in seedlings, leaves, crowns, roots, and water-conducting vascular tissues. Most diseases identified were present each of the three years with the exception of leaf diseases.

A list of individual fields surveyed and diseases and insects detected for each of the survey years is provided in the Appendix (Tables 1-3). Information in these tables served as the baseline (raw) data for most of the information presented in this report.

Incidence and Distribution of Diseases and Insects in Fields

Seedling Diseases

Seven pathogenic fungi were isolated from seedlings. Most of these fungi attack mature plants as well. *Pythium*, *Fusarium* and *Rhizoctonia* occurred each of the three years, while *Phoma*, *Aphanomyces*, *Phytophthora*,

and *Rhizopus* occurred only in one of the three years. Seedling diseases (post-emergence damping-off and seedling blight) were detected in 1992 and 1993. Seedling stands and incidence of seedling diseases for each county are given in Table 2. Although overall incidence was relatively low, incidence within individual fields varied from 0-12.1 percent. This low level of seedling disease becomes more critical as more growers convert to the “plant-to-stand” method of seeding.

Both the use of high-quality and fungicide-treated seed by growers most likely reduced seedling disease in the region surveyed.

Crown and Root Diseases

Two fungal diseases were identified from diseased roots and crowns. **Rhizoctonia root and crown rot (RRCR)** caused by *Rhizoctonia solani* and **Phytophthora Root Rot (PRR)** caused by *Phytophthora drechsleri* both occurred each of the three years. Field and plant symptoms of RRCR and PRR are shown in Figures 2 and 3. RRCR-diseased crowns, lower petioles, and roots turn black, while PRR-diseased lower roots are reddish-brown in color. Yearly incidence of RRCR is shown in Figure 4, and yearly incidence of PRR is shown in Figure 5. Overall, RRCR occurred in 48.1 percent of fields while PRR occurred in 14.7 percent. Location of fields in 1992-1994 having RRCR and PRR is shown in Figures 6 and 7.

PRR was found predominantly in fields, or in areas within fields, that remained wet or waterlogged after irrigation due to poor soil drainage, while RRCR was more widespread throughout the growing area. RRCR became more evident and severe after the last ditching, which throws *Rhizoctonia*-infected soil into the crown of plants and initiates the devastating crown rot phase of the disease.

Vascular Wilt Disease

The only vascular wilt disease identified was **Fusarium yellows (FY)**, which is caused by *Fusarium oxysporium f. sp. betae*. Plant symptoms of FY are shown in Figure 8 (as well as on the front cover). FY-diseased plants may either be scattered throughout the field or occur in localized areas. FY occurred all three years. Yearly incidence of FY is shown in Figure 9. Overall field incidence of the disease was 27.1 percent. Location of fields in 1992-94 having FY is shown in Figure 10.

Leaf Diseases

Three different fungal leaf diseases were identified (Table 1). These included **Phoma leaf spot (PLS)** caused by *Phoma betae*, **Alternaria leaf spot (ALS)** caused by *Alternaria brassicae*, and **Powdery mildew (PM)** caused by *Erysiphe polygoni*. PLS, although detected in 1994, was important only in 1992 and was found in 41.7 percent of fields (Figure 11). Symptoms of PLS are shown in Figure 12. This fungal pathogen is seed-borne and was identified as a seedling pathogen in 1992 as well. It can also cause a storage rot on mature beet roots. ALS, which is also seed-borne, occurred in 45.2 percent of the fields in 1993 (Figure 11). Location of fields with PLS in 1992 and ALS in 1993 are shown in Figure 13. Although PM was detected in only 2.8 percent of fields in 1992 and 3.9 percent in 1994, its incidence is most likely much greater since it occurs late in the season after the last surveys were conducted. Symptoms of PM are shown in Figure 14. **Cercospora leaf spot** caused by *Cercospora beticola* was not detected but may occur in other years.

Virus Diseases

Two diseases caused by viruses were detected. These include **beet curly top virus (BCTV)** and **beet western yellows virus (BWYV)**. Symptoms of both the mild and severe strains of BCTV are shown in Figure 15. The severe strain of BCTV was only noticed in 1993 while the mild strain was detected all three years. Yearly incidence of BCTV is shown in Figure 16. Overall incidence in fields was 52.7 percent and was similar all three years. Since BCTV is transmitted by the sugar beet leafhopper, disease incidence during the growing season is primarily a reflection of spring leafhopper populations. BWYV, which is transmitted by an aphid, was only detected in the early part of the growing season during 1993. Symptoms of BWYV are shown in Figure 17. Location in fields in 1992-94 having BCTV is shown in Figure 18.

Parasitic Nematodes

The only parasitic nematode found was the **sugar beet (cyst) nematode (SBN)**, *Heterodera schachtii*, which parasitizes the small feeder roots. Symptoms of the SBN are shown in Figure 19. Incidence of parasitism in fields

from 1992-94 is shown in Figure 20. Overall incidence of SBN-parasitism for the three years was 28.7 percent. Location of fields from 1992-94 having plants parasitized with *H. schachtii* is shown in Figure 21.

In 1994, soil was collected and analyzed for *H. schachtii* from the 51 survey fields (Figure 22). Ninety-six percent of the fields in Washakie County had detectable populations of *H. schachtii*, and 72 percent exceeded the estimated damage threshold (EDT) of 2.8 eggs/1cc soil. Forty-two percent of the fields sampled in Big Horn County had *H. schachtii*, and 14.3 percent of the fields exceeded the EDT. *Heterodera schachtii* was not detected in fields surveyed in Fremont or Park counties.

Insect Pests

Several insects were identified during the disease surveys and their incidence in fields determined. The **pale-striped flea beetle (PSFB)**, *Systema blanda*, and the **beet carrion beetle (BCB)**, *Silpha opaca*, both caused injury to sugar beet seedlings during 1994 (Table 1). The percent of fields with injury from the two beetles was similarly high with overall means of 70.9 percent for the PSFB and 68.8 percent for the BCB. Many fields were sprayed with an insecticide due to severe injury. Field infestations during 1992-94 of the **sugar beet root aphid**, *Pemphigus populivena*, and the **sugar beet root maggot**, *Tetanops myopaeformis*, are shown in Figure 23. Overall infestation levels were 56 percent for the SBRA and 14.4 percent for the SBRM. Location of fields infested with the SBRA and the SBRM is shown in Figures 24 and 25.

Incidence of Diseased Plants within Individual Fields

The incidence of disease in mature plants within individual fields was estimated as a percent of the total plants present. Average and maximum incidence of Rhizoctonia root and crown rot, Phytophthora root rot, Fusarium yellows, and Beet curly top virus for the three years is given in Figure 26. Although the estimated average incidence of diseases was relatively low, maximum incidence for individual fields in a given year was relatively high: 50 percent for RRCR in 1992, 50 percent for PRR in 1992, 30 percent for FY in 1994, and 45 percent for BCTV in 1994.

Incidence of Plants Parasitized by Nematodes or Insects Within Individual Fields

Average and maximum plant parasitism for the sugar beet (cyst) nematode, sugar beet root maggot, and the sugar beet root aphid for 1993 and 1994 are given in **Figure 27**. Again, overall estimated average plant parasitism was relatively low. Overall maximum parasitism within individual fields in a given year was relatively high for certain pests: 41 percent and 45 percent for SBN in 1993 and 1994, and 50 percent for SBRA in 1993.

Overall Incidence and Frequency of Diseases

The overall incidence of diseases from 1992-94 is shown in **Figure 28**. Beet curly top virus and Rhizoctonia root and crown rot were the most prevalent diseases, occurring in 53 percent and 48 percent of the surveyed fields, respectively.

Frequencies of one or more major diseases occurring within individual fields in the five survey counties for 1992, 1993, and 1994 are given in **Tables 3-5**. Over the three-year period, fields having zero, one, two, three, four or five major diseases was 22.5 percent, 19.4 percent, 25.6 percent, 24.0 percent, 7.8 percent, and 1.6 percent, respectively.

Additional information on disease and insect parasites occurring in Fremont, Washakie, and Big Horn counties is provided in the Appendix (**Tables 4-6** and **Figures 1-3**).

Conclusion

To conquer the enemy, one must first know its position and strength. Thus it is with controlling plant disease. Knowledge of location, distribution, and inoculum potential, as well as frequency of occurrence, means of survival, and effect of environment are all important in developing a sound disease management program to reduce loss from plant disease.

Information obtained from the observation of sugar beet fields over a three-year period will hopefully provide a better overview of the location and distribution of sugar beet diseases in the Wind and Big Horn River basins which will aid in the development of sound disease management programs for sugar beet producers.

As anticipated, the intensity and type of diseases were greatest near the factory located in Worland where sugar beets have been grown the longest period of time. This was particularly true for soil-borne diseases (including RRCR, SBN, FY, and PRR) that increase over time with continuous cropping of sugar beets. Each of these disease organisms has survival structures that allow it to persist during the normal one- to two-year rotation between sugar beet crops. Therefore, accurate identification of these diseases is especially important as they will most likely be present every year sugar beets are grown.

The presence of multiple diseases occurring in the same fields presents a special challenge for many Washakie and Big Horn County growers. As many as five major diseases were found in a single field. However, one thing that was noticed over the years is that most American farmers thrive on challenge. Somehow they find a way to produce a good crop most years. This is especially the case with Wyoming sugar beet growers.

TABLES

Table 1. List of 16 sugar beet diseases and four insect parasites identified from field surveys conducted in the Wind and Big Horn River Basins of northwestern Wyoming

DISEASES/INSECT PARASITES	1992	1993	1994
FUNGAL DISEASES			
<u>Fungi isolated from roots of diseased seedlings</u>			
<i>Fusarium sp./F. oxysporium f.sp. betae</i>	X	X	X
<i>Rhizoctonia solani</i>	X	X	X
<i>Pythium ultimum</i>	X	X	X
<i>Rhizopus sp.</i>		X	
<i>Aphanomyces cochlioides</i>		X	
<i>Phoma betae</i> (Black Leg)	X		
<i>Phytophthora drechsleri</i>	X		
<u>Root and Crown Rots</u>			
Phytophthora Root Rot	X	X	X
Rhizoctonia Root and Crown Rot	X	X	X
<u>Vascular Wilts</u>			
Fusarium Yellows	X	X	X
<u>Leaf Diseases</u>			
Phoma Leaf Spot	X		X
Alternaria Leaf Spot		X	
Powdery Mildew	X		X
NEMATODE DISEASES			
Sugar Beet Nematode	X	X	X
VIRUS DISEASES			
Beet Curly Top Virus	X	X	X
Beet Western Yellows Virus		X	
INSECT PARASITES			
<u>Seedling Parasites</u>			
Pale-Striped Flea Beetle			X
Beet Carrion Beetle			X
<u>Root Parasites</u>			
Sugar Beet Root Aphid	X	X	X
Sugar Beet Root Maggot	X	X	X

Table 2. Sugar beet seedling population and estimated disease in fields in the Wind and Big Horn River Basins

Year	Plant Counts	County				Park	Yearly Mean
		Fremont	Washakie	Big Horn	Park		
1992	Plants/1 ft row (range) ^a	1.9 (1.2-2.6)	1.8 (1.3-3.0)	2.1 (1.1-2.7)	2.3 (1.5-3.0)	2.0 (1.3-2.8)	
	% Unhealthy (range) ^b	2.2 (0.7-7.5)	0.5 (0-4.2)	2.1 (0-12.1)	2.1 (0-7.4)	1.7 (0.2-7.8)	
1993	Plants/1 ft row (range)	2.3 (1.9-2.5)	3.2 (1.3-6.3)	2.0 (1.3-2.9)	2.0 (1.5-2.4)	2.4 (1.5-1.7)	
	% Unhealthy (range)	3.6 (0-4.6)	1.3 (0-3.8)	0.4 (0-3.6)	0	1.3 (0-3.0)	
1994	Plants/1 ft row (range)	1.4 (0.8-1.9)	1.5 (1.0-2.0)	1.6 (1.2-2.6)	1.3 (1.3-1.5)	1.5 (1.1-2.0)	
	% Unhealthy (range)	0	0	0	0		
MEAN (1992-1994)	Plants/1 ft row (range)	1.9 (1.3-2.3)	2.2 (1.2-3.8)	1.9 (1.2-2.7)	1.9 (1.4-2.3)		
	% Unhealthy (range)	1.9 (0.5-4.7)	0.6 (0-2.7)	0.8 (0.4-5.2)	0.7 (0-2.5)		

^a Values are the average of 10 sites (3 row ft each)/acre.

^b Values are the estimated percent seedlings with visible disease in sampling sites. Pre-emergence death is unaccounted for in values presented.

Table 3. Frequency of major diseases within individual sugar beet fields surveyed in 1992

Number of major diseases/field*	Number of fields in each county				Number of total fields	percent of total fields
	FRE	WAS	BH	PARK		
0	6	0	0	1	7	19.4
1	1	4	1	3	9	25.0
2	0	2	4	1	7	19.4
3	0	4	5	0	9	25.0
4	0	2	2	0	4	11.1
5	0	0	0	0	0	0

*Major diseases included the Sugar Beet Nematode, Beet Curly Top Virus, Rhizoctonia Root and Crown Rot, Phytophthora Root Rot, and Fusarium Yellows.

Table 4. Frequency of major diseases within individual sugar beet fields surveyed in 1993

Number of major diseases/field*	Number of fields in each county				Number of total fields	percent of total fields
	FRE	WAS	BH	PARK		
0	7	1	1	1	10	23.8
1	0	1	4	2	7	16.7
2	0	5	5	0	10	23.8
3	0	5	3	0	8	19.1
4	0	4	1	0	5	11.9
5	0	2	0	0	2	4.8

*Major diseases included the Sugar Beet Nematode, Beet Curly Top Virus, Rhizoctonia Root and Crown Rot, Phytophthora Root Rot, and Fusarium Yellows.

Table 5. Frequency of major diseases within individual sugar beet fields surveyed in 1994

Number of major diseases/ field*	Number of fields in each county					Number of total fields	percent of total fields
	FRE	HS	WAS	BH	PARK		
0	8	1	0	0	3	12	23.5
1	1	0	4	3	0	8	15.7
2	0	0	8	8	0	16	31.4
3	0	0	12	2	0	14	27.5
4	0	0	0	1	0	1	2.0
5	0	0	0	0	0	0	0

*Major diseases included the Sugar Beet Nematode, Beet Curly Top Virus, Rhizoctonia Root and Crown Rot, Phytophthora Root Rot, and Fusarium Yellows.

