

SUNFLOWER DISEASE MAPPING IN EUROPE AND  
ADJACENT MEDITERRANEAN COUNTRIES

By

W. E. SACKSTON<sup>(1)</sup>

Summary

Representatives of eight countries organized a European network for scientific cooperation in sunflower research at a meeting sponsored by F.A.O. in Bucharest in October 1975. The National Research Center for Oilseed Crops (World Bank-Government of Spain project), Cordoba, Spain, was named liaison center to organize sunflower disease mapping. Arrangements were made by correspondence and by meetings at Krasnodar, U.S.S.R. in July 1976, and reviewed at Cordoba in September 1977. Lists of diseases were provided from: Bulgaria, Egypt, France, Hungary, Israel, Italy, Poland, Romania, Spain, Tunisia, Turkey, and Yugoslavia; and distribution maps from Bulgaria, Egypt, France, Romania, Spain, Turkey, and Yugoslavia. Uniform methods for making disease surveys were agreed upon, but it was not possible to use them in all countries. Much work remains to be done in countries where the crop is relatively new and where fewer trained people and resources are available. At present it is possible to prepare only tentative overall maps for each disease showing the countries in which it has been reported and if it is considered major or minor there. Detailed maps showing crop and disease distribution should be prepared separately for each country.

Introduction

Sunflowers have been an important oilseed crop in eastern Europe, particularly in the U.S.S.R., for many years. They are a new crop in many countries of Europe and adjacent areas of the Mediterranean basin, where large and increasing areas are being devoted to sunflower production.

A great deal of research has been done on sunflowers in some of the older producing areas. Research programs are being established, some of them on an ambitious scale, in various "new" sunflower growing countries. To help coordinate these efforts and to establish closer contacts among the institutions in various countries, F.A.O. sponsored a meeting at Bucharest in October 1975 which organized a European network for scientific cooperation in sunflower research. One of the subnetworks established was on sunflower disease mapping in Europe, with the National Research Center for Oilseed Crops (a joint project of the World Bank and the Government of Spain) at Cordoba, Spain, named as the liaison center for the first two-year period.

---

(1) Professor of Plant Pathology, Macdonald College of McGill University, Ste. Anne de Bellevue, Que., H0A 1C0, Canada. (From 1972 to 1977, Research Coordinator, National Research Center for Oilseed Crops, Cordoba, Spain.)

### Objectives and Justification of Mapping

Sunflower diseases have been studied intensively in only a few countries; relatively little work has been done on them in most of the new sunflower growing areas. Diseases known to be prevalent and destructive in some countries apparently do not occur in others, or have not been recognized or reported there. Diseases considered minor in some older sunflower growing areas, have proved destructive in new areas for the crop.

It is important to know what diseases are present and which are destructive in each country, in order to allocate research resources where they are most needed and to develop programs of the greatest practical value for that country. It is important to know what diseases exist in other countries from which seed is imported, or from which pathogens may spread by natural means or by accidental transport.

It is important to determine relationships between disease occurrence and severity, and such factors as soil and climatic conditions. Some diseases destructive in one area may be of little significance in another because of differences in environment or cultural practices. Disease occurrence, prevalence, and severity may change from year to year. It is important to know if such changes are local or general, and if they are attributable to introduced or changed pathogens, changes in crop cultivars, or in environmental factors.

Knowledge of the distribution, severity, and regularity of occurrence of diseases in various countries may make it possible to share research efforts among cooperating institutions, to mutual advantage.

Much of the necessary information can be presented most effectively and understood most readily in the form of disease maps.

### Methodology

The initial organization of sunflower disease mapping in Europe was done by correspondence. A meeting of pathologists and agronomists interested in the mapping project was held at Krasnodar, U.S.S.R. in July 1976 in connection with the Seventh International Sunflower Conference. Representatives of nine European countries and an observer from U.S.A. reported on the disease situation in their respective countries, and those who made systematic surveys described the methods used.

It was agreed to use a common survey method insofar as possible in each country, as follows:

1. Make two surveys in each country, the first when plants are at about the 10-leaf stage, and the second after full bloom. Where possible make another survey when plants are maturing, to determine head rot.
2. Examine at least 100 plants per field of 10 hectares or less. In small fields walk along the diagonals crossing the field from corner to corner, making two counts of 50 consecutive plants along each diagonal. In fields larger than 10 ha walk along one diagonal,

counting 50 consecutive plants at each of six or more locations evenly spaced along the diagonal.

3. Record all the diseases which can be recognized in the field, or diagnosed later in the laboratory.
4. Describe any unidentified symptoms in detail, for future reference.
5. Record the intensity of attack, as well as the number of plants affected by each disease in each sample of 50 plants.
6. For diseases which occur in patches, estimate the area in the patches as a percentage of the total area of the field. Record any other diseases observed in the field, in addition to diseases seen on the plants sampled systematically.
7. For leaf spots and other foliage diseases, indicate if symptoms are present on the lower, middle, or upper part of the plant.
8. Estimate intensity of leaf spots and other diseases as light, moderate, or severe, with reference to area affected as a proportion of total leaf or stem area.
9. Record estimated field size, and inspect a suitable number of fields in each sunflower area of the country, to be able to estimate the significance of each disease in the whole country.
10. The comment was appended: "It has been found useful in some countries to prepare survey sheets, with one sheet to be used for each field examined. Spaces are provided for information on the date; location of the field; its estimated size; plant stage; soil type; and any other general information of interest. The diseases which may be expected to occur in surveys made at specific stages of plant development are listed, with space to record number of plants affected by each disease in each count of 50 plants, and intensity of disease. Space is also provided for miscellaneous diseases not listed. Additional sheets bearing the same field number may be used for detailed descriptions of unfamiliar symptoms observed in the field, or for additional comments."

Not included in the methodology agreed at the time, but desirable, is the preparation of herbarium specimens of each of the diseases seen, and taking general and close photographs of symptoms. These are extremely useful in confirming or correcting diagnoses at some future date.

#### Disease Lists and Maps

##### Lists

A meeting to review the results of the first two years of work by the various subnetworks was organized by F.A.O. at Cordoba in September 1977.

The response of collaborators in the disease mapping project was most gratifying. Disease lists were prepared and submitted for 14 countries. The information in the lists and the contributors are given in Tables 1 to 14.

