



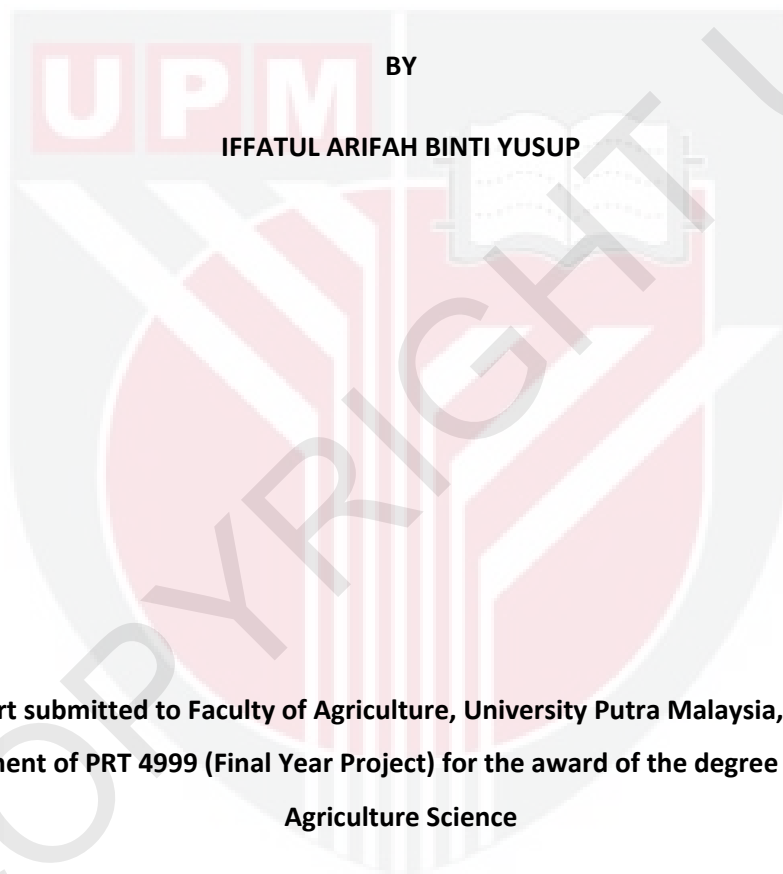
UNIVERSITI PUTRA MALAYSIA

***CHARACTERISATION OF PUCCINIA POLYSORA UNDERW
ISOLATES AND RUST DISEASE ON CORN IN PENINSULAR
MALAYSIA***

IFFATUL ARIFAH BINTI YUSUP

FP 2013 67

**CHARACTERISATION OF *Puccinia polysora* UNDERW ISOLATES AND RUST DISEASE ON CORN IN
PENINSULAR MALAYSIA**



BY

IFFATUL ARIFAH BINTI YUSUP

**A project report submitted to Faculty of Agriculture, University Putra Malaysia, in fulfillment of
the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of
Agriculture Science**

Faculty of Agriculture

University Putra Malaysia

2012/2013

This project report entitled “Characterisation of *Puccinia Polysora* Underw Isolates from Corn in Peninsular Malaysia” is prepared and submitted by Iffatul Arifah Binti Yusup in fulfillment of the requirement of the PRT 4999 for the award of degree of Bachelor of Agriculture Science.

Student’s name:

Student’s signature:

Iffatul Arifah Binti Yusup

Certified by,

Assoc. Prof Dr. Zainal Abidin Bin Mior Ahmad

Supervisor,

Department of Plant Protection,

Faculty of Agriculture,

University Putra Malaysia,

Serdang,

Selangor Darul Ehsan.

ACKNOWLEDGEMENTS

First of all, I would like to praise Allah S.W.T for giving me the strength to finish my project entitled Characterisation of *Puccinia Polysora* Underw Isolates from Corn in Peninsular Malaysia. A great appreciation and thanks to my project supervisor, Assoc. Prof Dr. Zainal Abidin Bin Mior Ahmad, who gave guidance, help, and information from the beginning until the submission of my thesis. I will always appreciate his invaluable effort and guidance.

I also would like to thank Mr. Yusof bin Kasim and his family and Mohd Hamizan bin Hasim for allowing me to get samples from their farm. Not forgetting Mr, Azwan bin Juperi for helping, especially in transportation as well as giving advice and moral support.