FIGURES

Disease Survey Fields

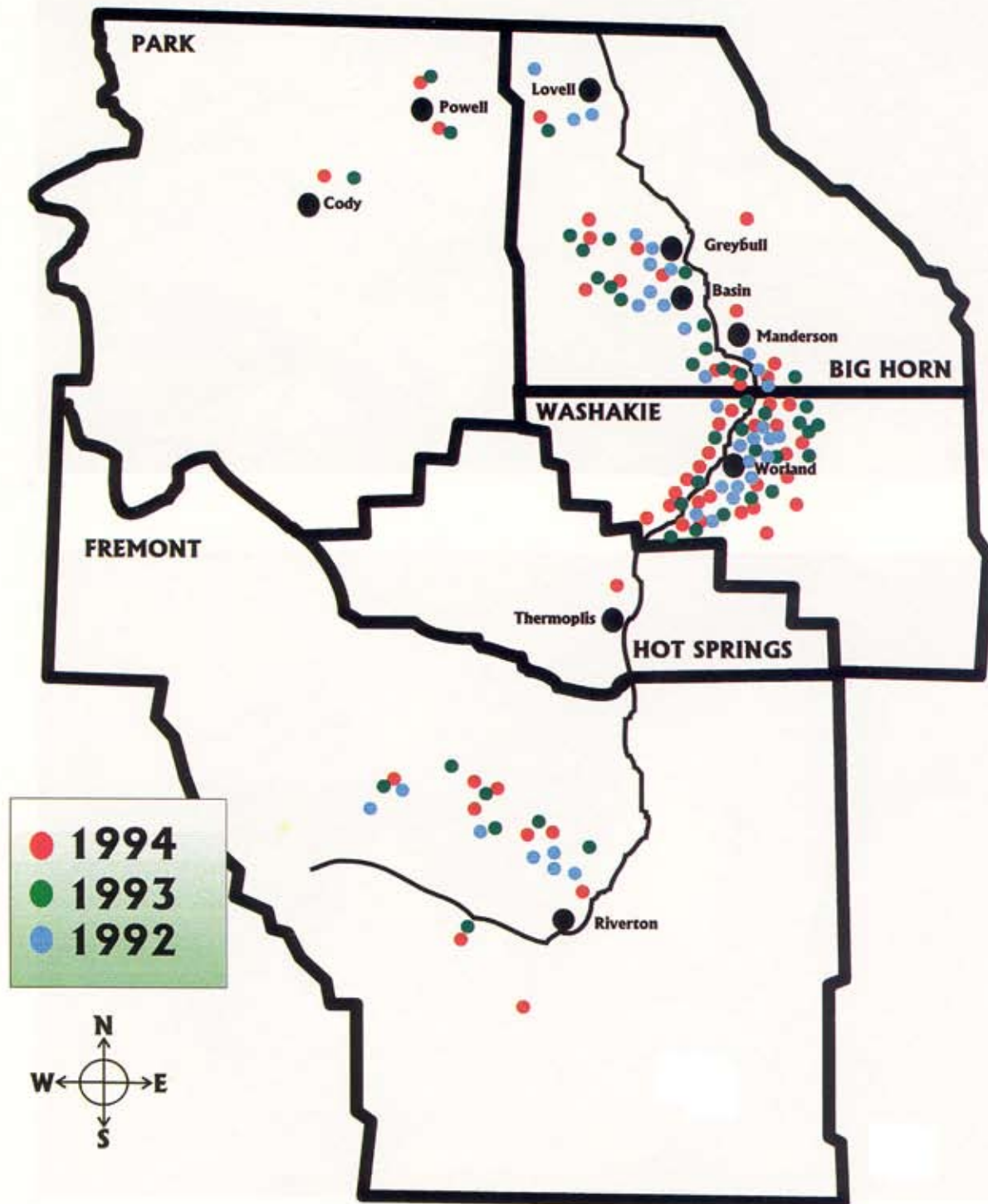
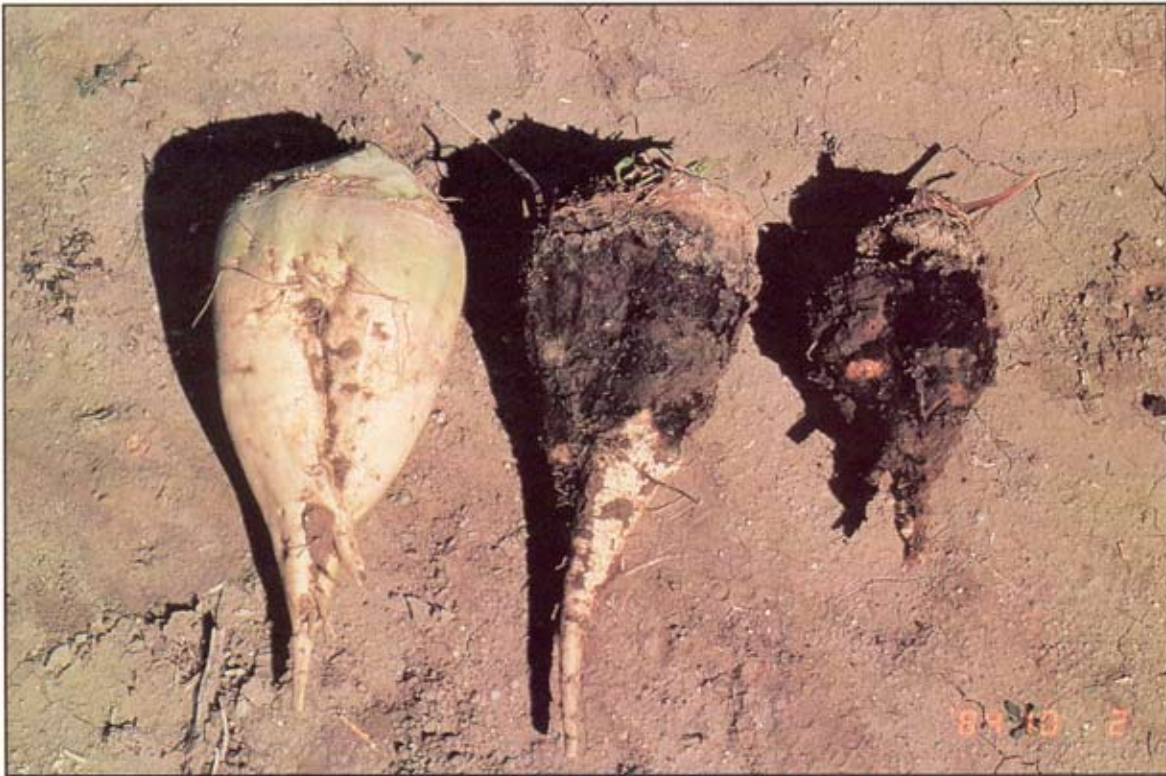


Figure 1. Location of the 129 sugar beet fields surveyed (36 in 1992, 42 in 1993, 51 in 1994).



a



b

Figure 2. Rhizoctonia Root and Crown Rot (a=area in field with dead and diseased plants, b=healthy and rotted roots)



a



b

Figure 3. Phytophthora Root Rot (a=diseased plants in field, b=healthy and diseased plants showing reddish-brown rot of lower root)

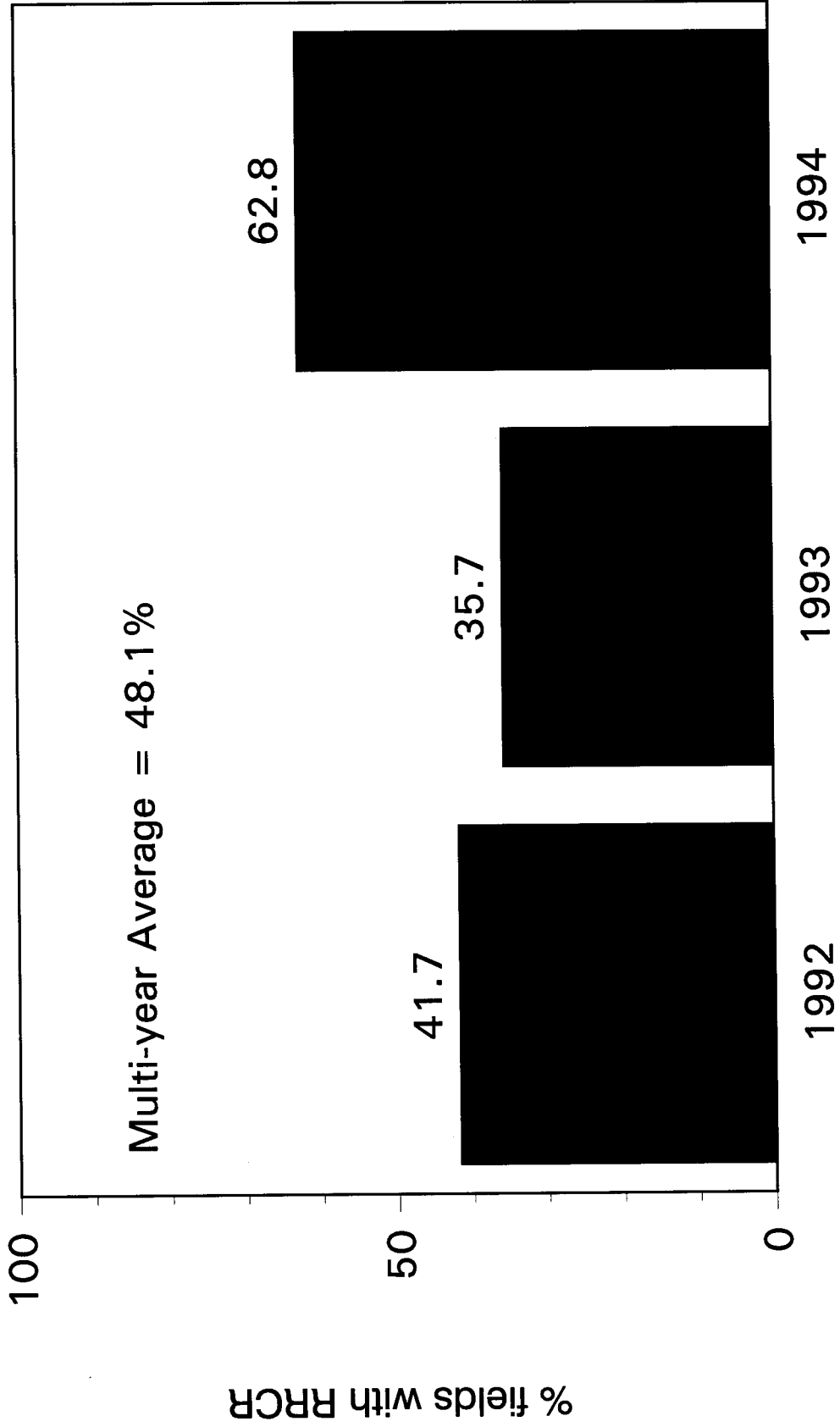


Figure 4. Incidence of Rhizoctonia Root and Crown Rot (RRCR) in sugar beet fields in the Wind and Big Horn River Basins

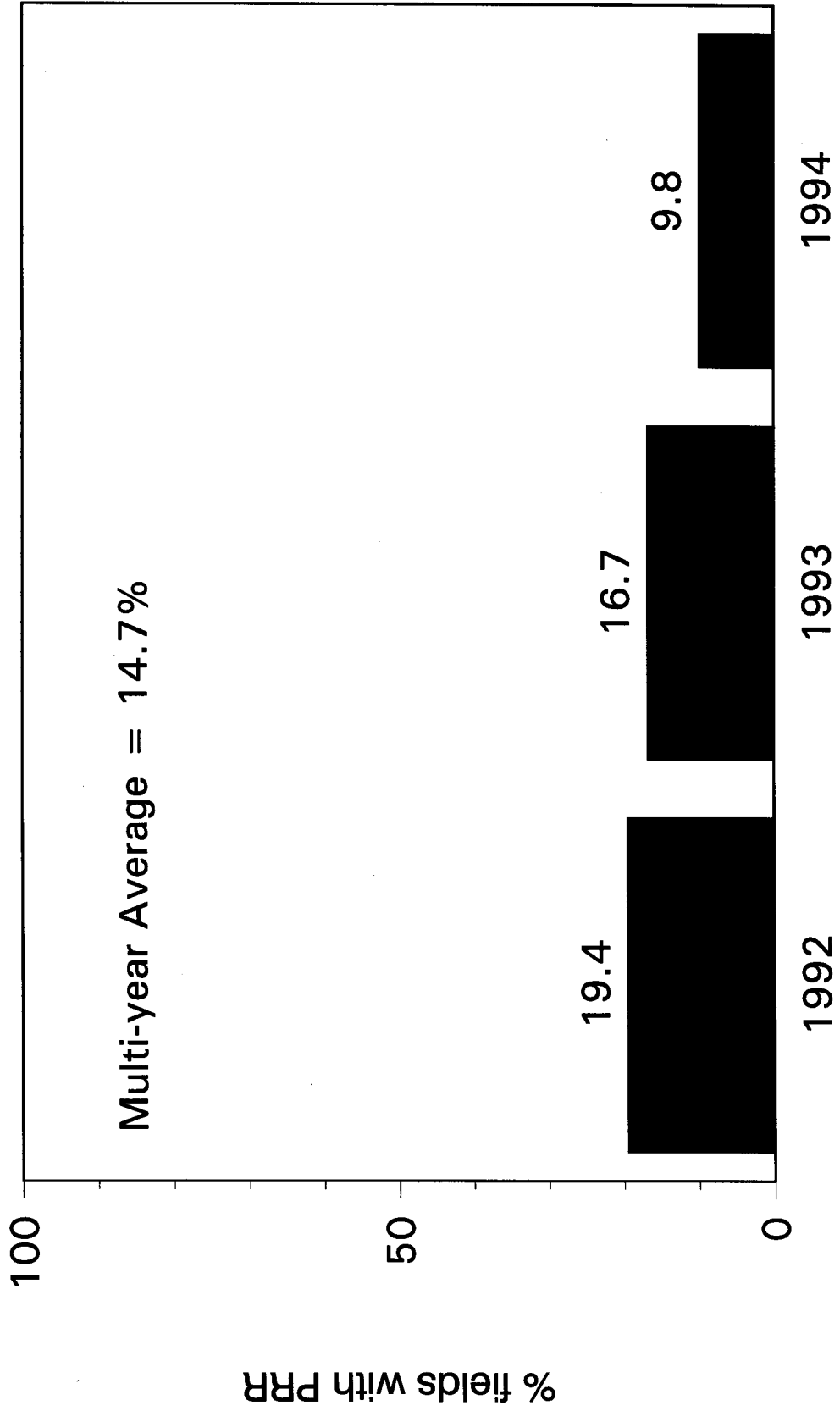


Figure 5. Incidence of Phytophthora Root Rot (PRR) in sugar beet fields in the Wind and Big Horn River Basins

Rhizoctonia

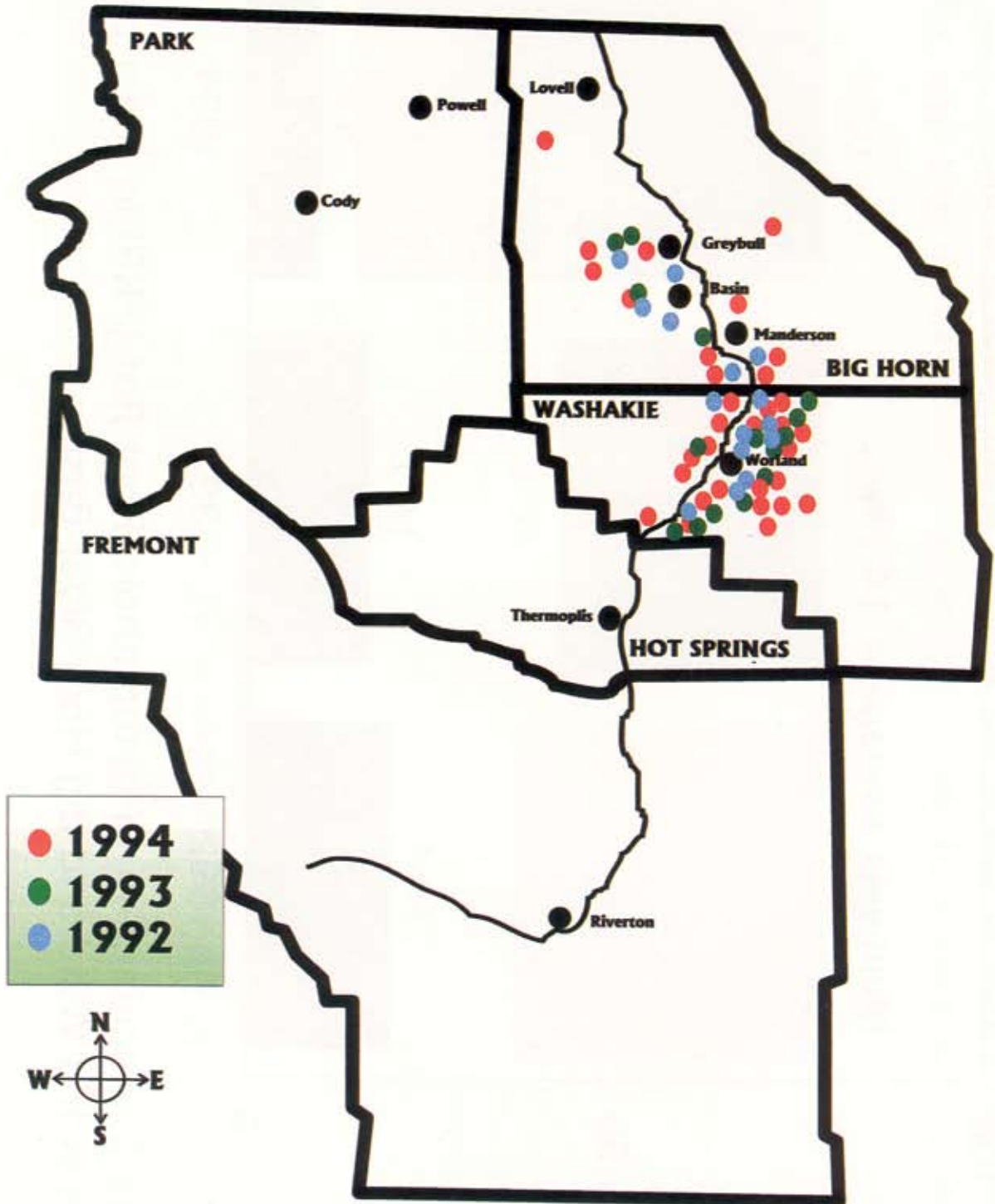


Figure 6. Location of 62 sugar beet fields with Rhizoctonia Root and Crown Rot (15 in 1992, 15 in 1993, 32 in 1994).