TABLE 1. Sunflower Diseases in Bulgaria\*

Disease	Pathogen	Comment
Downy mildew	<u>Plasmopara helianthi</u> Novot. (= <u>P. halstedii</u> )	Major disease
Rust	<u>Puccinia helianthi</u> Schw.	Major disease
White rot	<u>Sclerotinia sclerotiorum</u> (Lib.) deBary (= <u>S. libertiana</u> )	Major disease
Leaf spot	<u>Septoria helianthi</u> Ell. and Keller	Major disease
Leaf spot	<u>Alternaria</u> sp.	(First report in Bulgaria, 1976)
Broomrape	<u>Orobanche</u> sp.	Severe on Peredovik in one location since 1974

\* Submitted by Rossitza Bochvarova, Institute for Wheat and Sunflower, General Tosheva, Tolbuhin, Bulgaria.

TABLE 2. Sunflower Diseases in Egypt\*

Disease	Pathogen	Comment
Charcoal rot	<u>Macrophomina phaseolina</u> (Tassi). Goidanich (= <u>M. phaseoli</u> = <u>Sclerotium bataticola</u> )	Major disease
Rust	<u>P. helianthi</u>	Major disease
Leaf spots (Complex)	<u>Alternaria alternata</u> (Fr.) Keissler <u>Curvularia lunata</u> Wakkar <u>Drechslera rostrata</u> (Drech.) Richardson and Fraser <u>D. spicifera</u> (Bain) V. Arx <u>Ulocladium botrytis</u> Preuss. <u>U. spetiosporum</u> (Preuss) Simons <u>Botryodiplodia theobromae</u> Pat.	Major disease First record Isolated from leaf spots " " " " " " " "
Wilt	<u>Fusarium oxysporum</u> Schlecht. amend. Snyd. and Hans. <u>F. solani</u> App. and Wr.	Uncommon Uncommon
Southern blight	<u>Sclerotium rolfsii</u> Sacc.	Increasing prevalence
Stalk and head rot	<u>Whetzelinia sclerotiorum</u> (Lib.) Korf and Dumont (= <u>S. sclerotiorum</u> = <u>S. libertiana</u> )	Rare
Powdery mildew	<u>Erysiphe cichoracearum</u> D.C. (= <u>Oidium</u> sp.)	Scarce
Head rot	<u>Rhizopus arrhizus</u> Fisher <u>A. alternata</u> <u>Aspergillus</u> sp.	Heavy damage on short cultivars Isolated from heads " " "
Root rot (Complex)	<u>Rhizoctonia solani</u> Kuhn <u>Pythium</u> sp. <u>Fusarium</u> sp.	Minor disease " " " "
Leaf mottle (verticillium wilt)	<u>Verticillium dahliae</u> Kleb.	New in 1977, major disease
Root Knot	<u>Meloidogyne</u> sp.	Heavy losses in sandy soils

\* Submitted by A.M. El Zarka, Institute of Plant Pathology, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

TABLE 3. Sunflower Diseases in France\*

Disease	Pathogen	Comment
Downy mildew	<u>P. helianthi</u>	Major disease
White rot (stalk and head rot)	<u>S. sclerotiorum</u>	Major disease
Gray rot (stalk and head rot)	<u>Botrytis cinerea</u> Fr.	Major disease
Charcoal rot (pre-mature ripening)	<u>M. phaseolina</u>	Major disease
Verticillium wilt (leaf mottle)	<u>V. dahliae</u>	Minor disease
Rust	<u>P. helianthi</u>	Minor disease
Powdery mildew	<u>Oidium</u> sp.	Minor disease
Black stem	<u>Phoma oleracea</u> Sacc.	Minor disease
Head rot	<u>Rhizopus</u> sp.	Minor disease
Head rot	<u>Aspergillus</u> sp.	Minor disease

\* Submitted by Y. Regnault and collaborators, C.E.T.I.O.M., 174 Av. Victor Hugo, 75116, Paris, France; and J.J. Guillaumin, INRA, Station de Pathologie Vegetale, Domaine Monte Desir, 12 Av. de l'Agriculture, and Felicity Vear, INRA, Station d'Amelioration des Plantes, Domaine de Crouelle, 63110 Clermont-Ferrand, France. Detailed information is provided in Guillaumin et al. (1975, 1976).

TABLE 4. Sunflower Diseases in Hungary\*

Disease	Pathogen	Comment
Downy mildew	<u>Plasmopara halstedii</u> (Farl.) Berl. and de Toni	Occurrence and
White rot	<u>S. sclerotiorum</u>	severity vary
Gray rot	<u>B. cinerea</u>	from year to
Charcoal rot	<u>M. phaseolina</u>	year with
Verticillium wilt	<u>V. dahliae</u>	climatic con-
Leaf spot	<u>S. helianthi</u>	ditions and
Leaf spot	<u>Alternaria zinniae</u> Pape	with host
Leaf spot	<u>A. helianthi</u> (Hansf.) Tubaki and Nishihara	cultivar.
Leaf spot	<u>Alternaria</u> sp.	

\* Submitted by J. Voros, Research Institute for Plant Protection, H-1525 Budapest 11, P.F. 102, Herman Otto U. 15, Hungary.

TABLE 5. Sunflower Diseases in Iran\*

Disease	Pathogen	Comment
Leaf spot	<u>Alternaria</u> sp.	Major
Charcoal rot	<u>Sclerotium bataticola</u> Taub.	Major
Wilt	<u>Fusarium</u> sp.	Minor
Head rot	<u>Rhizopus</u> sp. <u>Alternaria</u> sp.	Significant in humid regions
Downy mildew	<u>P. halstedii</u>	" " "
Rust	<u>P. helianthi</u>	On large-seeded types
White rot	<u>Sclerotinia libertiana</u> Fckl.	Sporadic

\* Submitted by M. Acimovic, Institute for Agricultural Research, Maksima Gorkog 30, Novi Sad, Yugoslavia. Detailed information is given by Acimovic (1975 b).

TABLE 6. Sunflower Diseases in Israel\*

Disease	Pathogen	Comment
Rust	<u>P. helianthi</u>	Major disease
Head rot	<u>Rhizopus</u> sp.	Major disease
White rot	<u>S. sclerotiorum</u>	Minor disease
Charcoal rot	<u>M. phaseolina</u>	Minor disease
Powdery mildew	<u>Oidium</u> sp.	Minor disease
Collar rot	<u>Sclerotium rolfsii</u> Sacc.	Rare disease
Downy mildew	<u>P. halstedii</u>	One doubtful record

\* Submitted by R. Kenneth, Department of Plant Pathology and Microbiology, Faculty of Agriculture, P. O. Box 12, Rehovot 76-100, Israel.