I also would like to dedicate my sincere acknowledgement to Mr Nazri, Mr. Johari, and also all the staff of the Department of Plant Protection, Faculty of Agriculture, University Putra Malaysia. I am also grateful to Miss Latifah and other postgraduate students and my course mates for their support and help while carrying out the experiments until completion.

I also would like to dedicate my love and appreciation to my parents, Mr. Yusup Bin Omar and Mdm. Sa'audah Binti Hamdin for their kindness, support and encouragement during my study here.

Lastly, I would like to thank everyone who was involved during the completion of this project and thesis writing. Their contribution whether directly or indirectly, would never be forgotten.

CONTENTS

	PAGES
ACKNOWLEDGEMENTS	i
CONTENTS	ii – iv
LIST OF TABLES	v - vi
LIST OF PLATES	vii – viii
LIST OF APPENDICES	ix - xi
ABSTRACT	xii
ABSTRAK	xiii
CHAPTER 1	
1.0 INTRODUCTION	1 – 3
CHAPTER 2	
2.0 LITERATURE REVIEW	
2.1 Differences between Polysora Rust and Common Rust	4 – 6
2.2 Taxonomy of <i>Puccinia polysora</i>	7
2.3 History and Distribution of <i>Puccinia polysora</i> Underw.	8 – 9
2.4 Disease Symptom	9 – 10
2.5 Reproduction of <i>P. polysora</i>	10 – 12
2.6 Disease Development	13 – 14
2.7 Effect on The Host Plant	14 – 15

2.8 Control of Rust Disease	15 – 16
-----------------------------	---------

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1 Sources of <i>Puccinia polysora</i> Underw. from infected corn	17 – 18
3.2 Experiment 1: Comparative Study on Morphology and Size of Spores	18
3.3 Experiment 2: Assessment of Disease Symptoms, Incidence and Severity	18
3.3.1 Disease incidence	19
3.3.2 Disease severity	19 – 20
3.4 Experiment 3: Assessment of spore viability	20

CHAPTER 4

4.0 RESULTS AND DISCUSSION

4.1 Result	
4.1.1 Morphology and Size of Spores	21 – 22
4.1.2 Disease Incidence and Severity	23 – 26
4.2 Percentage Germination of <i>P. polysora</i> Spores	27 – 33

CHAPTER 5

5.0 CONCLUSIONS 34

REFERENCES 35 – 39

APPENDICES 40 – 59



© COPYRIGHT UPM

LIST OF TABLES

Tables	Pages
Table 1: Comparisons between characteristics of corn rust	6
Table 2: Reproductive stages of Uredinales	11
Table 3: Disease incidence and severity of <i>Polysora</i> rust in Selangor and Melaka	23
Table 4: Percentage germination of <i>P. polysora</i> uredospores after incubation at 27 °C	27
Table 5: Length of immature uredospores of <i>Puccinia polysora</i>	29
Table 6: Width of immature uredospores of <i>Puccinia polysora</i>	29
Table 7: Length of mature uredospores of <i>Puccinia polysora</i>	29
Table 8: Width of mature uredospores of <i>Puccinia polysora</i>	30

Table 9: Cell wall thickness of immature uredospores of *Puccinia polysora* 30

Table 10: Cell wall thickness of mature uredospores of *Puccinia polysora* 30



© COPYRIGHT UPM

LIST OF PLATES

Pages

Plate 1: Magnified pustules of corn rust

5

Plate 2: Geographical distribution of Polysora rust

9

Plate 3: Close-up of southern corn rust pustules on the upper side of
a corn leaf

9

Plate 4: Uredospores of *P. polysora* collected from Ladang 2, UPM

22

Plate 5: Uredospores of *P. polysora* collected from Ladang 10, UPM

22

Plate 6: Corn leaf, stem and comb infected by Polysora rust in

Ladang 2, UPM

24

Plate 7: High severity of Polysora rust on corn leaf sample in

Ladang 2, UPM

24

Plate 8: Corn plants infected by Polysora rust during the late stage of planting

in Ladang 10, UPM

25

Plate 9: Symptom of rust disease on corn leaf in Ladang 10, UPM

25

Plate 10: Absence of Polysora rust incidence on corn plant in

Kg. Nyalas Farm, Melaka.