Phytophthora

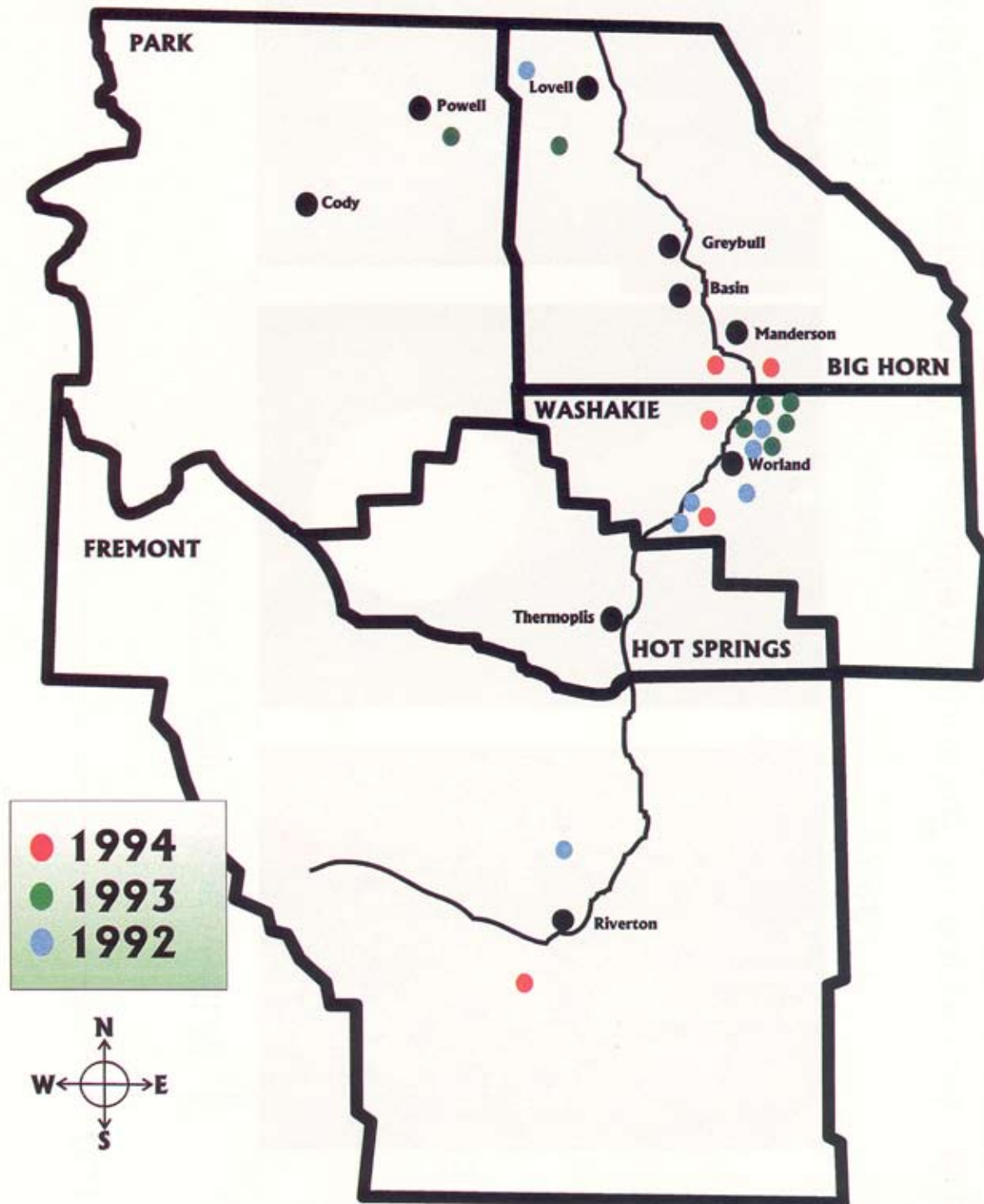


Figure 7. Location of 18 sugar beet fields with *Phytophthora* Root Rot (7 in 1992, 6 in 1993, 5 in 1994).



a



b



c

Figure 8. Fusarium Yellows (a=diseased plant in field, b=discoloration of water-conducting tissues, c=early seedling blight)

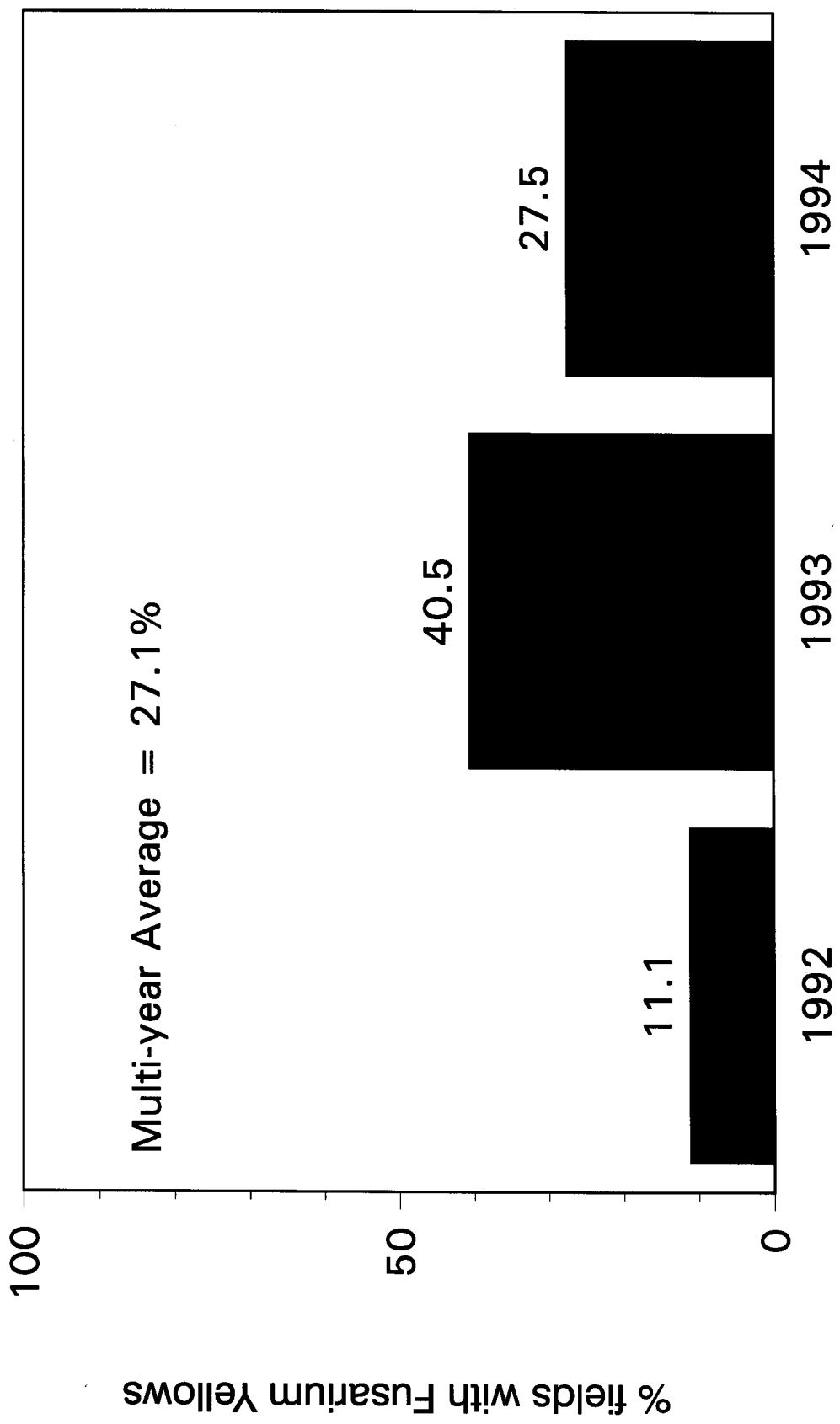


Figure 9. Incidence of Fusarium Yellow (FY) in sugar beet fields during 1992-1994 in the Wind and Big Horn River Basins

Fusarium Yellows

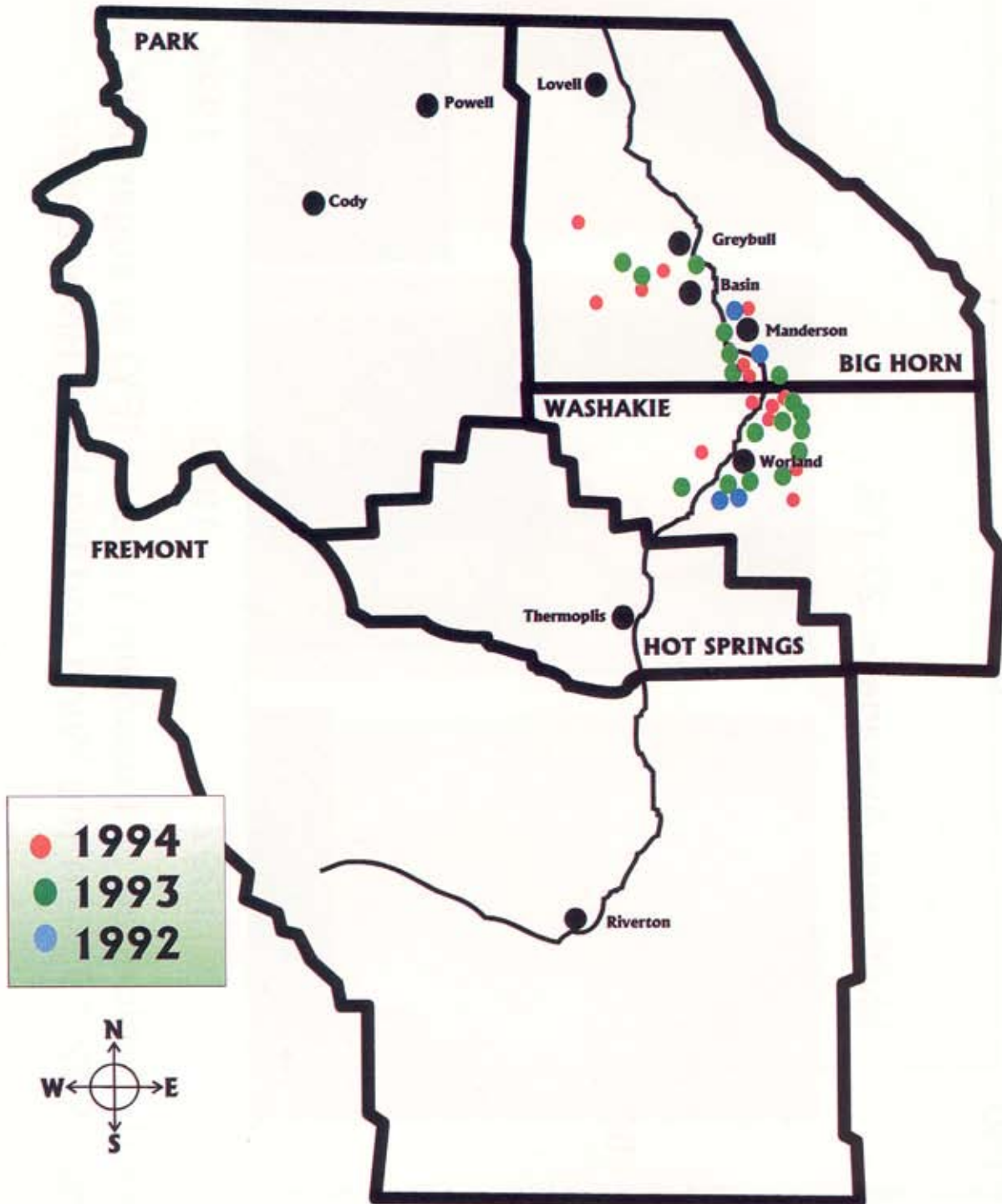


Figure 10. Location of 35 sugar beet fields with Fusarium Yellows (4 in 1992, 18 in 1993, 14 in 1994).