TABLE 7. Sunflower Diseases in Italy\*

Disease	Pathogen	Comment
Downy mildew	<u>P. halstedii</u>	Minor disease
White rot	<u>S. sclerotiorum</u>	Variable
Brown rot	<u>B. cinerea</u>	Variable

\* Submitted by G. Vicentini (deceased) and G.P. Vannozzi, Istituto di Agronomia Generale e Coltivazioni Erbacee, Universita di Pisa, Pisa, Italy; and R. Tuberosa, Istituto di Agronomia Generale e Coltivazioni Erbacee, Universita di Bologna, Bologna, Italy.



TABLE 8. Sunflower Diseases in Poland\*

Disease	Pathogen	Comment
Gray rot	<u>B. cinerea</u>	Major disease
White rot	<u>S. sclerotiorum</u>	Minor disease
Downy mildew	<u>P. halstedii</u>	First found 1975
Verticillium wilt	<u>V. dahliae</u>	Potentially dangerous

\* Submitted by Z. Kloczowski, Instytut Hodowli i Aklimatyzacji Roslin, Oddzial Poznanski-Gorzowski Zaklad Roslin Oleistych Poznan, Sieroca 1a-61-611, Poznan, Poland.

TABLE 9. Sunflower Diseases in Romania\*

Disease	Pathogen	Comment
Downy mildew	<u>P. helianthi</u>	Major disease
White rot (stalk and head rot)	<u>S. sclerotiorum</u>	Major disease
Gray rot	<u>B. cinerea</u>	Major for first time in 1976
Black stem	<u>P. oleraceae</u> var. <u>helianthi tuberosi</u> Sacc.	Minor disease
Charcoal rot	<u>S. bataticola</u>	Minor disease
Rust	<u>P. helianthi</u>	Minor disease
Verticillium wilt	<u>V. dahliae</u>	First found in 1976
Broomrape	<u>Orobancha</u> sp.	New race

\* Submitted by H. Iliescu and A.V. Vranceanu, Research Institute for Cereals and Industrial Crops, Fundulea, Jud. Ilfov, Bucharest, Romania. Detail is given by Iliescu (1974).

TABLE 10. Sunflower Diseases in Spain\*

Disease	Pathogen	Comment
Downy mildew	<u>P. halstedii</u>	Major disease
Charcoal rot	<u>S. bataticola</u>	Major disease
White rot (stalk rot)	<u>S. sclerotiorum</u>	First found in farm field in 1976
Gray rot (stalk rot)	<u>B. cinerea</u>	Scarce - in research plots and greenhouse
Rust	<u>P. helianthi</u>	Scarce
Head rot	<u>Rhizopus</u> sp.	Minor
Verticillium wilt	<u>V. dahliae</u>	First found in farm field in 1976
Broomrape	<u>Orobanche</u> sp.	First found on oilseed sunflowers 1976
Head drop	Cause unknown, possibly physiologic or insect attack	Scarce
Bract necrosis	Cause unknown	General, associated with drought

\* Submitted by W.E. Sackston, Rafael Jimenez-Diaz, Carlos Garcia-Baudin, and Fernando Romero-Munoz, Research Center for Oilseed Crops, INIA, Alameda del Obispo, Aptdo. 240, Cordoba, Spain.

TABLE 11. Sunflower Diseases in Tunisia\*

Disease	Pathogen	Comment
Charcoal rot (black root rot)	<u>M. phaseoli</u>	Major disease
White rot (stalk rot)	<u>S. sclerotiorum</u>	Major disease
Head rot	<u>Rhizopus arrhizus</u> Fischer	Major disease
Fusarium wilt	<u>F. oxysporum</u> f. sp. <u>helianthi</u> Mahjoub	Rare
Gray rot	<u>B. cinerea</u>	Found once on seeds, once on necrotic leaf

\* Submitted by A. Jouhri, Laboratoire des plantes Industrielles, and M. El Mahjoub, Laboratoire de Phytopathologie, INRAT, Ariana, Tunisia. Additional information is given by Mahjoub and Ben Othman (1974a, 1974b, and 1975).

TABLE 12. Sunflower Diseases in Turkey\*

Disease	Pathogen	Comment
Downy mildew	<u>P. helianthi</u>	Widespread disease
White rot	<u>S. sclerotiorum</u>	Widespread disease
Gray rot	<u>B. cinerea</u>	Widespread disease
Rust	<u>P. helianthi</u>	Widespread disease
Leaf spot	<u>S. helianthi</u>	Widespread disease
Leaf spot	<u>Alternaria</u> sp.	Widespread disease
Leaf rot	<u>Helminthosporium</u> sp.	Widespread disease
Head rot	<u>Rhizopus</u> sp.	Localized
Charcoal rot	<u>M. phaseoli</u>	Localized
Broomrape	<u>Orobanche</u> sp.	Widespread disease

\* Submitted by R. Tashan, Agricultural Research Institute, P.O. Box 1, Yesikoy, Istanbul, Turkey, and M.M. Yucer, Erenkoy Regional Plant Protection Research Institute, Kadikoy, Istanbul, Turkey.

TABLE 13. Sunflower Diseases in U.S.S.R.\*

Disease	Pathogen	Comment
Downy mildew	<u>P. helianthi</u>	
White rot	<u>S. libertiana</u>	
Root rot	<u>Fusarium</u> sp.	
Rust	<u>P. helianthi</u>	
Verticillium wilt	<u>V. dahliae</u>	
Broomrape	<u>Orobanche cumana</u> Wallr.	
Broomrape	<u>O. ramosa</u> L.	
Broomrape	<u>O. aegyptiaca</u> Pers.	
Charcoal rot	<u>S. bataticola</u>	
Gray rot	<u>B. cinerea</u>	
Head rot	<u>R. nodosus</u>	
Powdery mildew	<u>Erysiphe cichoracearum</u> D.C. f. <u>helianthi</u> Jaca.	
White rust	<u>Cystopus tragopogonis</u> Schrot. (= <u>Albugo tragopogonis</u> )	
Leaf spot	<u>S. helianthi</u>	
Black leaf spot	<u>Ascochyta helianthi</u> Abramov.	
Angular leaf spot	<u>Pseudomonas solanacearum</u> E.F. Smith	

\* This list was not submitted but translated from the Russian book by Khokhryakov et al. (1966).