26

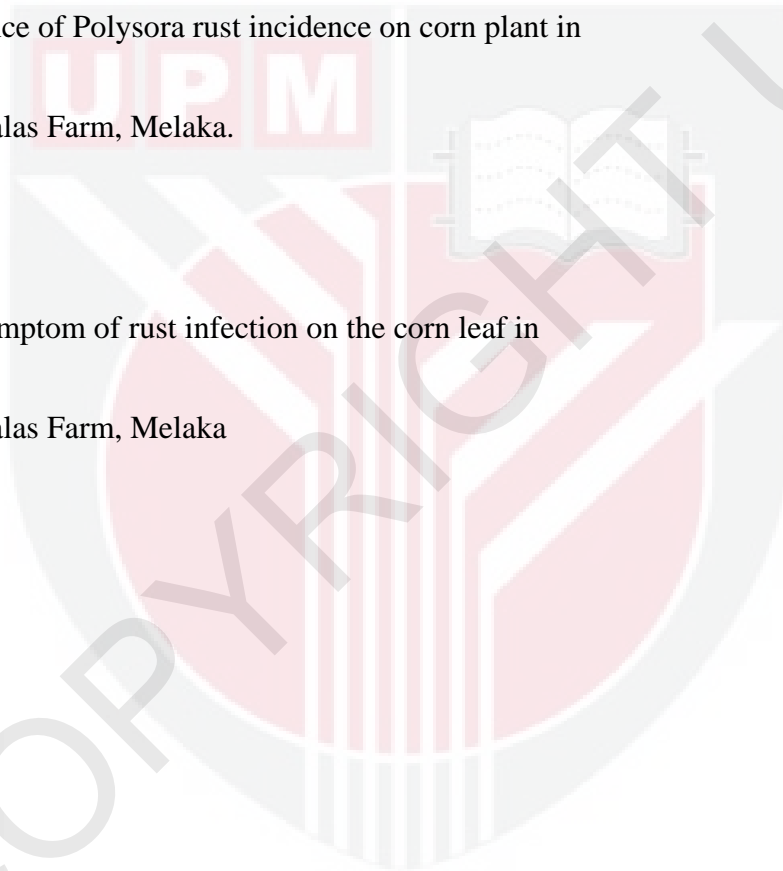
Plate 11: No symptom of rust infection on the corn leaf in

Kg. Nyalas Farm, Melaka

26



COPYRIGHT



UPM

LIST OF APPENDICES

Pages

Appendix 1: Size of *P. polysora* uredospores from Ladang10, UPM

at 62 days (Rep1)

40

Appendix 2: Size of *P. polysora* uredospores from Ladang 10, UPM

at 62 days (Rep2)

41

Appendix 3: Size of *P. polysora* uredospores from Ladang 10, UPM

at 62 days (Rep3)

42

Appendix 4: Size of *P. polysora* uredospores from Ladang 2, UPM

at 62 days (Rep1)

43

Appendix 5: Size of *P. polysora* uredospores from Ladang 2, UPM at

62 days (Rep2)