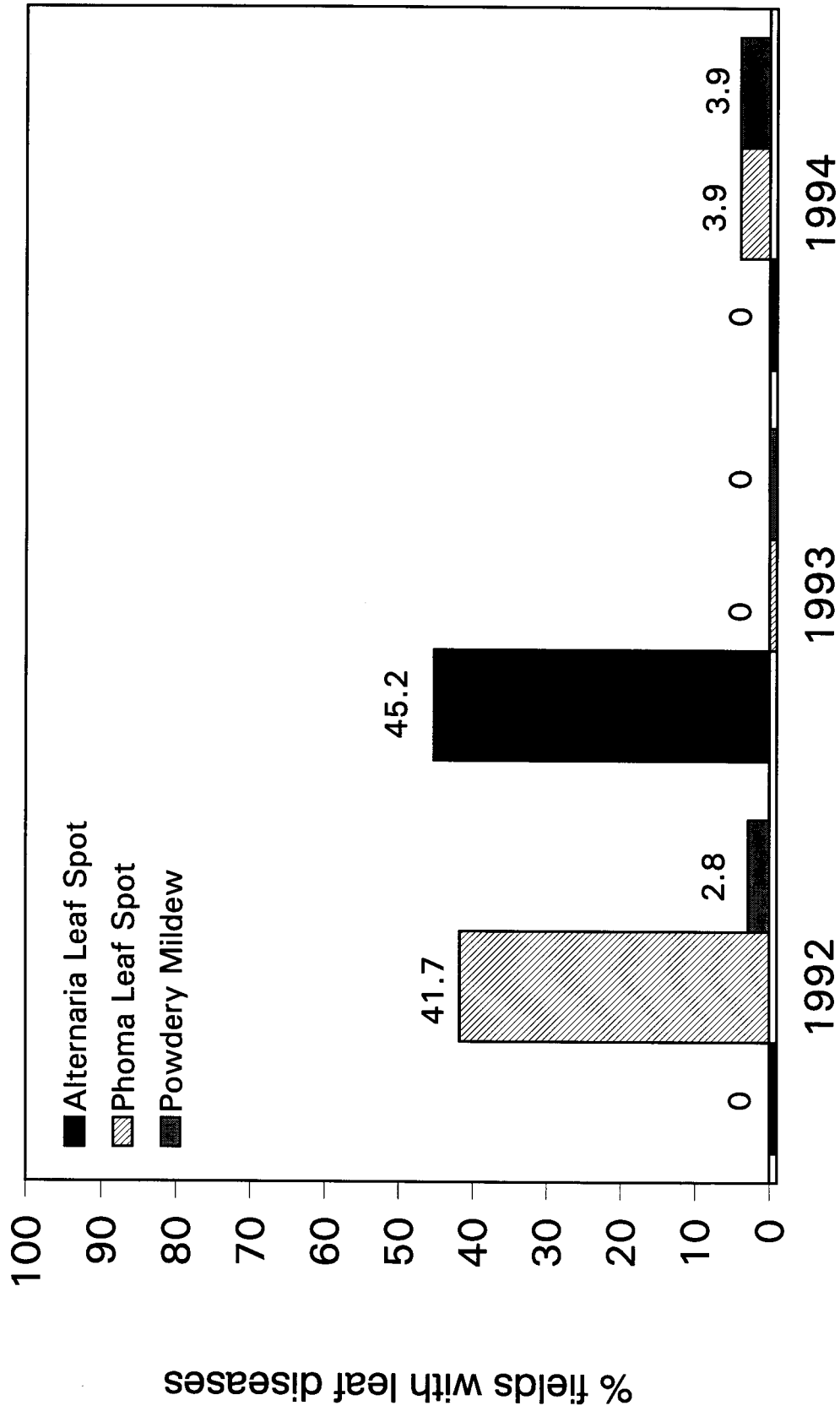


Figure 11. Incidence of leaf diseases in sugar beet fields during 1992-1994 in the Wind and Big Horn River Basins



a



b

Figure 12. Phoma Leaf Spot (a=diseased leaf, b=close-up of diseased spots)

Fungal Leaf Diseases

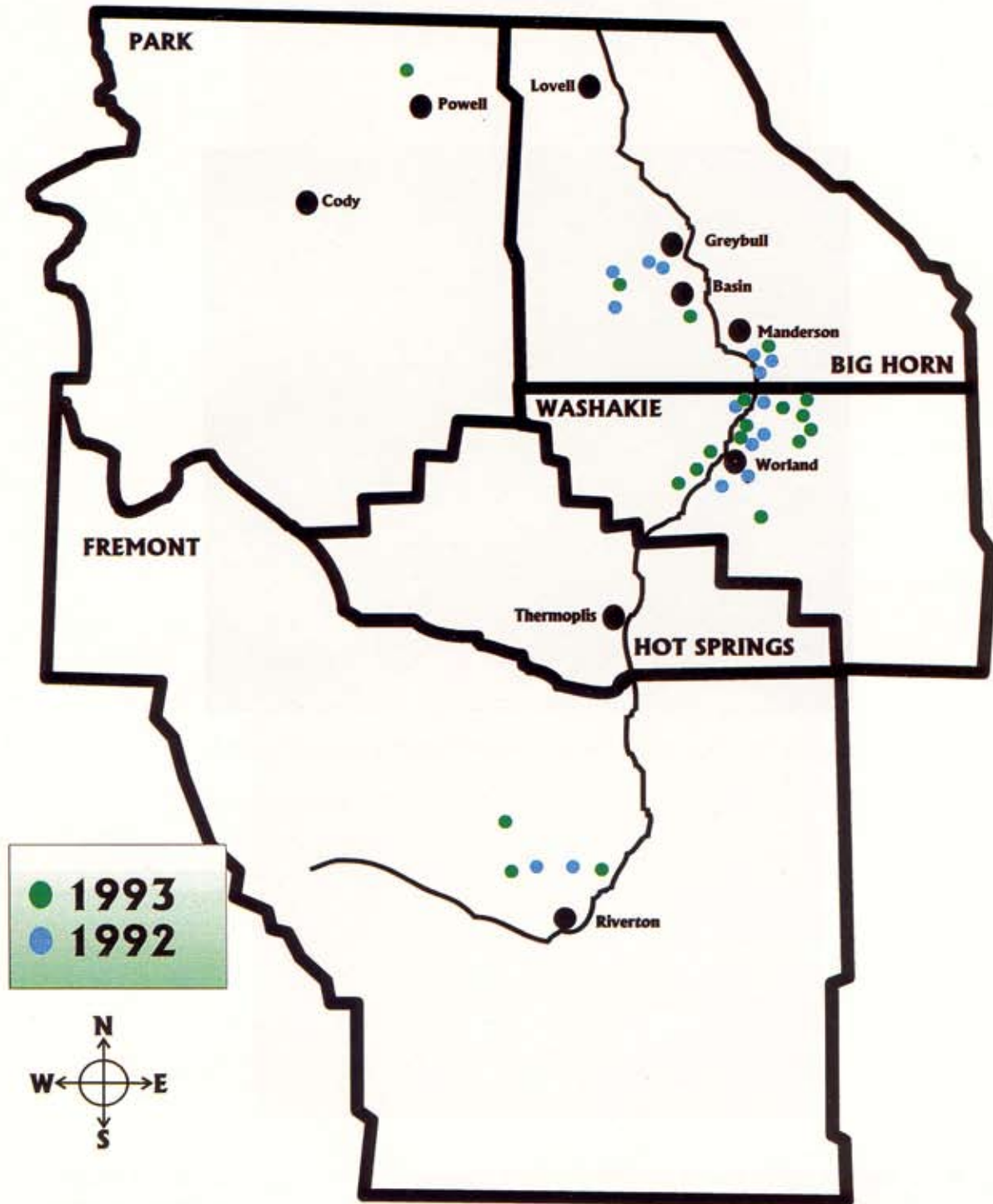
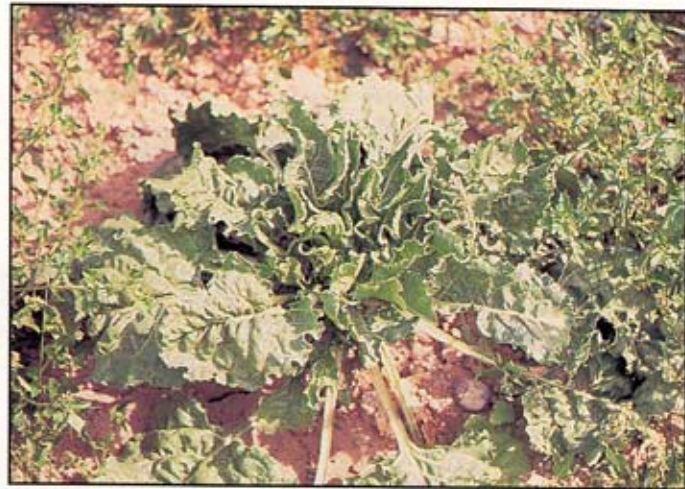


Figure 13. Location of the 15 sugar beet fields having Phoma Leaf Spot in 1992 and the 19 fields having Alternaria Leaf Spot in 1993.



Figure 14. Powdery Mildew. Healthy and diseased leaves.



a



b



c

Figure 15. Beet Curly Top Virus (a=mild strain, b=severe strain which causes death of the growing point, c=vascular discoloration)

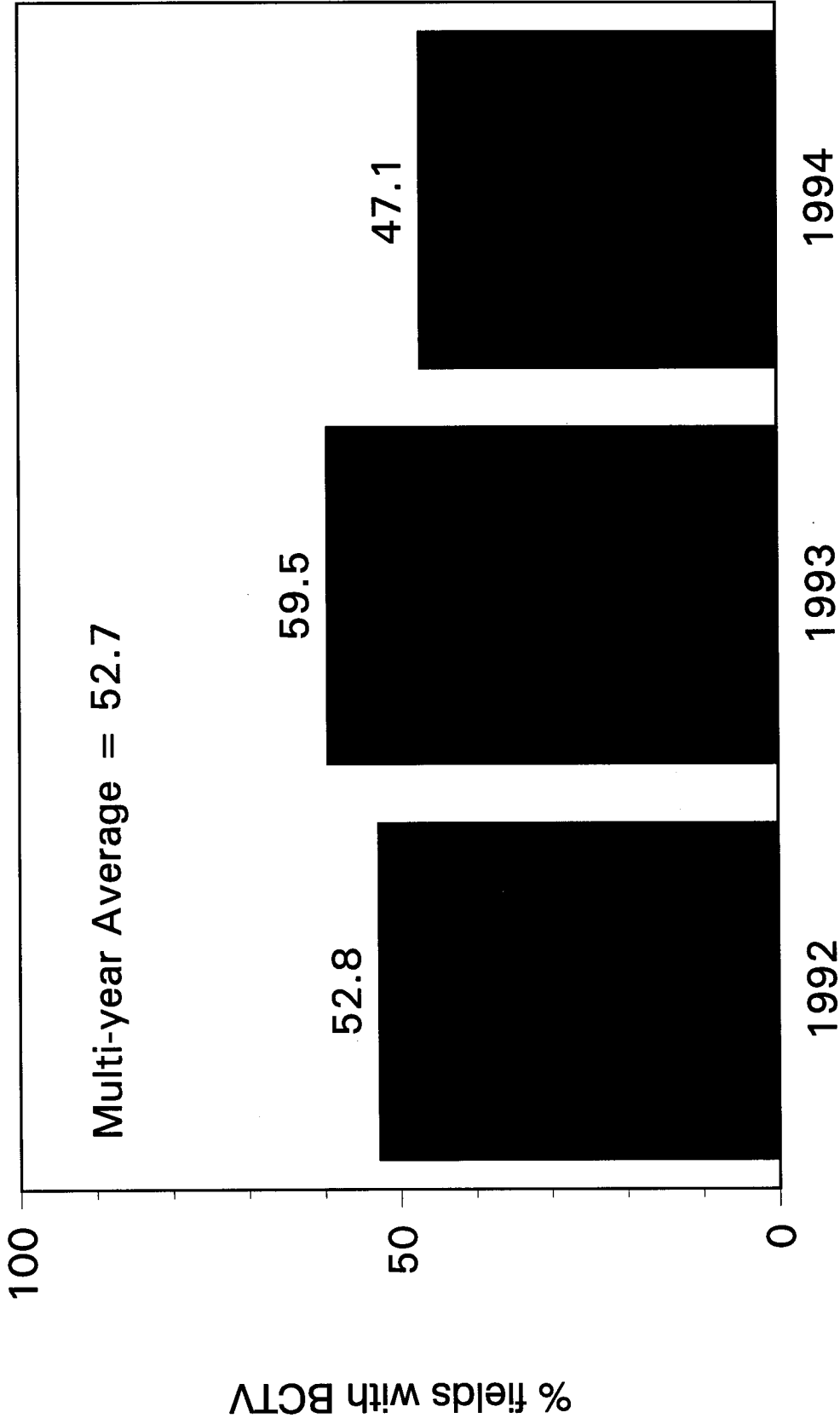


Figure 16. Incidence of Beet Curly Top Virus (BCTV) during 1992-1994 in sugar beet fields in the Wind and Big Horn River Basins



Figure 17. Beet Western Yellows Virus (early symptoms)

Curly Top Virus

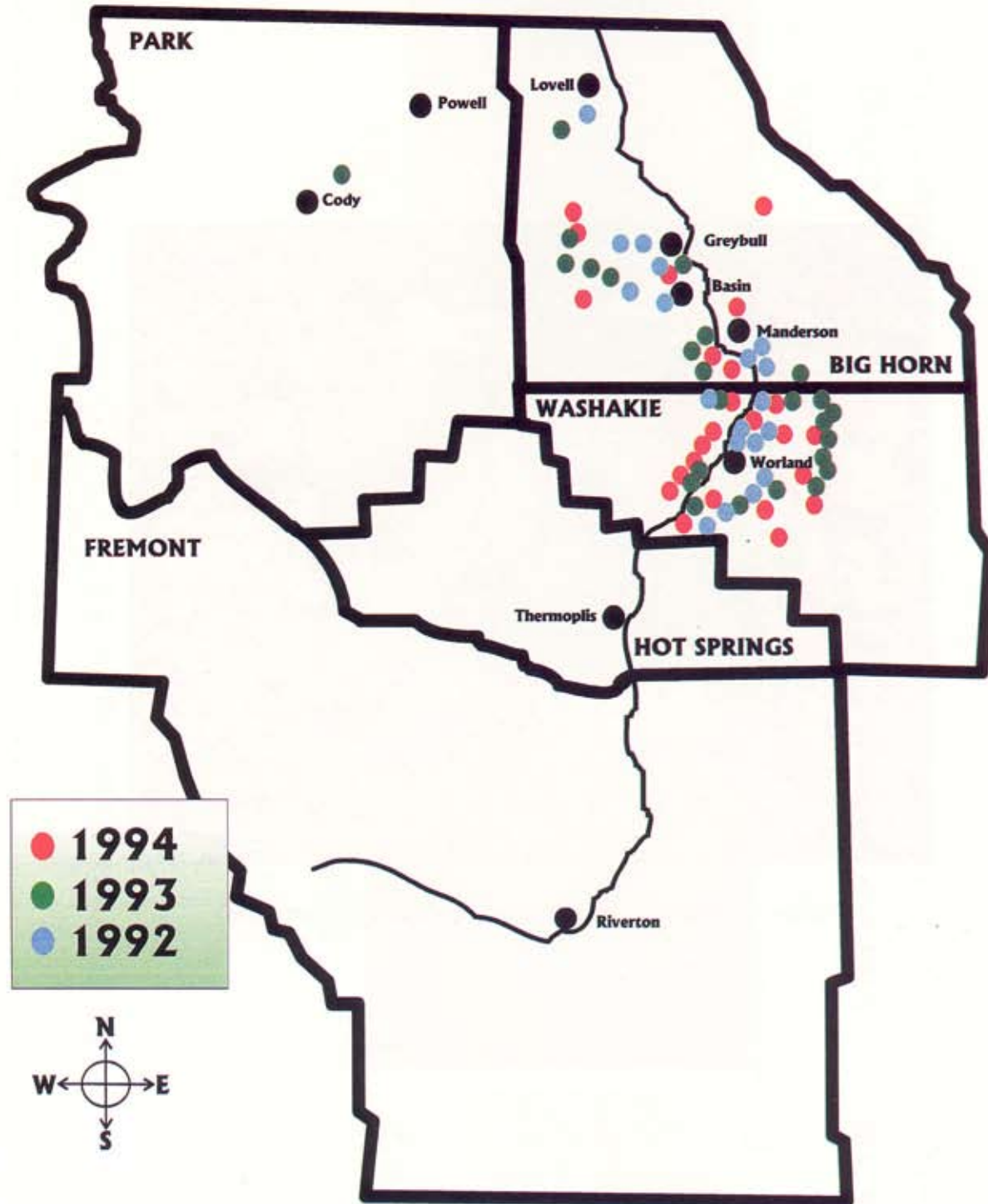


Figure 18. Location of 68 sugar beet fields with Curly Top Virus (19 in 1992, 25 in 1993, 24 in 1994).



a



b



c

Figure 19. Sugar Beet Nematode (a=diseased areas in field showing severe yellowing and stunting, b=close-up of healthy and parasitized plants showing foliage symptoms, c=mature female nematodes attached to feeder root; white mature female and brown, dead female "cyst" containing eggs, 8 magnifications).