TABLE 14. Sunflower Diseases in Yugoslavia\*

Disease	Pathogen	Comment
Downy mildew	<u>P. halstedii</u>	Major disease
White rot	<u>S. sclerotiorum</u>	Major disease
Gray rot	<u>B. cinerea</u>	Major disease
Leaf spot	<u>Alternaria</u> sp.	Major disease
Charcoal rot	<u>M. phaseolina</u>	Major disease
Black stem	<u>Phoma</u> sp.	Minor disease
Rust	<u>P. helianthi</u>	Minor disease
Leaf spot	<u>S. helianthi</u>	Minor disease
Verticillium wilt	<u>V. dahliae</u>	Minor disease
Fusarium wilt	<u>Fusarium</u> sp.	Minor disease
Bacterial rot	<u>Pectobacterium carotovorum</u> (Jones) Waldee (= <u>Erwinia carotovora</u> )	Minor disease
Head rot	<u>Rhizopus</u> sp.	Minor disease
Broomrape	<u>Orobanche</u> sp.	Major disease

\* Submitted by M. Acimovic, Institute for Agricultural Research, Maksima Gorkog 30, Novi Sad, Yugoslavia. Detailed information is provided in Acimovic (1962, 1965, 1969, 1974a, 1974b, 1975a).

#### Individual Country Maps

Maps were submitted from nine countries, as follows:

Bulgaria: 5 maps, one of sunflower regions indicating suitability of climate for sunflowers in each zone, and four maps of distribution of *Alternaria* leaf spot, downy mildew, gray rot, and broomrape, respectively.

Egypt: 1 map showing sunflower regions.

France: 4 maps, one of sunflower regions showing departments with less than 1,000 ha, 1,000 to 5,000, and over 5,000 ha of sunflowers, respectively; one, distribution of downy mildew showing foci of infection, infested zones,

and zones apparently free of the disease; one, distribution of Sclerotinia rot, showing zones of severe infection and of widespread occurrence; and one, distribution of charcoal rot.

Iran: 1 map of sunflower regions, and text giving distribution of diseases listed in Table 5.

Italy: 3 maps, one showing distribution and area of sunflowers as a percentage of total agricultural and forest area, and two showing distribution and severity of downy mildew in two main areas in 1977.

Romania: 6 maps of data for 1976, one of downy mildew showing zones with 0 to 1, 1 to 10, and over 10% infection; one of Sclerotinia rot, showing zones with 0 to 5, 6 to 10, 11 to 20, and over 20% infection; a similar map for gray rot; one showing distribution of broomrape; one of black stem and of charcoal rot; and one of Verticillium wilt and of rust; with detailed notes on each disease.

Spain: 7 maps, one showing distribution of sunflowers and provinces in which they occupied under 5, from 5 to 10, and over 10% of total area of annual crops in 1974 to 1976; 5 maps based on surveys in 1976 and 1977, showing distribution of charcoal rot; downy mildew; bract necrosis; head drop; Rhizopus head rot; and one indicating scattered occurrences of rust, Sclerotinia rot, Verticillium leaf mottle, and broomrape.

Tunisia: 1 map showing sunflower regions, and a list indicating occurrence and severity of diseases (Table 11) in each zone.

Yugoslavia: 11 maps, one showing the distribution of sunflower production, and 10 showing distribution of downy mildew; white rot; gray rot; rust; Septoria leaf spot; Alternaria leaf spot; black stem; charcoal rot; Verticillium wilt; and broomrape, respectively. Accompanying text indicates the importance of each disease, when and by whom it was first reported, and gives details of soil and climatic characteristics of each sunflower region.

### Overall Maps

Maps of the entire area were prepared showing the occurrence of those diseases considered major in at least four of the reporting countries (Tables 1 to 14). They are for downy mildew, white rot, charcoal rot, gray rot, leaf spots, and rust, respectively (Figures 1 to 6).

### Discussion

Considerable information on sunflower disease was available prior to 1975 in a number of the participating countries. Where much effort and enthusiasm have been devoted to studying sunflower diseases for many years, detailed and precise data have been collected on the occurrence, severity, variation with weather conditions, soil types, and host cultivars, for the major diseases. In only a few instances have these data been published in readily available form.

N<sup>o</sup> 1002 le 3.8.74

Where sunflowers are a relatively new crop, and where trained staff and facilities to study their diseases are scarce, the information is much more limited. Much work remains to be done everywhere, particularly where least has been done in the past, to determine what diseases occur on sunflowers in each country, whether their prevalence and severity are changing, and what effects they have on the quantity and quality of the crop.

The fact that disease lists of various degrees of completeness, and some maps, could be prepared 2 years after the project was organized, is highly encouraging.

Methods of making disease surveys and estimating disease losses have been studied and reported upon in considerable detail (Chiarappa 1971). Methods to be used in surveying sunflower diseases for the mapping project were agreed upon at Krasnodar in 1976, but could not be used uniformly in all countries because of shortages of staff and resources in many of them. It is to be hoped that these difficulties can be overcome, and data as complete as necessary can be collected in all participating countries.

Basic principles to be considered in mapping plant diseases were well reviewed by Weltzien (1972). They were kept in mind when formulating a program for mapping sunflower diseases, although in many details fulfillment of the requirements remains an objective rather than a reality.

The objective of this project was to prepare and publish maps showing the distribution and severity in Europe and adjacent areas of each of the common sunflower diseases, in more detail than is possible in Commonwealth Mycological Institute maps such as those for rust and downy mildew (Anon. 1969, 1977). Although not impossible, it would be difficult to prepare usable maps in such detail for an area as large and variable as Europe without using color or else making the maps larger than normal journal pages. Apart from the cartographic difficulties, it would be premature to prepare such maps at present; the information is not sufficiently complete to make them useful. It is however possible to prepare tentative maps showing the countries in which the more important diseases occur, and if they are considered major or minor in each country. A start has been made on this work.

The most pressing need is for each country to accumulate the necessary information and to prepare and publish detailed maps of occurrence and severity of sunflower diseases within its own borders, together with maps showing distribution of sunflower production, and climatic and soil conditions in the various zones. Several countries are already able to publish such maps, and others should be able to do so in the near future. Some skilled cartographer may then be appointed to put the information from each country on overall maps of the whole area.