44

Appendix 6: Size of *P. polysora* uredospores from Ladang 2, UPM at

62 days (Rep3) 45

Appendix 7: Size of *P. polysora* uredospores from Ladang 10, UPM at

80 days (Rep1) 46

Appendix 8: Size of *P. polysora* uredospores from Ladang 10, UPM at

80 days (Rep2) 47

Appendix 9: Size of *P. polysora* uredospores from Ladang 10, UPM at

80 days (Rep3) 48

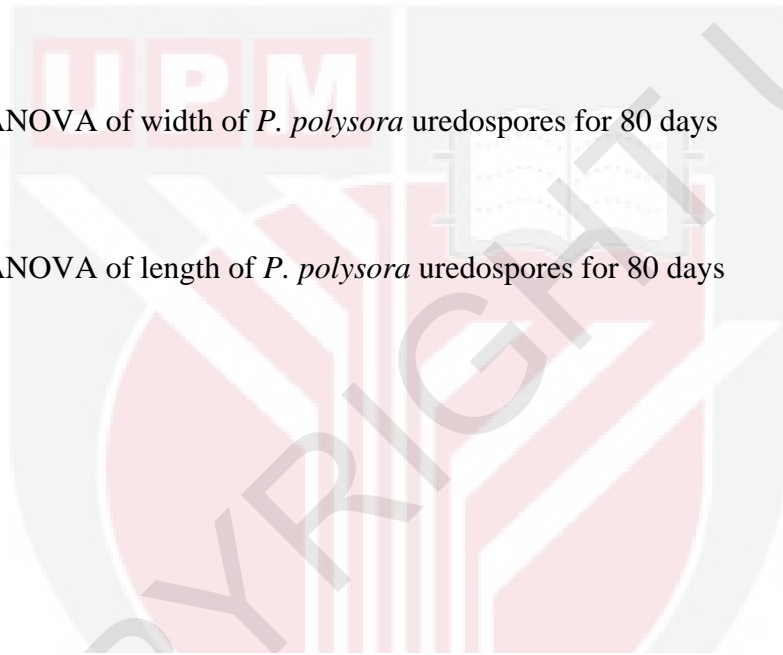
Appendix 10: Size of *P. polysora* uredospores from Ladang 2, UPM at

80 days (Rep1) 49

Appendix 11: Size of *P. polysora* uredospores from Ladang 2, UPM at

80 days (Rep2) 50

Appendix 12: Size of <i>P. polysora</i> uredospores from Ladang 2, UPM at 80 days (Rep3)	51
Appendix 13: ANOVA of width of <i>P. polysora</i> uredospores for 62 days	52 – 53
Appendix 14: ANOVA of length of <i>P. polysora</i> uredospores for 62 days	54 – 55
Appendix 15: ANOVA of width of <i>P. polysora</i> uredospores for 80 days	56 – 57
Appendix 16: ANOVA of length of <i>P. polysora</i> uredospores for 80 days	58 – 59



ABSTRACT

Corn rust disease which is caused by *Puccinia polysora* Underw. may incur 40% losses in productivity. In Malaysia there has been little information on this obligate parasite. This study was conducted to examine the sizes and morphology of spores of *P. polysora* in Selangor and Melaka. Secondly, to distinguish differences between species in these variations in disease symptoms, incidence and severity were also observed and recorded from both locations. The results of study revealed no significant difference between isolates recorded from Selangor. Rust disease was found to be absent in Melaka. The variety planted, time of cultivation and difference in environment condition were possible factors for the difference of rust incidence in the two states.



ABSTRAK

Puccinia polysora Underw. merupakan patogen penyakit karat jagung Polysora yang boleh mengakibatkan 40% penurunan dalam hasil pengeluarannya. Di Malaysia, bilangan kajian ke atas *P. polysora* Underw adalah sangat sedikit. Oleh itu kajian ini bertujuan bagi mengenal pasti saiz dan sifat spora *P. polysora* Underw. di Selangor dan Melaka dan untuk mengenal pasti perbezaan antara spesis dalam kawasan kajian berdasarkan sifat dan simptom penyakit. Sampel diambil dari Selangor dan Melaka untuk di uji. Berdasarkan keputusan ujian, tiada perbezaan signifikan antara sampel dari dua lokasi di Selangor. Di Melaka didapati tiada kejadian penyakit karat jagung berlaku. Pemilihan varieti, Jangka masa tanaman dan perbezaan faktor persekitaran merupakan faktor penyebab yang mempengaruhi kejadian penyakit karat jagung di lokasi tersebut.

CHAPTER 1

INTRODUCTION

Corn (*Zea mays L.*) is classified as the same family with rice and wheat which is Gramineae. Among these crops, corn ranks third in terms of production acreage (Park, 2001). The crop grows productively throughout the world, covering the lowland tropical, subtropical and temperate agroclimatic conditions in Asia.

This crop originated from the American continent. Thousands of years ago, corn was a staple fruit of indigenous people in America. Christopher Columbus was responsible to spread corn and other crops from their originate lands in America (Redaksi Agromedia, 2010).

Corn was first brought into Malaysia by the Portuguese in 17th century (Redaksi Agromedia, 2010). Since then, it has become the second most important crop after rice in the archipelago. It had become as one of the main choices of crop by most farmers in Malaysia due to the increase in economic value as it is not only demanded for human consumption but also as feed for livestock. In the year 2012, Malaysia forecasted crop production of 100 000 MT (United States Department of Agriculture, 2012). Malaysia corn domestic consumption in year 2012 was 3 400 000 MT and corn import in 2012 was 3 100 000 MT. This shows the large amount of corn supply needed by Malaysia.