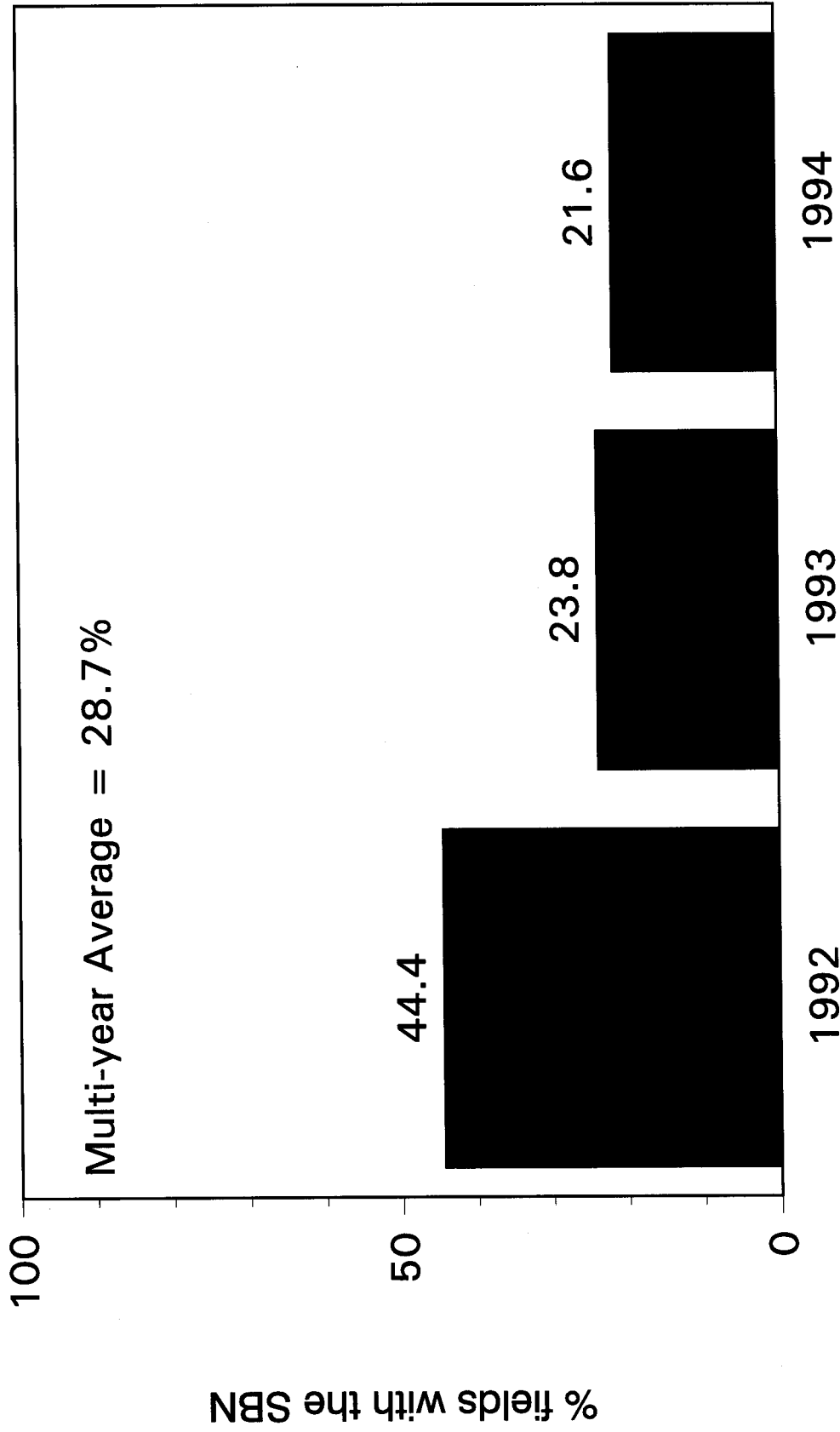


Figure 20. Incidence of fields having plants parasitized by the Sugar Beet (Cyst) Nematode (SBN) during 1992-1994 in the Wind and Big Horn River Basins

Sugar Beet Nematode

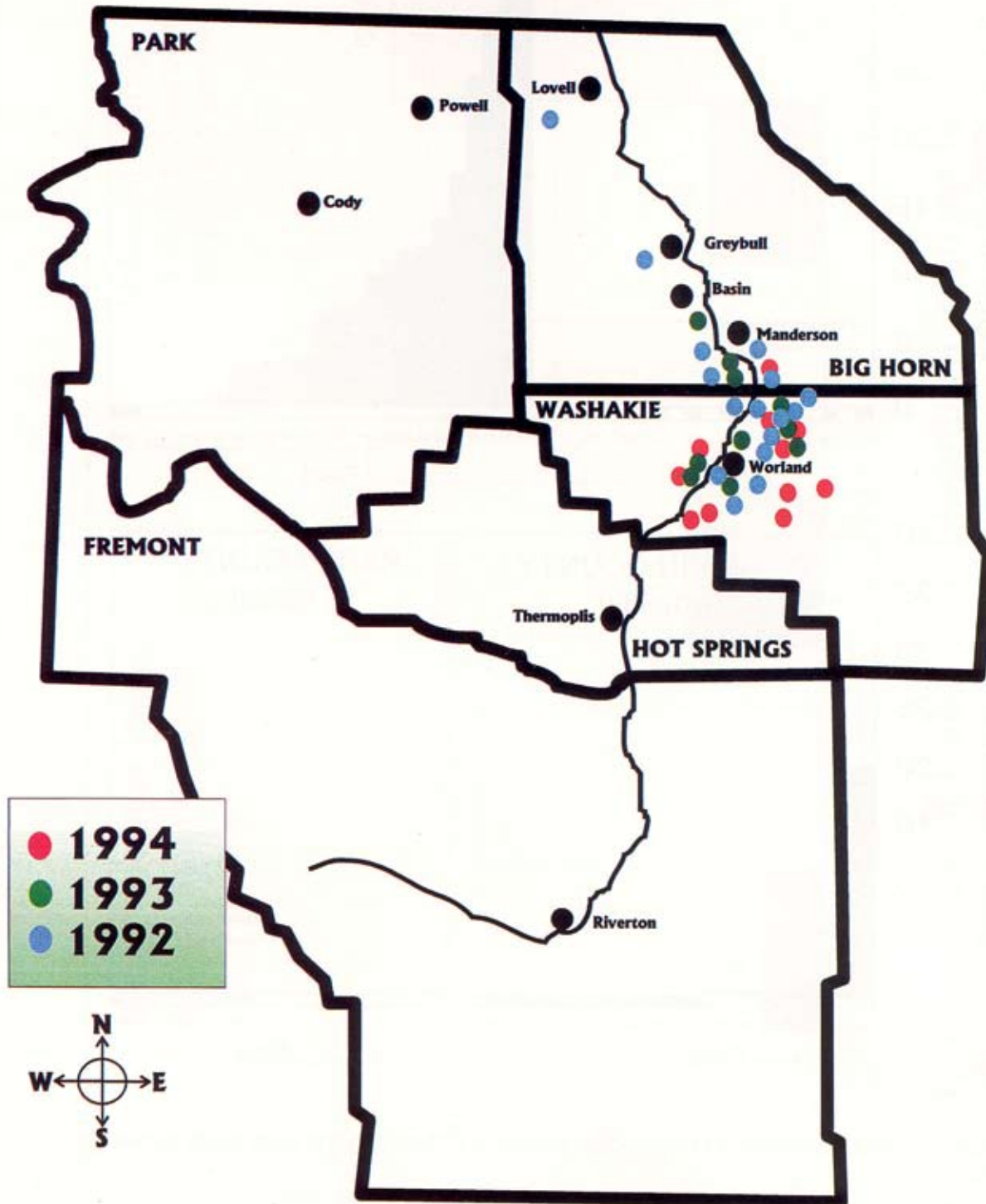


Figure 21. Location of 37 sugar beet fields with the Sugar Beet Nematode (16 in 1992, 10 in 1993, 11 in 1994).

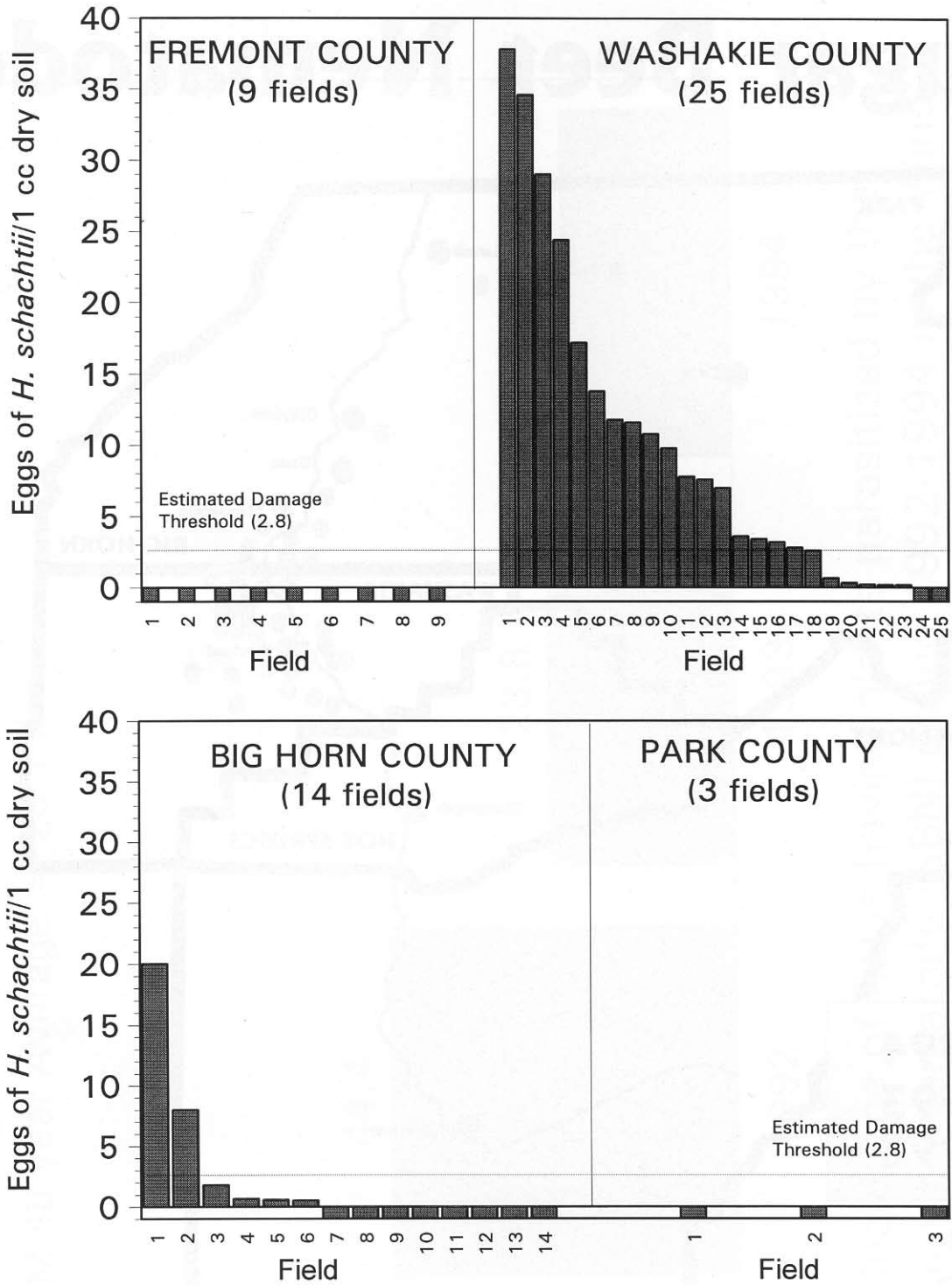


Figure 22. Soil population of *Heterodera schachtii* in the 51 sugar beet fields surveyed in 1994

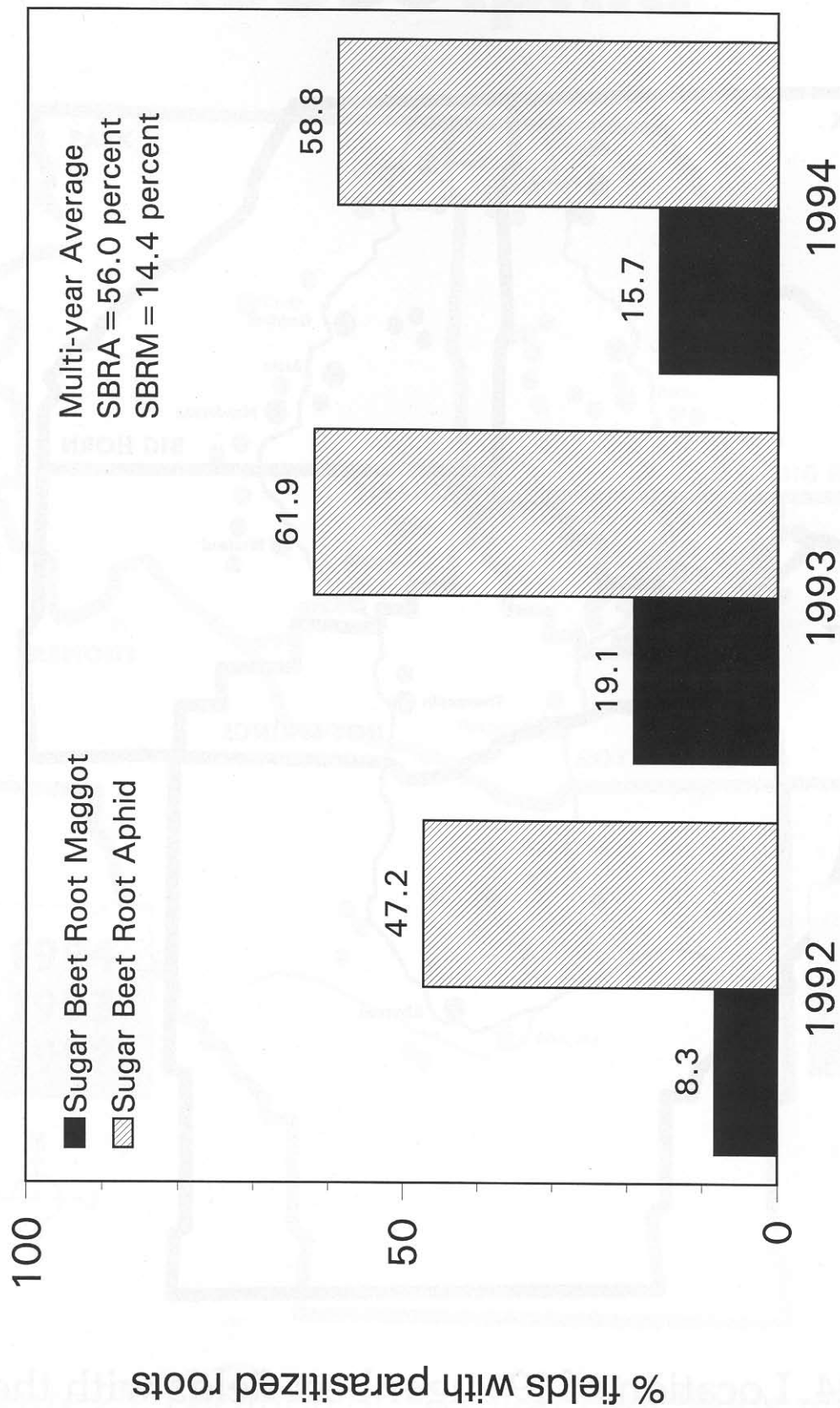


Figure 23. Incidence of insect root parasitism in sugar beet fields during 1992-1994 in the Wind and Big Horn River Basins