#### Acknowledgements

The author acknowledges with regret his inadequacy as a cartographer, with consequent shortcomings in the work. He acknowledges with pleasure the enthusiasm and cooperation of all the individuals involved in the project and their institutions and governments, those named as contributors to the disease

lists and the many others who gave valuable assistance. Particular appreciation must be expressed to Dr. A.V. Vranceanu of Fundulea, Romania, for stimulating formation of the European network on sunflower research, and to F.A.O. for organizing and supporting it. My warmest personal thanks go to Drs. Ing. Agr. Tomas Millan Valderrama and Rafael Gimenez Ortiz, Director and Assistant Director respectively of the Research Center at Cordoba, to Dr. Ing. Agr. Manuel de Leon Lopez, head of the oilseed crops department and all my colleagues at the Center, and the many agronomists of oilseed companies throughout Spain who gave their encouragement, help, and friendship not only in the disease survey and mapping projects, but throughout my stay as research coordinator at Cordoba.

#### References

- ACIMOVIC, M. 1962. Sclerotium bataticola Taub. kao uzrocnik uvelosti suncokreta u Vojvodini, Zastita bilja, br. 69-70, Beograd, Yugoslavia.
- ACIMOVIC, M. 1965. Phoma sp. novi parazit suncokreta u Jugoslaviji. Zbornik radova Instituta, br. 3, Novi Sad, Yugoslavia.
- ACIMOVIC, M. 1969. Alternaria sp. novi parazit suncokreta u Jugoslaviji, Zastita bilja, br. 106, Beograd, Yugoslavia.
- ACIMOVIC, M. 1974a. Pojava ekonomski vaznijih bolesti na novim sortama suncokreta u 1973. godini, Biltzen za biljna ulja i masti, br. 1-2, Beograd, Yugoslavia.
- ACIMOVIC, M. 1974b. Bolesti kao uzrok niskih prinosa suncokreta 1974. godine, Bilten za biljna ulja i masti, br. 3-4, Beograd, Yugoslavia.
- ACIMOVIC, M. 1975. Otpornost novih sorata i hibrida suncokreta prema ekonomski vaznijim bolestima, Bilten za biljna ulja i masti, br. 1-2, Beograd, Yugoslavia.
- ACIMOVIC, M. 1975. Pojava i intenzitet napada nekih vaznihih bolesti na suncokretu u Iranu 1971 i 1972 godine. Bilten za Biljna Ulja i Masti. Broj: 3-4; 27-32. Beograd, Yugoslavia (English summary).
- ANON. 1969. Puccinia helianthi Schw. Distribution maps of plant diseases No. 195 (3rd Ed.). Commonw. Mycol. Inst. Slough, U.K.
- ANON. 1977. Plasmopara halstedii (Farl.) Berl. and de Toni. Map No. 286 (4th Ed.). Commonw. Mycol. Inst. Slough, U.K.
- CHIARAPPA, L. (Ed.). 1971. Crop loss assessment methods. F.A.O. manual on the evaluation and prevention of losses by pests, diseases and weeds. Commonw. Agr. Bur. Slough, U.K.
- GUILLAUMIN, J.J. et J. PIERSON. 1976. Le tournesol, une culture en extension, et ses maladies cryptogamiques. Phytoma - Defense des cultures - Mai 1976; 5-11, Juillet-Aout 1976: 8-13



- ILIESCU, H. 1974. Boli, p. 265 to 285. In VRANCEANU, A.V., F. STOENESCU, H. ILIESCU, and Fl. PAULIAN. Floarea-Soarelui. Acad. Repub. Soc. Romania. Bucharest. (English Summary).
- KHOKHRYAKOV, M.K., DOBROZRKOVA, K.M. STEPANOV, and M.F. LETOVA. 1966. Diagnostic key to plant diseases, pp. 219-225. (Russian). Inst. "Kolos". 2nd Edition. Leningrad, U.S.S.R.
- MAHJOUB, M. El. et F. Ben OTHMAN. 1974a. Etude d'une pourriture du capitule du tournesol en Tunisie due au Rhizopus arrhizus Fisher. Ann. Inst. Nat. Rech. Agron. Tunisie 47(6): 1-8.
- MAHJOUB, M. El et F. Ben OTHMAN. 1975. Une fusariose vasculaire du tournesol en Tunisie due au Fusarium oxysporum (Sn. et H.) f. sp. helianthi Nov. sp. Ann. Inst. Nat. Rech. Agron. Tunisie 48(3): 1-12.
- WELTZIEN, H.C. 1972. Geophytopathology. Annu. Rev. Phytopathol. 10: 277-298.

#### Legends for Figures

- Fig. 1. Distribution and severity of downy mildew.<sup>1,2,3,4</sup>
- Fig. 2. Distribution and severity of white rot.<sup>1,2,3,4</sup>
- Fig. 3. Distribution and severity of charcoal rot.<sup>1,2,3,4</sup>
- Fig. 4. Distribution and severity of gray rot.<sup>1,2,3,4</sup>
- Fig. 5. Distribution and severity of leaf spots.<sup>1,2,3,4</sup>
- Fig. 6. Distribution and severity of rust.<sup>1,2,3,4</sup>

---

<sup>1</sup> The maps are intended to show the occurrence and relative severity of individual diseases in each country from which reports were received; they do NOT indicate distribution within the country.

<sup>2</sup> Diseases considered major in the respective countries are indicated by stippling with large dots; diseases considered minor are indicated by stippling with small dots.

<sup>3</sup> Letters used to designate countries are those recognized internationally to identify motor vehicles.

<sup>4</sup> The hollow circles indicate the capital city of each country.