Generally, the cultivation of corn plant is not always profitable to the farmers since many factors could influence the yields. One of the factors is the presence of diseases that may reduce yield such as corn leaf blight, smut, bacterial wilt and rust.

Corn rust is caused by the fungus, *Puccinia polysora* Underw. It is an obligate parasite of corn. This disease interferes with the process of photosynthesis which serves the food production of the crop. The disturbance to the process will cause stunted growth of the plant, reduce quality and quantity of the yield and results in great losses to the farmers. Severe infection may cause plant death (Redaksi Agromedia, 2010).

The fungus can be detected by identifying the presence of light orange to cinnamon red pustules which will turn brown as it matures. These pustules contain the rust spores, mostly consists of uredospore the main inoculum of the fungus responsible for spread of the disease.

A few factors are known to influence the success of infection by uredospores. These components must be present simultaneously for successful occurrence of disease infection. The absence of any one component may prevent the incidence of disease.

The present study was conducted with the following objectives:-

- 1) To determine morphology and size of spores of *P. polysora* Underw. in corn growing area in Peninsular Malaysia.
- 2) To assess differences between disease symptoms, incidence and severity based on locations.



REFERENCES

Agrios, G. N. (2005). *Plant pathology fifth edition*. Oxford: Elsevier Academic Press Publication.

Agarwal, R. K., Khetarpal, R. K. and Payak, M.M. (2001). Polysora rust of maize caused by *Puccinia polysora*. *Indian Journal of Agricultural Sciences* 71: 275-276.

American Phytopathological Society. (2010). *Southern corn rust*. Retrieved March 5, 2013, from Forestry images: <http://www.forestryimages.org/browse/subinfo.cfm?sub=17596>.

Barnes, E. H. (1968). *Atlas and manual of plant pathology*. Park Avenue: Appleton-Century-Crofts.

Brian, P. W. (1967). Obligate parasitism in fungi. *Proc. R. Soc. London, Ser, B* 168: 101-118.

Bushnell, W.R. and Roelfs, A. P. (1984). *The cereal rusts, vol 1*. Orlando: Academic.

Cammack, R. H. (1958). The world distribution of forms of *Puccinia polysora*. *Studies on Puccinia polysora Underwood* 41: 89-94.

Cammack, R. H. (1959a). Description and life cycle of *Puccinia polysora*. *Studies on Puccinia polysora Underw.* 42: 55-58.

Cammack, R. H. (1959b). A consideration of method of introduction of *P. polysora* into Africa. *Studies on Puccinia polysora Underw* 42: 27-32.

Carlos C. B. (1998). *Diagnosing Maize Diseases in Latin America*. Brazil: The International Service for the Acquisition of Agri-biotech.

Das, B. (undated). *Polysora rust (extended information)* . Retrieved December 15, 2012, from cimmyt, International Maize and Wheat improvement Centre: <http://maizedoctor.cimmyt.org/index.php/en/pests-and-diseases/243?task=view>.

Department of Crop Science (1991). *Plant disease: Common rust and southern rust of corn*. Retrieved December March, 2012, from University of Illinois: <http://ipm.illinois.edu/diseases/rpds/965.pdf>

Goodman, Kiraly, R. N. and Wood, Z. (1968). *The biochemistry and physiology of plant disease*. Lincoln: Missouri Press.

Hami, A. (2008). *Measures of disease frequency*. Kabul: United States Naval Medical Research Unit 3.

Hollier, C. A. and King, S.B. (1985a). Effect of dew period and temperature on infection of seedling maize plants. *Plant Disease* 69: 219-220.

Hollier, C. A. and King, S.B. (1985b). Effects of Temperature and Relative Humidity on Germinability and Infectivity of Puccinia polysora Uredospores. *Plant Disease* 69: 937-939.

Jackson, T. A. (2010). *CropWatch: Nebraska crop production and pest management information*. Retrieved December 13, 2012, from UNL: <http://cropwatch.unl.edu/web/cropwatch/archive?articleID=4237646>.