Root Maggot

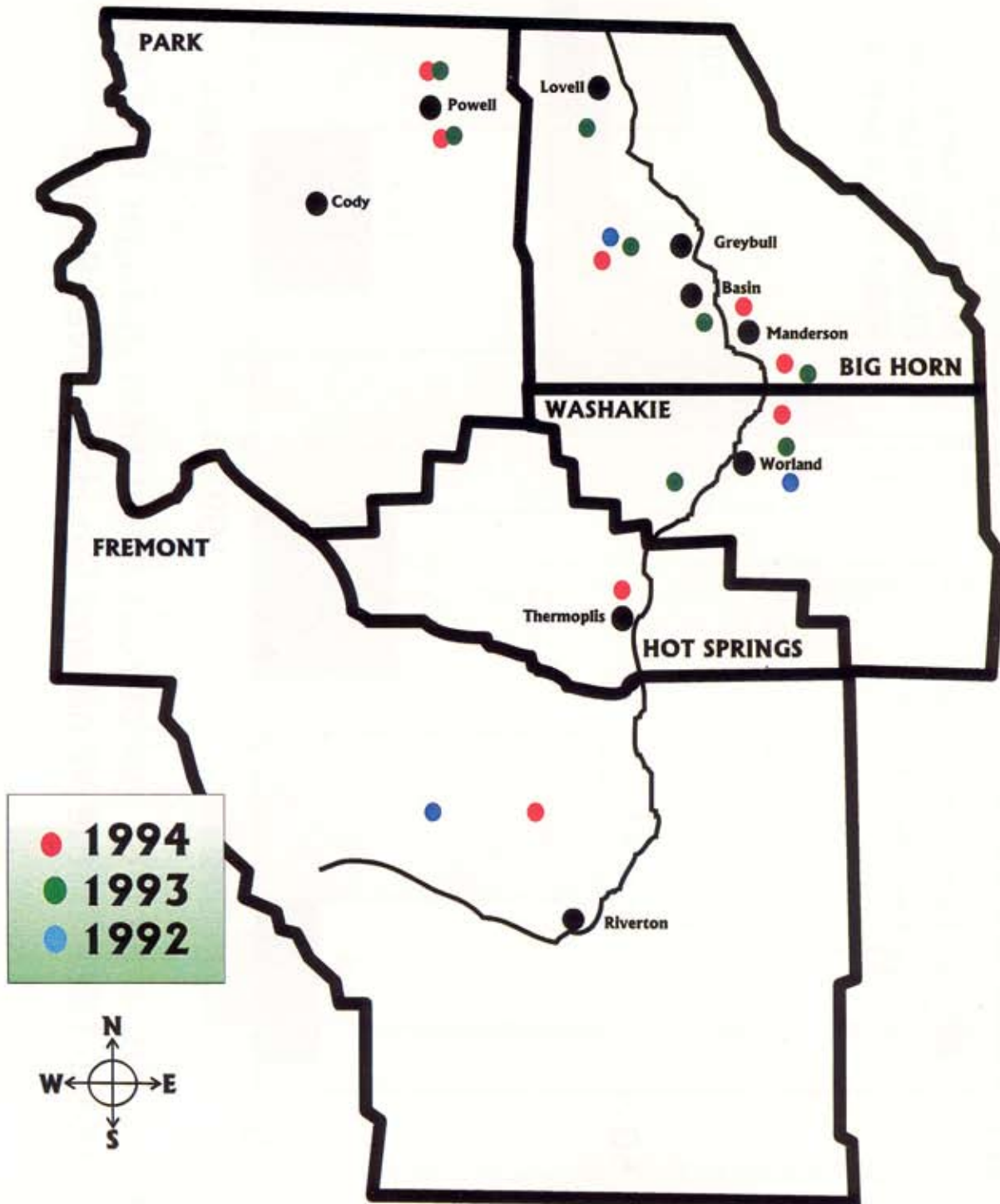


Figure 24. Location of 19 sugar beet fields with the Sugar Beet Root Maggot (3 in 1992, 8 in 1993, 8 in 1994).

Root Aphid

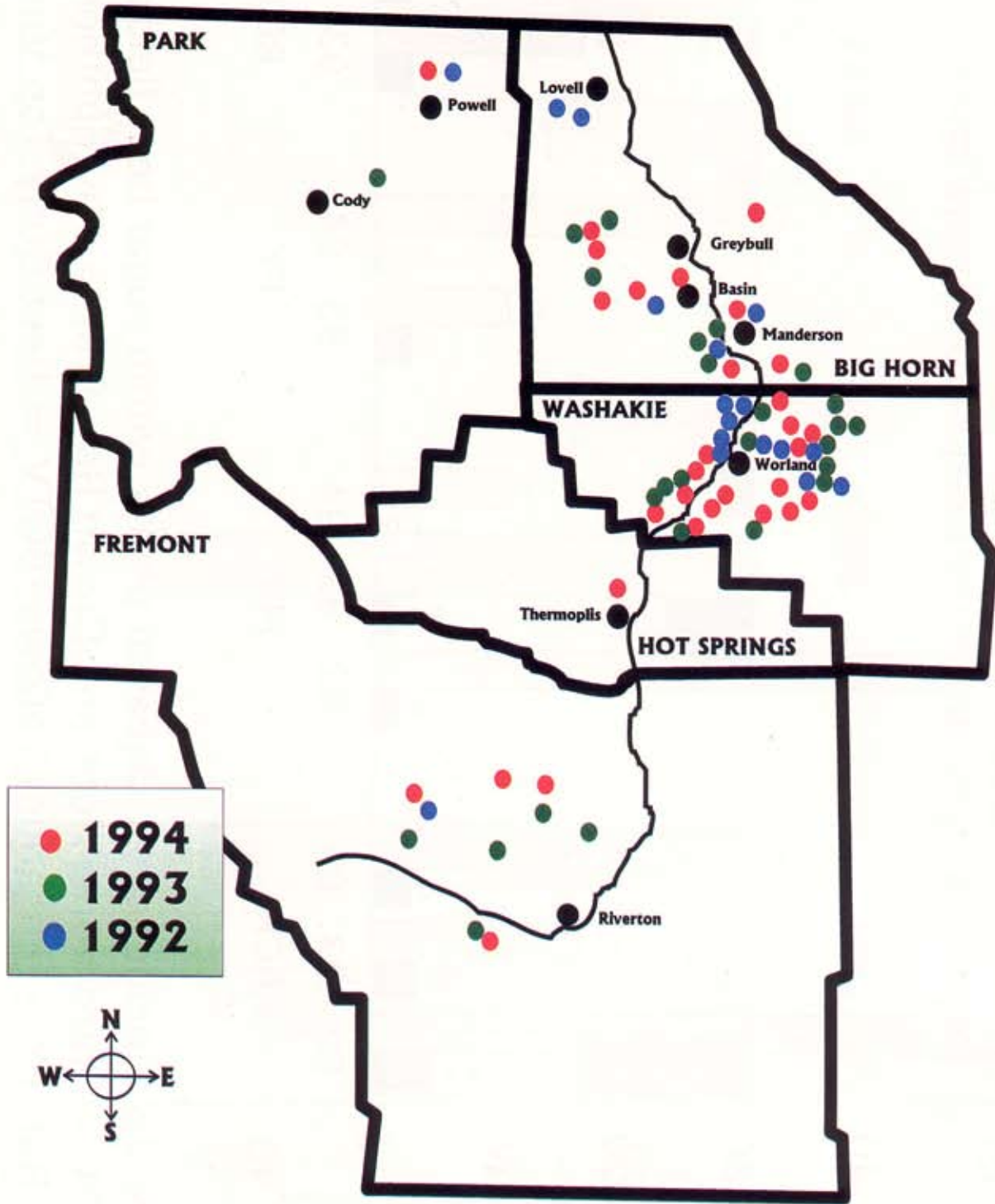


Figure 25. Location of 73 sugar beet fields with the Sugar Beet Root Aphid (17 in 1992, 26 in 1993, 30 in 1994).

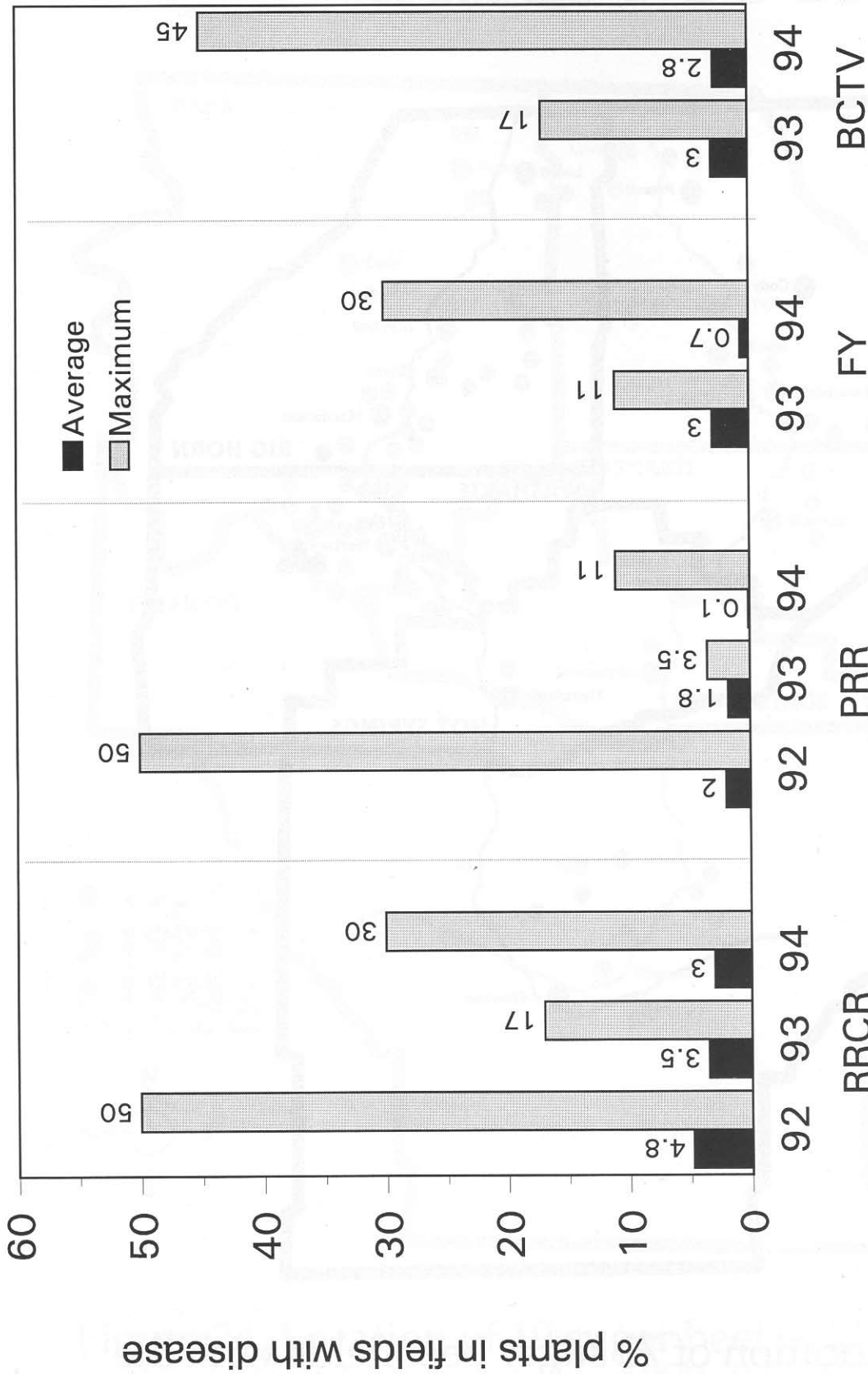


Figure 26. Incidence of diseased plants within sugar beet fields (RRCR = Rhizoctonia Root and Crown Rot, PRR = Phytophthora Root Rot, FY = Fusarium Yellow, BCTV = Beet Curly Top Virus)

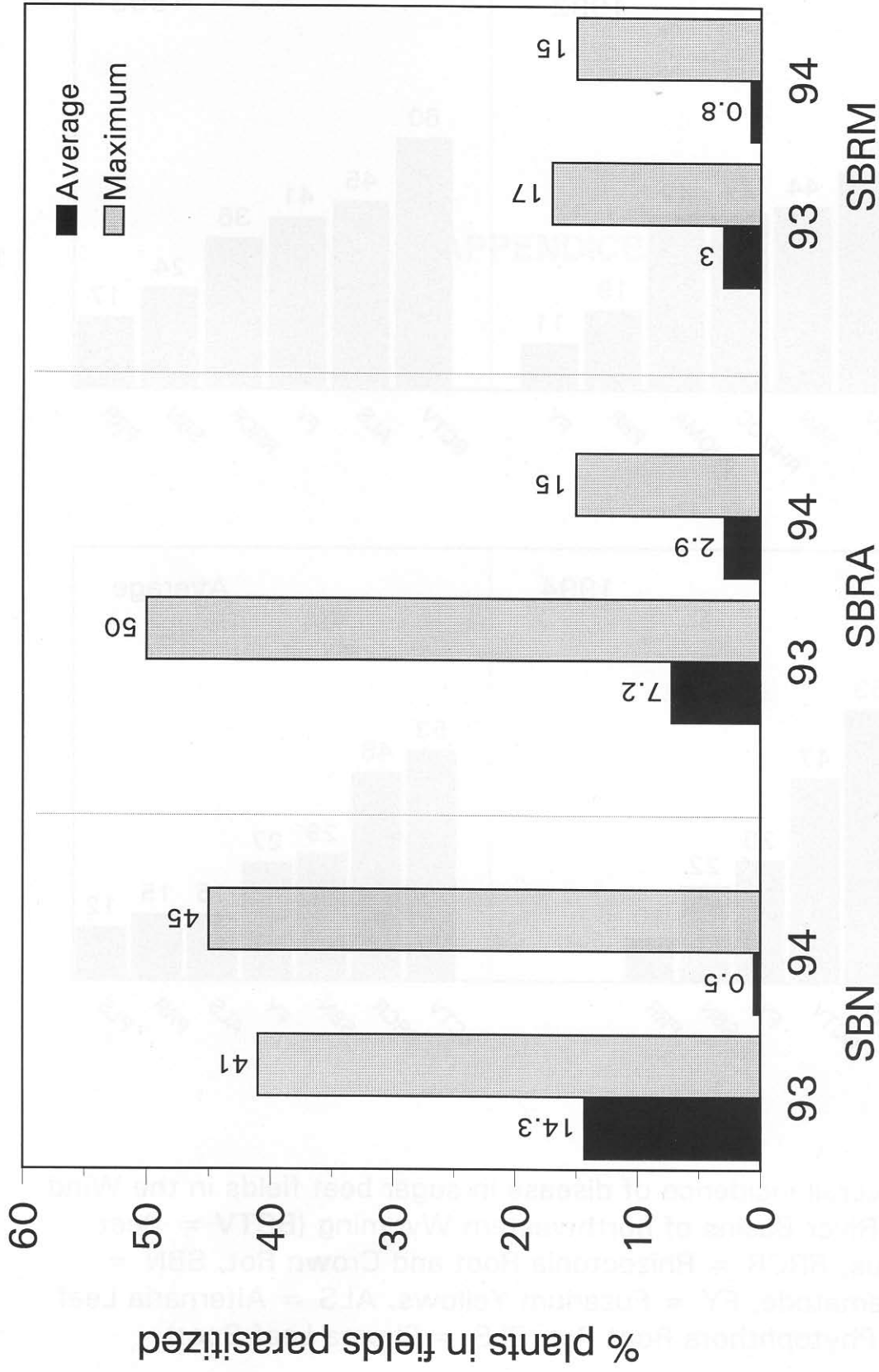


Figure 27. Incidence of plants parasitized within fields (SBN = Sugar Beet Nematode, SBRA = Sugar Beet Root Aphid and SBRM = Sugar Beet Root Maggot) during 1993 and 1994