FIGURE 1. DOWNY MILDEW

-24-

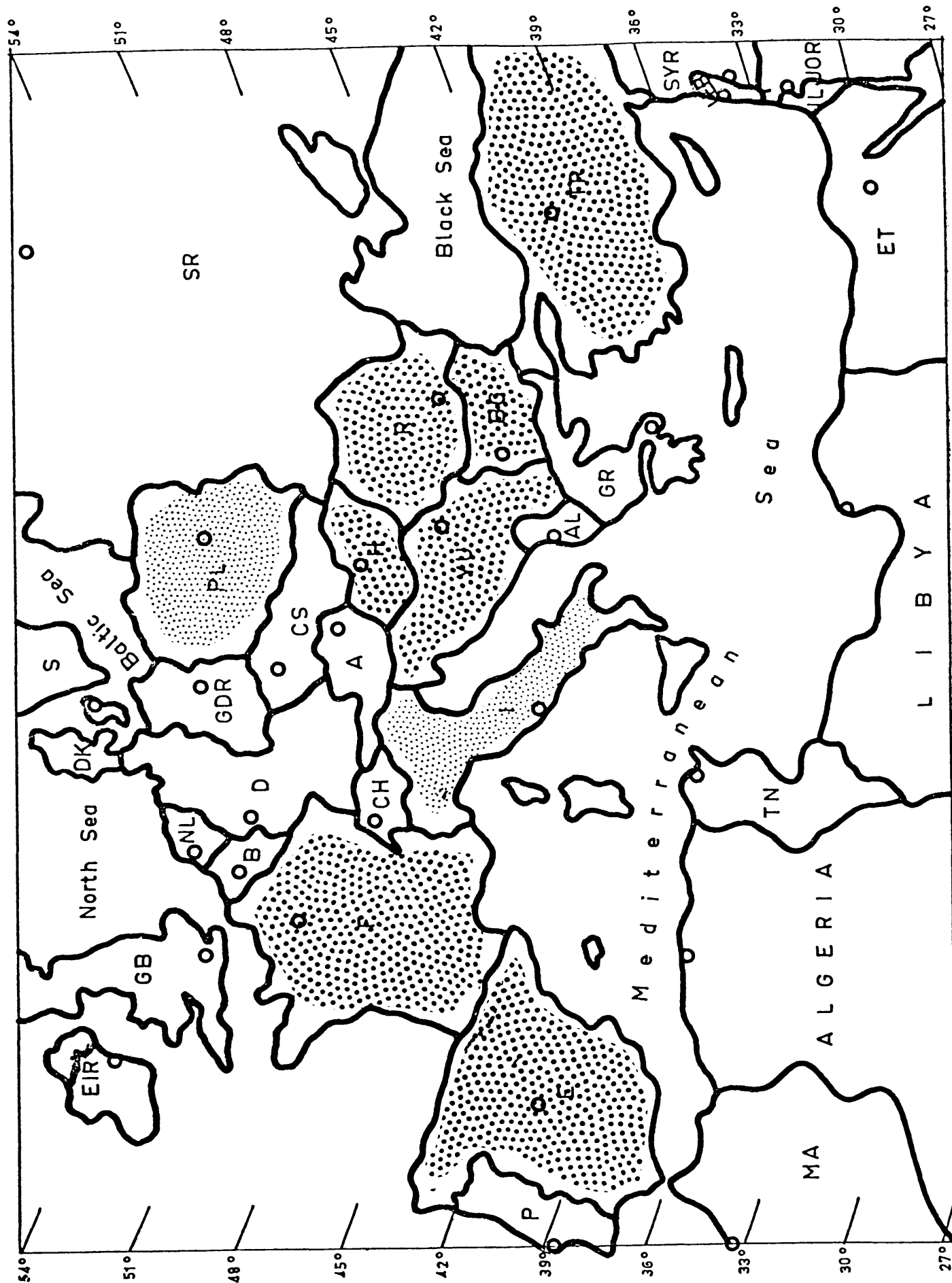
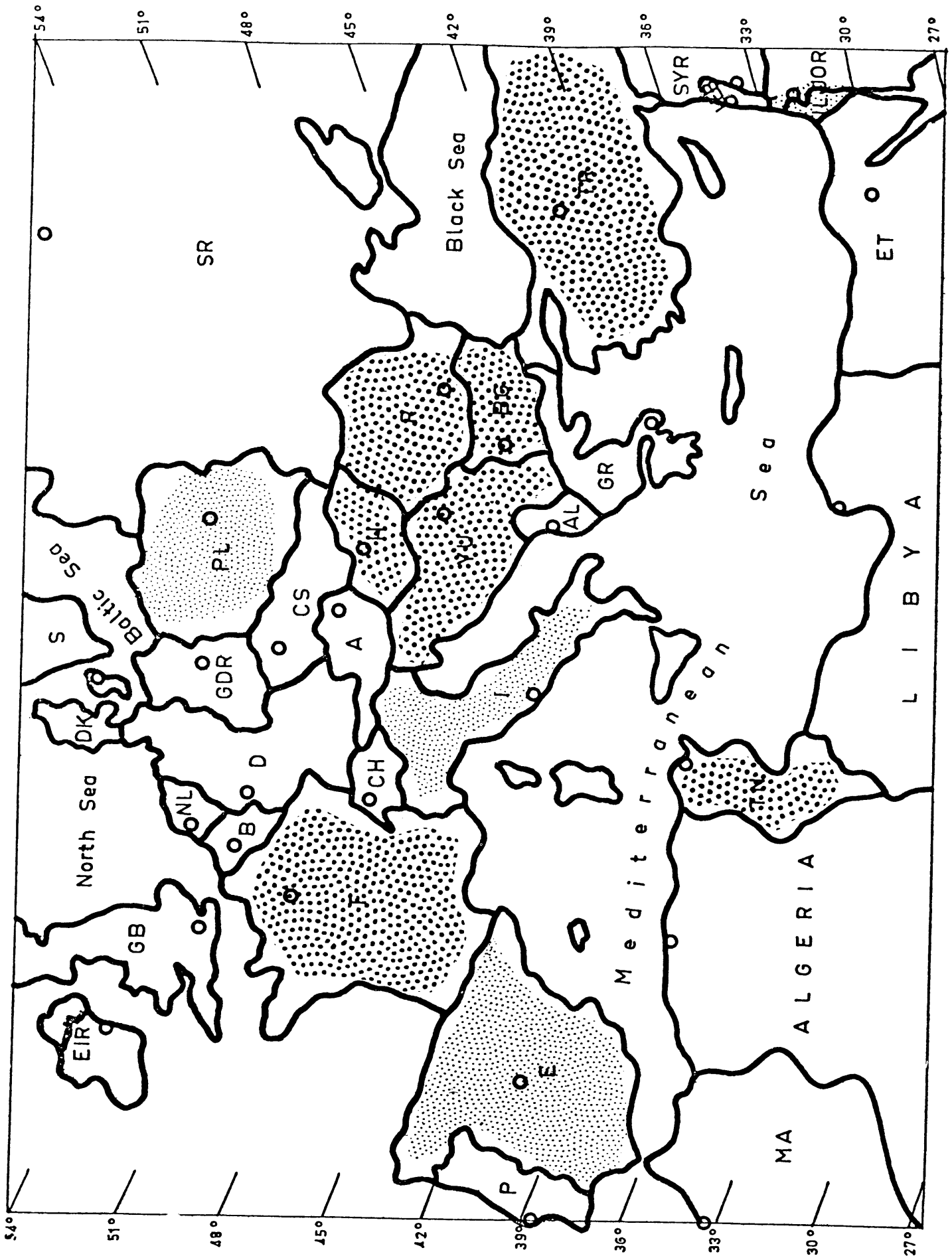