Jackson, T. A. (2007). *Publication: Rust Diseases of Corn in Nebraska*. Retrieved November 29, 2012, from NebGuide: <http://www.ianrpubs.unl.edu/pages/publicationD.jsp?publicationId=720>.

Kang, N. J. (2007). Inhibition of powdery mildew development and activation of antioxidant enzymes by induction of oxidative stress with foliar application of a mixture of riboflavin and methionine in cucumber. *Scientia Horticulture* 118: 181-188.

Ken Pernezny, T. K. (undated). *Rust Diseases of Several Legumes and Corn in Florida*. Retrieved November 29, 2012, from University of Florida : <http://edis.ifas.ufl.edu/pdffiles/VH/VH05100.pdf>.

Kuo, M. (2006, February). *Using a microscope: viewing and measuring spores*. Retrieved November 29, 2012, from Mushroom expert.com: http://www.mushroomexpert.com/microscope_spores.html.

Malaysian Meteorological Department. (2012). Retrieved February 15, 2013, from Official portal Malaysian meteorologi: http://www.met.gov.my/index.php?option=com_content&task=view&id=849&Itemid=1586.

Malaysian Meteorological Department. (2013). *Buletin cuaca bulanan: Febuari 2013*. Retrieved March 15, 2013, from Official portal Malaysian Meteorologi department: http://www.met.gov.my/index.php?option=com_content&task=view&id=843&Itemid=1586.

Malaysian Meteorological Department. (2013). *Monthly weather bulletin: January 2013*. Retrieved March 15, 2013, from Official portal Malaysian meteorological department: http://www.met.gov.my/index.php?option=com_content&task=view&id=848&Itemid=1586.

Malaysian Meteorological Department. (2013). *Monthly weather bulletin: march 2013*. Retrieved March 15, 2013, from Official portal Malaysian meteorological department: http://www.met.gov.my/index.php?option=com_content&task=view&id=846&Itemid=1586.

Maloy, O. C. (1993). *Plant disease control*. Canada: John Wiley & Sons inc.

Mcgee, D. C. (1988). *Maize diseases*. Minnesota: The American Phytopathology Society.

Munkvold, G. (1999). *Rust and other diseases are accelerating corn maturity*. Retrieved September 29, 2012, from Intergrated crop management: <http://www.ipm.iastate.edu/ipm/icm/1999/9-13-1999/rustaccel.html>.

Nature Publishing Group. (1954). *Lettersto nature*. Retrieved March 9, 2013, from nature: <http://www.nature.com/nature/journal/v173/n4402/abs/173505a0.html>.

Nyvall, R. F. (1989). *Field crop diseases handbook (2nd edition)*. New York: Van Nostrand Reinhold.

Park, K. J. (2001). *Corn production in Asia*. Taiwan: Food and fertilizer centre for the Asian and Pacific regions.

Pataky, J. K. (2000). Reactions of sweet corn hybrids to prevalent diseases. *Named varieties rated for resistance to common rust*.

Paul R. Miller, H. L. (1976). *Multilingual compendium of plant diseases*. United States of America: The American Phytopathological Society.

Plank, J. (1975). *Principles of plant infections*. South Africa: Academic Press.

Redaksi Agromedia. (2010) *Perusahaan tanaman jagung hibrid*. Kuala Lumpur: Synergy media.

Samuel R. Aldrich, Scott, O.W. and Leng, E. R. (1982). *Modern crop production*. Illinois: A & L publications.

Scheffer, R. (1997). *The Nature of disease in plants*. United States of America: Cambridge University Press.

United States Department of Agriculture. (2012). *Malaysia corn domestic consumption by year*. Retrieved April 29, 2013, from Indexmundi: <http://www.indexmundi.com/agriculture/?country=my&commodity=corn&graph=domestic-consumption>.

United States Department of Agriculture. (2012). *Malaysia corn import by year*. Retrieved April 29, 2013, from Indexmundi: <http://www.indexmundi.com/agriculture/?country=my&commodity=corn&graph=imports>.

United States Department of Agriculture. (2012). *Malaysia crop production by year*. Retrieved April 29, 2013, from indexmundi: <http://www.indexmundi.com/agriculture/?country=my&commodity=corn&graph=production>.

Hiratsuka, Y. and Cummins, G. B. (1963). Morphology of the spermatogonia of the rust fungi. *Mycologia* 18: 257-268.