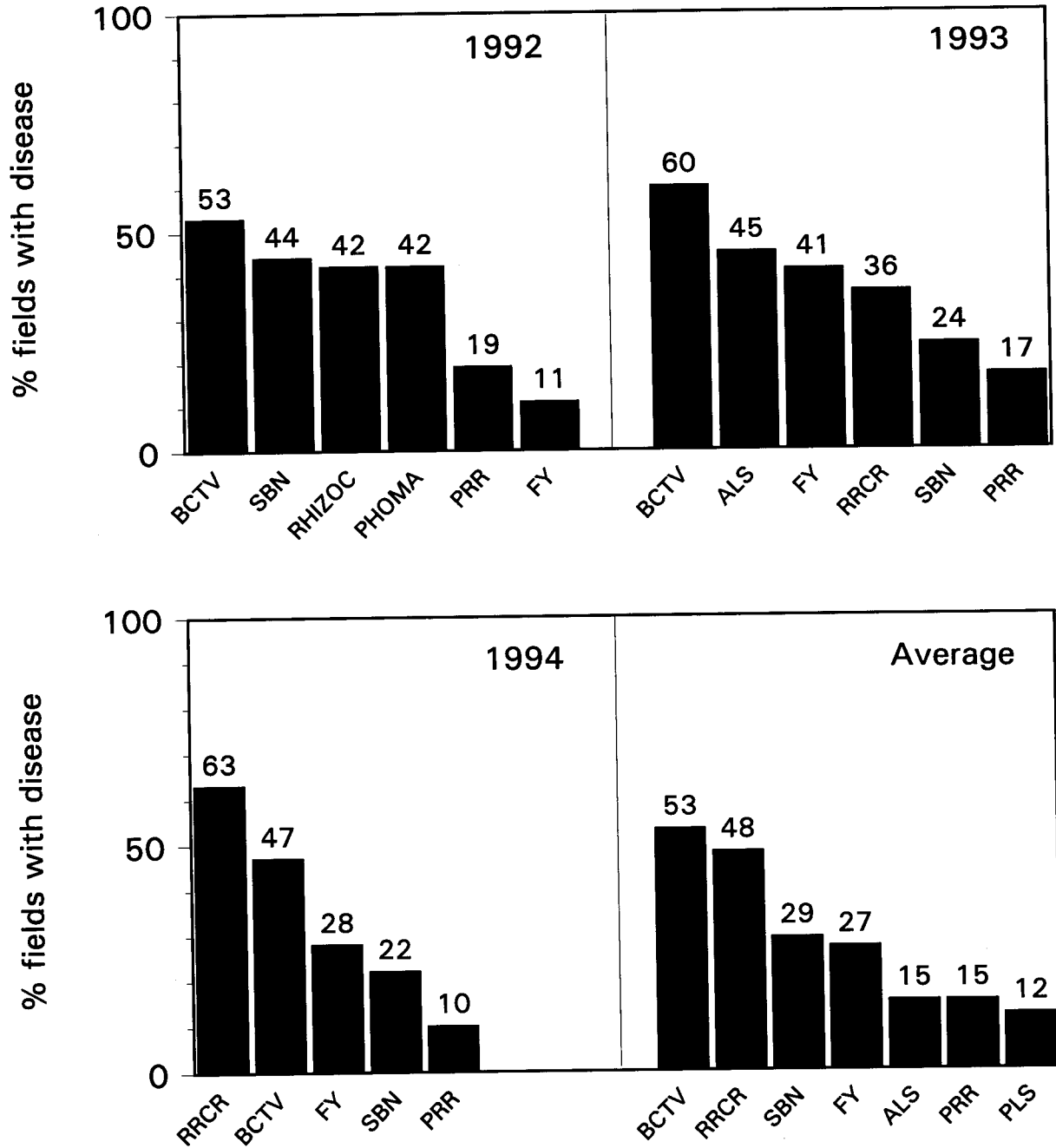


Figure 28. Overall incidence of disease in sugar beet fields in the Wind and Big Horn River Basins of northwestern Wyoming (BCTV = Beet Curly Top Virus, RRCR = Rhizoctonia Root and Crown Rot, SBN = Sugar Beet Nematode, FY = Fusarium Yellows, ALS = Alternaria Leaf Spot, PRR = Phytophthora Root Rot, PLS = Phoma Leaf Spot).

APPENDICES

Table 1. Raw data of the 1992 sugar beet disease survey

Farms in the four areas surveyed	Diseases/Insects*										
	SD**	SBN	BCTV	RHIZOC	PHYTOP	PHOMA	FY	APHID	MAGGOT	OTHER	
<u>Riverton/Midvale/Pullian Districts</u>											
1. Jennings Farm	+	-	-	-	-	-	-	-	-	-	
2. Dick Pattison	-	-	-	-	-	-	-	-	-	-	
3. Dave Pinse	+	-	-	-	-	-	-	-	-	-	
4. Dennis Pinse	-	-	-	-	-	+	-	-	-	-	
5. Wayne Wilson	-	-	-	-	+	+	-	-	-	-	
6. Rick Kline	-	-	-	-	-	-	-	-	-	-	
7. Dan Pinse	-	-	-	-	-	-	-	-	-	-	
8. Jake Schuerman	-	-	+	+	+	-	-	+	+	-	
9. Dick Weber	-	-	+	-	+	-	-	-	-	-	
<u>Factory Districts</u>											
10. Jim Bower	-	+	+	+	-	-	-	+	-	-	
11. Palesk/Kister Place	+	-	+	+	-	-	-	-	-	-	
12. Gene Miller/Benson Place	-	+	+	+	-	-	-	-	+	-	
13. Larry Wagner	-	-	+	+	+	-	-	+	-	-	
14. T & T Inc./Tom Clark	+	+	+	+	+	+	-	+	-	-	
15. McKamey Farms	-	+	-	-	-	+	+	+	-	-	
16. Sage Creek/John Snyder	-	+	-	-	-	+	-	+	-	-	
17. Wayne Keller	+	+	+	+	+	-	-	-	-	-	
18. Victor Weber	+	+	-	-	-	+	+	-	-	-	
19. LGL Farms/Bob Lass	-	+	-	-	-	+	-	-	-	-	
<u>Worland N., Basin E./Rairden/Eccles Districts</u>											
20. Steve Green	+	+	-	-	-	-	+	+	-	-	
21. John Harwood	-	-	+	-	-	-	-	-	-	BWYV	
22. Winston Miller	-	-	+	+	-	+	-	-	-	BWYV	
23. Wayne Mooseguard	+	+	-	+	-	-	+	+	-	-	
24. Alvin Nelson	-	+	+	-	-	+	-	+	-	-	
25. Jordan/John Sherman	+	+	+	+	-	-	-	+	-	-	
26. George Sinn & Son	+	+	+	-	-	+	-	+	-	-	
27. Howard Wildman #1	+	-	+	+	-	+	-	+	-	-	
28. Howard Wildman #2	-	+	+	+	-	+	-	+	-	-	

Table 1. Raw data of the 1992 sugar beet disease survey (continued).

Farms in the four areas surveyed	Diseases/Insects*										
	SD**	SBN	BCTV	RHIZOC	PHYTOP	PHOMA	FY	APHID	MAGGOT	OTHER	
<u>Basin W./Emblem Districts</u>											
29. Bullinger/Allens	+	-	+	+	-	-	-	+	-	-	
30. Wayne Sparks	+	-	-	+	-	+	-	-	-	-	
31. Edward's Ranch/Mayland	+	+	+	+	-	+	-	-	-	-	
32. Stutzman	+	-	-	-	+	-	-	-	+	-	
33. Rick Stroh	-	+	-	-	-	-	-	+	-	-	
34. Penrose Land & Cattle	+	-	+	-	-	-	-	+	-	-	
35. Werbelow	-	-	-	-	-	-	-	+	-	PM	
36. Howard Gernant/Kellersman	-	-	+	-	-	+	-	-	-	-	

*. SD = Seedling disease, SBN = Sugar Beet Nematode, BCTV = Beet Curly Top Virus, RHIZOC = Rhizoctonia Root & Crown Rot, -PHYTOP = Phytophthora Root Rot, PHOMA = Phoma Leaf Spot, FY = Fusarium Yellows, APHID = Beet Root Aphid, MAGGOT = Beet Root Maggot, PM = Powdery Mildew, BWVY = Beet Western Yellows Virus

** Seedling diseases identified included, *Rhizoctonia solani*, *Phoma betae*, *Pythium* sp., and *Phytophthora* sp. See Table 3.

Table 2. Raw data on the presence of diseases and insects in the 42 sugar beet fields surveyed in 1993

Grower	SD	SBN	BCTV	RRCR	PRR	FY	ALS	SBRA	SBRM	County
1. Gary Jennings	-	-	-	-	-	-	+	+	-	Fremont(7)
2. Charles Eckley	+	-	-	-	-	-	-	+	-	"
3. Richard Klein	-	-	-	-	-	-	-	+	-	"
4. Dan Weilever	+	-	-	-	-	-	+	+	-	"
5. Dan Pinse	-	-	-	-	-	-	-	-	-	"
6. Dick Pattison	-	-	-	-	-	-	+	-	-	"
7. Wayne Wilson	-	-	-	-	-	-	-	+	-	"
8. T. Nelson (A)	-	-	-	+	-	-	-	+	-	Washakie(18)
9. Con Keller	-	-	+	+	-	+	-	-	-	"
10. Dick Weber*	-	-	-	-	-	-	+	+	-	"
11. T. Nelson (B)*	-	+	+	+	-	+	+	+	-	"
12. Victor Weber	-	+	+	-	-	-	+	+	+	"
13. Jim Bower	+	+	+	+	-	+	+	+	-	"
14. Wayne Keller	-	-	+	-	-	+	-	-	-	"
15. John Snyder	-	-	+	+	-	-	-	+	-	"
16. Palask Farm	+	+	-	+	-	-	+	+	-	"
17. D. McKamey	+	+	+	+	+	-	+	+	+	"
18. Larry Wagner	+	-	+	+	-	+	-	+	-	"
19. Tom Clark	-	+	+	-	-	+	-	+	-	"
20. Jordan Farms	-	-	+	+	-	+	+	-	-	"
21. Gene Miller	-	-	-	-	+	+	+	-	-	"
22. L. Delker	-	-	+	+	+	+	+	+	-	"
23. H. Wildman	-	-	+	-	+	+	+	-	-	"
24. Bob Lass	+	-	+	-	-	-	+	+	-	"
25. Hefenieder*	-	+	+	+	+	-	+	+	-	"
26. A. Nelson	-	-	+	-	-	+	+	+	+	Big Horn(14)
27. J. Widman	+	-	+	-	-	-	-	-	-	"
28. Mosegard* A	-	+	+	-	-	+	-	-	-	"
29. Mosegard* B	-	+	+	+	-	+	-	+	-	"
30. Rubis Ranch	-	-	-	-	-	-	-	+	-	"
31. Steve Green	+	+	-	-	-	+	+	+	+	"
32. W. Miller	-	-	+	-	-	+	-	-	-	"
33. Bullinger	-	-	+	+	-	+	-	-	-	"

Table 2. Raw data on the presence of diseases and insects in the 42 sugar beet fields surveyed in 1993 (continued).

Grower	SD	SBN	BCTV	RRCR	PRR	FY	ALS	SBRA	SBRM	County
34. W. Hibbert	-	-	+	-	-	+	-	-	-	"
35. W. Sparks	-	-	+	-	-	-	+	+	-	"
36. S.C.S.	-	-	+	-	+	-	-	-	+	"
37. Edwards R.	-	-	+	-	-	-	-	+	-	"
38. Werebelow	-	-	-	+	-	-	-	+	-	"
39. H. Gernant	-	-	-	+	-	-	-	-	+	"
40. M. Dutton	-	-	+	-	-	-	-	+	-	Park(3)
41. J. Stutzman	-	-	-	-	-	-	+	-	+	"
42. Rich Stroh	-	-	-	-	+	-	-	-	+	"
No. Fields	9	10	25	15	7	17	19	26	8	
Positive	21.4	23.8	59.5	35.7	16.7	40.5	45.2	61.9	19.1	
% Fields										

SD=Seedling Disease, **SBN**=Sugar Beet Nematode, **BCTV**=Beet Curly Top Virus, **RRCR**=Rhizoctonia Root and Crown Rot, **PRR**=Phytophthora Root, **FY**=Fusarium Yellow, **ALS**=Alternaria Leaf Spot, **SBRA**=Sugar Beet Root Avid, **SBRM**=Sugar Beet Root Maggot, *=Survey field with experimental plots.

Table 3. Raw data on the presence of diseases and insects in the 51 sugar beet fields surveyed in 1994

Grower	FB	CB	SBN on roots	SBN in soil	BCTV	RRC	PRR	FY	SBRA	SBR	County	District
1 Russell Weber				-		R	+				Fremont (9)	Riverton
2 Charlie Eckley				-					+		"	"
3 Richard Klein				-					+		"	Midvale
4 Dave Pinse	+	+		-					+		"	"
5 Dick Pattison	+	+		-					+	+	"	"
6 Dan Weliever	+	+		-							"	"
7 Wayne Wilson	+			-							"	Riverton
8 Dennis Pinse	+	+		-							"	"
9 Gary Jennings	+	+		-							"	"
10 Vern Lofink	+	+		+					+	+	Hot Springs (1)	Pullian
11 Jim Bower	+	+		+	+	+			+		Washakie (24)	Factory
12 Wayne Keller		+		+	+	+			+		"	"
13 Sage Creek (East)				+		+					"	"
14 Sage Creek (West)				+	+	+					"	"
15 Palask Farms	+	+		+	+	+			+		"	"
16 Bush Farms	+	+		+		+			+		"	"
17 McKamey Farms	+	+		+	+	+			+		"	"
18 Gene Miller		+		+		+			+		"	"
19 Hefenieder Farms	+	+		+	+	+			+		"	"
20 Jim Michael	+			+	+	+			+		"	"
21 Ujifusa Brothers	+	+		+	+	+			+		"	"
22 LGL Farms				+		+	+				"	"
23 Ted Propp	+			+		+			+		"	"
24 Conrad Keller				+	+	+			+		"	Pullian
25 Keith Bower	+	+		+			+				"	"
26 Vic Weber	+	+		+		+			+		"	"
27 Terry Nelson	+	+		+	+	+			+		"	Factory
28 Louis Weber	+	+		+	+						"	Pullian
29 Jordan Farms	+	+		+	+	+			+		"	Eccles

Table 3. (continued)

Grower	FB	CB	SBN on roots	SBN in soil	BCTV	RRCR	PRR	FY	SBRA	SBRM	County	District	Disease					
													SBN on roots	SBN in soil	BCTV	RRCR	PRR	FY
30 Tom Clark			+	+	+	+			+		"	Factory						
31 Larry Wagner				-	+	+		+			"	Eccles						
32 Ken Ogg				+	+	+		+		+	"	"						
33 Joe Salzman	+	+		-		+		+			"	"						
34 Howard Wildman	+			+	+			+			"	Rairden						
35 Deiker Farms			+	+		+					Big Horn (14)	Eccles						
36 Alvin Nelson	+	+		-		+	+		+	+	"	"						
37 Steve Green	+	+		+	+	+		+	+	+	"	Rairden						
38 Wayne Mosegard	+	+		+	+			+			"	"						
39 Joe Wildman				-	+	+	+	+			"	"						
40 Jimmy Rubis				+		+					"	"						
41 Tod Werbelow		+		-		+					"	Emblem						
42 Dave Edwards				-	+	+		+	+	+	"	"						
43 Howard Gernant				-	+	+					"	"						
44 Hibbert Ranch				+	+			+	+	+	"	Basin						
45 John Bullinger	+	+		-		+		+			"	"						
46 Winston Miller	+	+		-	+			+	+		"	"						
47 Bog Yeager	+	+		-	+	+			+		"	"						
48 Penrose/Shoshone	+	+		+		+					"	Emblem						
49 Merle Dutton	+	+		-							Park (3)	"						
50 Stutzman Inc.	+	+		-					+	+	"	"						
51 Rick Stroh	+	+		-						+	"	"						
													Insect					
													Disease					
			SBN on roots	SBN in soil	BCTV	RRCR	PRR	FY	SBRA	SBRM								
No. fields positive			11	29	24	32	5	14	30	8								
% fields positive			21.6	56.9	47.1	62.8	9.8	27.5	58.8	15.7								

FB = Flea Beetle, CB = Carrion Beetle, SBN = Sugar Beet Nematode, BCTV = Beet Curly Top Virus, RRCR = Rhizoctonia Root and Crown Rot, PRR = Phytophthora Root Rot, FY = Fusarium Yellow, SBRA = Sugar Beet Root Aphid, SBRM = Sugar Beet Root Maggot.