FIGURE 2. WHITE ROT

-25-



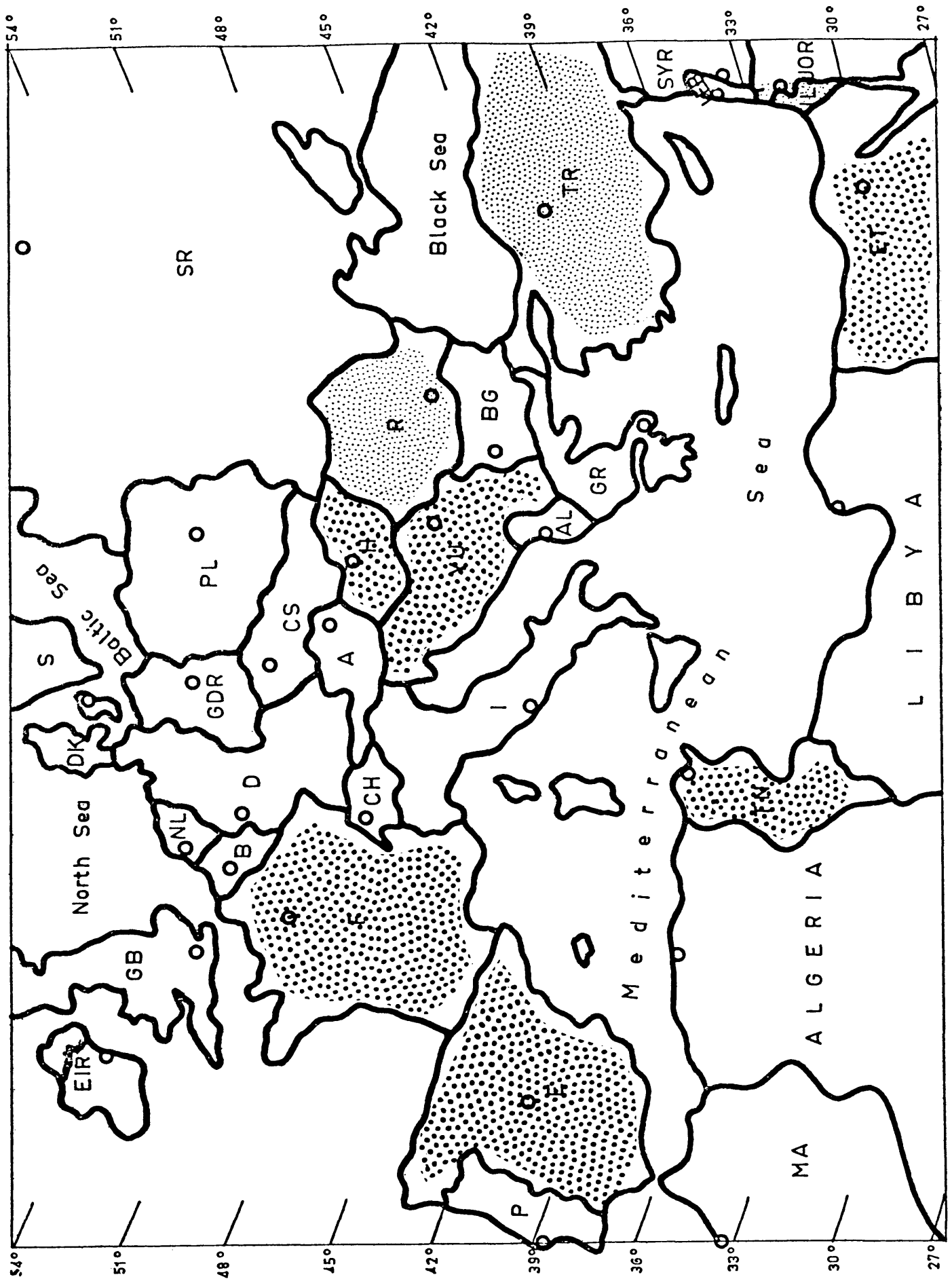


FIGURE 4. GRAY ROT