Table 4. List of seven diseases and four insect parasites in sugar beet fields in Fremont County (1992-1994)

DISEASES/INSECT PARASITES

FUNGAL DISEASES

Fungi isolated from roots of diseased seedlings

Phoma betae

Pythium sp.

Rhizopus sp.

Fusarium sp./*F. oxysporium* f. sp. *betae*

Root and Crown Rots

Phytophthora Root Rot

Leaf Diseases

Phoma Leaf Spot

Alternaria Leaf Spot

INSECT PARASITES

Seedling Parasites

Beet Carrion Beetle

Pale-Striped Flea Beetle

Root Parasites

Sugar Beet Root Aphid

Sugar Beet Root Maggot

Table 5. List of 15 diseases and four insect parasites identified in sugar beet fields in Washakie County (1992-1994)

DISEASES/INSECT PARASITES

FUNGAL DISEASES

Fungi isolated from roots of diseased seedlings

Rhizoctonia solani
Phytophthora drechsleri
Fusarium sp./F. oxysporium f.sp. betae
Aphanomyces cochlioides
Rhizopus sp.
Pythium sp.

Root and Crown Rots

Phytophthora Root Rot
 Rhizoctonia Root and Crown Rot

Vascular Wilts

Fusarium Yellows

Leaf Diseases

Phoma Leaf Spot
 Alternaria Leaf Spot
 Powdery Mildew

NEMATODE DISEASES

Sugar Beet Nematode

VIRUS DISEASES

Beet Curly Top Virus
 Beet Western Yellows Virus

INSECT PARASITES

Seedling Parasites

Beet Carrion Beetle
 Pale-Striped Flea Beetle

Root Parasites

Sugar Beet Root Aphid
 Sugar Beet Root Maggot

Table 6. List of 14 diseases and four insect parasites identified in sugar beet fields in Big Horn County (1992-1993)

DISEASES/INSECT PARASITES

FUNGAL DISEASES

Fungi isolated from roots of diseased seedlings

Rhizoctonia solani
Phoma betae (Black Leg)
Pythium sp.
Aphanomyces cochlioides
Fusarium sp./*F. oxysporium* f.sp. *betae*

Root and Crown Rots

Phytophthora Root Rot
 Rhizoctonia Root and Crown Rot

Vascular Wilts

Fusarium Yellow

Leaf Diseases

Phoma Leaf Spot
 Alternaria Leaf Spot
 Powdery Mildew

NEMATODE DISEASES

Sugar Beet Nematode

VIRUS DISEASES

Beet Curly Top Virus
 Beet Western Yellow Virus

INSECT PARASITES

Seedling Parasites

Beet Carrion Beetle
 Pale-Striped Flea Beetle

Root Parasites

Sugar Beet Root Aphid
 Sugar Beet Root Maggot

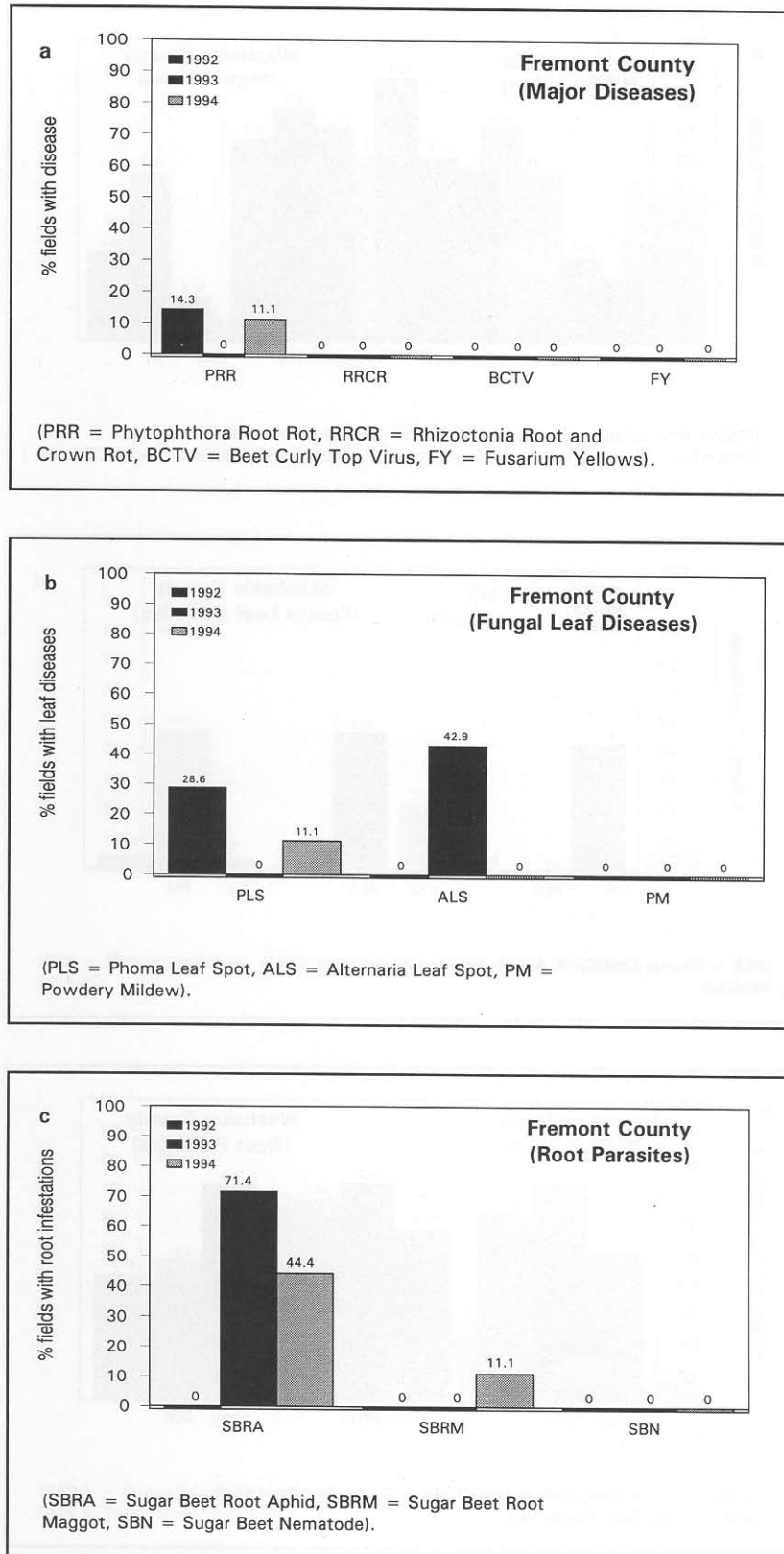


Figure 1. Incidence of: (a) major diseases; (b) leaf diseases; and (c) root parasites in sugar beet fields in Fremont County.

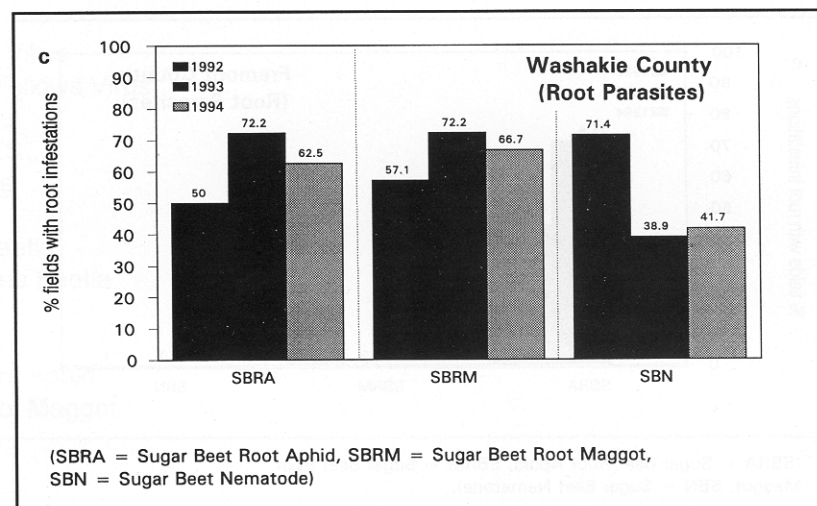
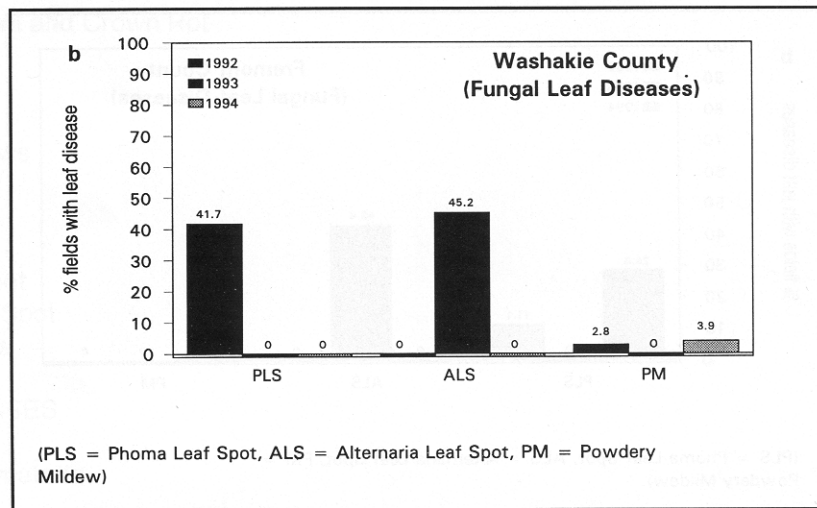
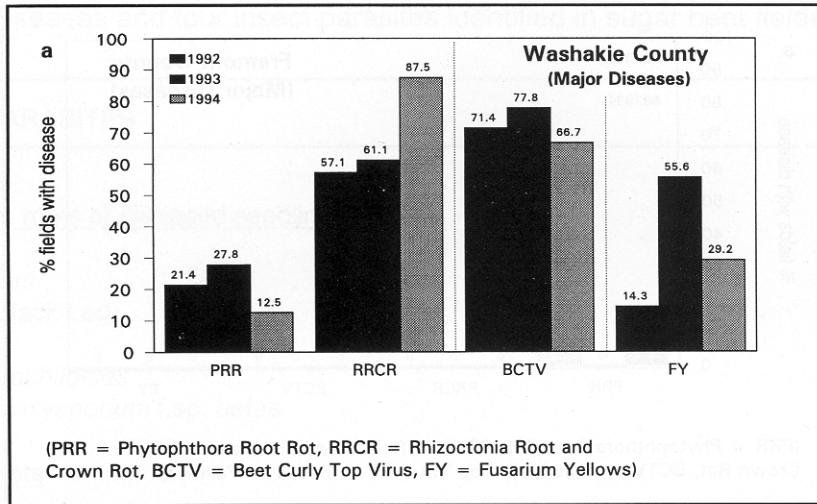


Figure 2. Incidence of: (1) major diseases; (b) leaf diseases; and (c) root parasites in sugar beet fields in Washakie County

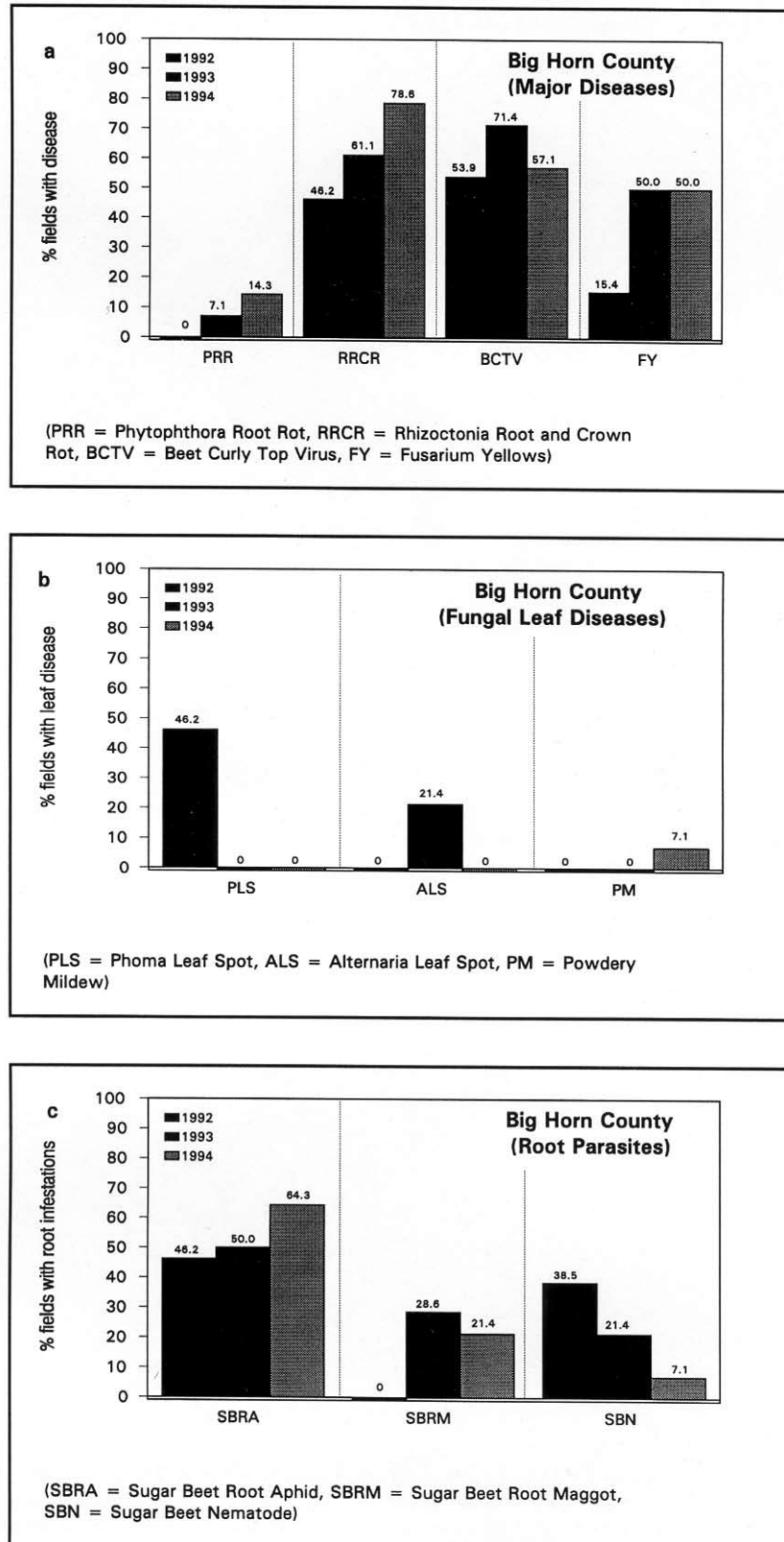


Figure 3. Incidence of: (a) major diseases; (b) leaf diseases; and (c) root parasites in sugar beet fields in Big Horn County

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