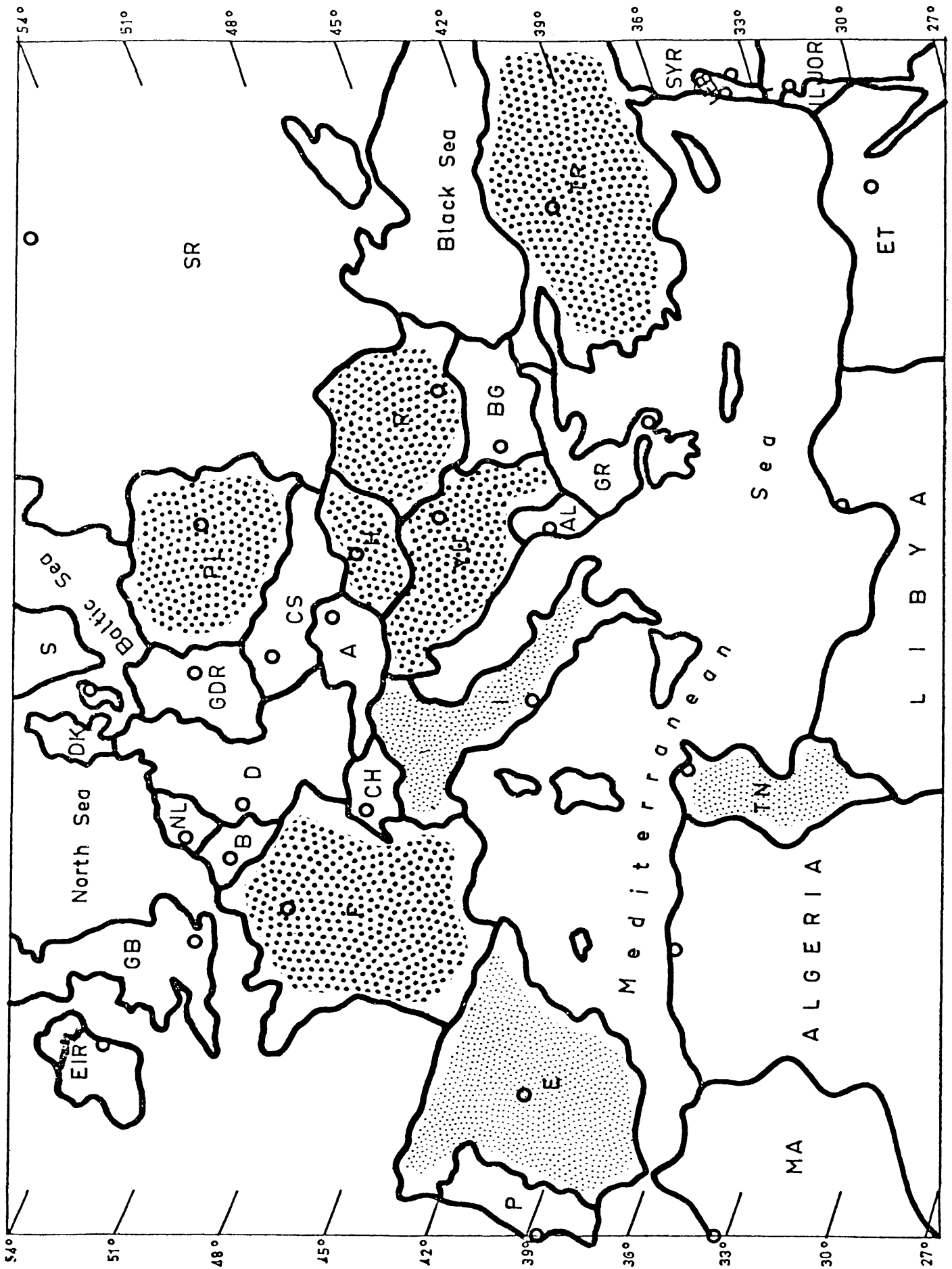


FIGURE 5. LEAF SPOTS

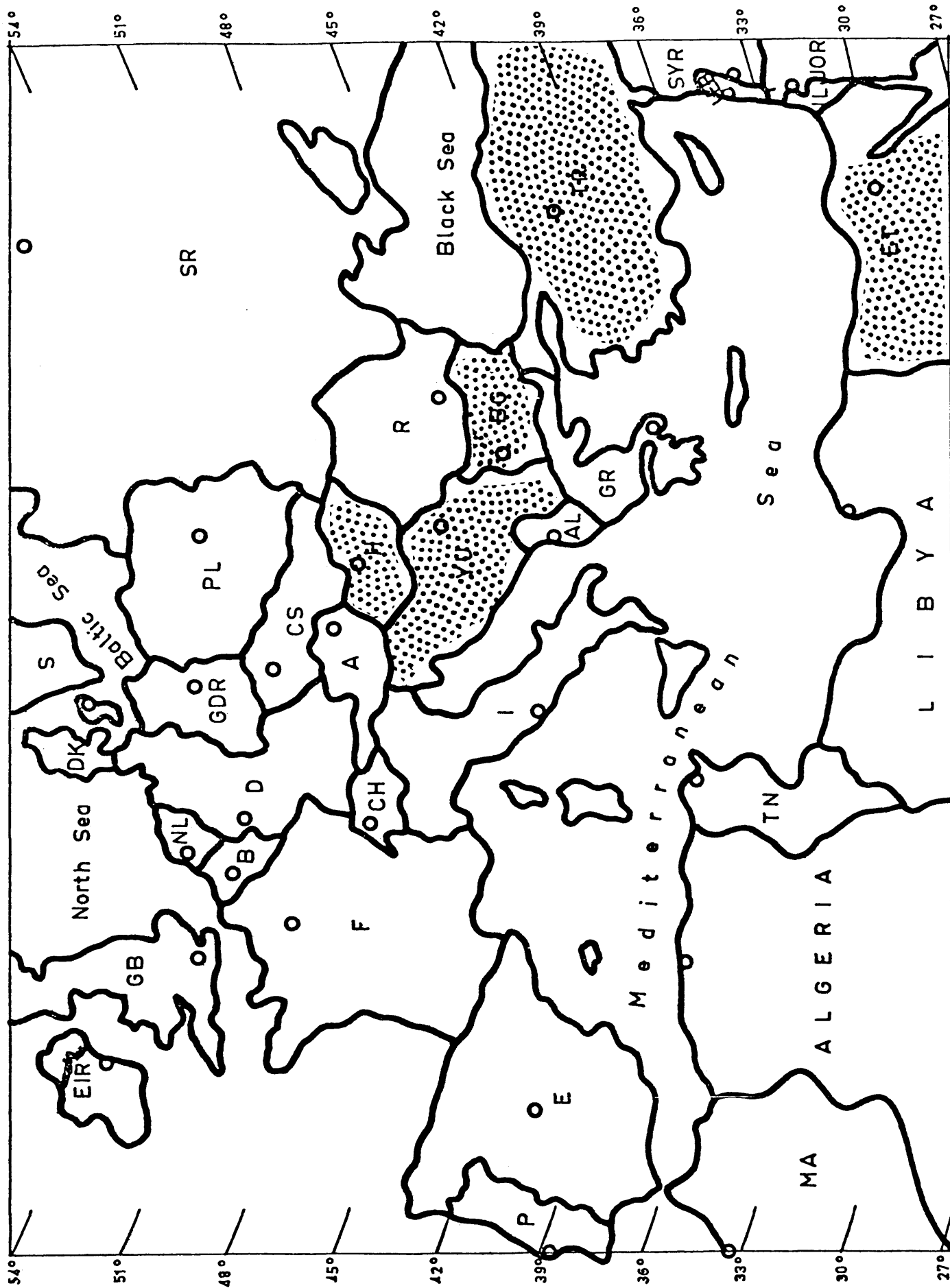


FIGURE 6. RUST

