

Actual state of the rust fungi systematics in the world

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Urban Z. (1995): Actual state of the rust fungi systematics in the world.- Czech Mycol. 48: 221-224

The article was presented at the 7th International Congress of Mycology Division (IUMS-94) in Praha, July 3-8, 1994. The rust fungi are damaging for many important crops. Many rust species possess complicated life cycle. Up to now the most effective method has appeared to be the production of rust resistant cultivars and biological control on integrated basis. Therefore the thorough knowledge of taxonomy, biology and ecology of not only economically important rusts but also potentially harmful rust species on wild plants is highly desired. Especially in tropics and subtropics the rust taxonomy and ecology is known imperfectly. The author informs briefly on steps concerning the improvement of rust systematics organized at the rust symposia at International Mycological Congresses (IMC) in Tampa (USA) 1977, Tokyo, 1983 and Regensburg (BRD) 1990. In the international cooperation it should be prepared, through computers and videodisc technology, the "World data base for plant rust fungus species". Most limiting factors are: to find leaders in relatively rich and major institutions and funds from national and international organizations.

Key words: Rust fungi (Uredinales), systematics in the world, improvement.

Urban Z. (1995): Současný stav studia systematiky rzí (Uredinales) ve světě.- Czech Mycol. 48: 221-224

Článek je příspěvkem předneseným na 7. mezinárodním kongresu mykologického odboru (IUMS - 94) v Praze 3. až 8. července 1994. Rzi jsou paraziti mnohých plodin. Mnohé druhy mají komplikovaný životní cyklus. Nejúčinnější způsob boje je šlechtění k odolnosti a integrovaná ochrana. Proto je třeba dokonale poznat taxonomii, biologii a ekologii rzí nejen na plodinách, ale i na planých rostlinách. Taxonomie a ekologie rzí je nedokonale známá především v tropech a subtropích. Autor referuje o úkolech a možnostech uredinologů, které byly diskutovány na symposiích o rzích na Mezinárodních mykologických kongresech (IMC) v Tampě (USA) 1977, Tokiu, 1983 a v Řezně (BRD) 1990. V rámci mezinárodní spolupráce je třeba připravit, za pomoci počítačů a videodiskové technologie, „Banku základních údajů o rzích světa“. Největší problém je: získat vedoucí pracoviště a domácí i mezinárodní finanční podporu.

The rust fungi (Uredinales, Basidiomycetes) are obligate parasites of vascular plants. The mycelium is intercellular, well protected against the exterior environment. The life cycle of many species is complicated as displayed by the production of up to 5 various spore states. Moreover, there are many species which in their complete life cycle possess host alternation, i.e. their life cycle is completed on two host plants belonging to families which are very distant from each other. Especially the subtropics and tropics are full of rust species, the life cycle of which is, however, more or less shortened.

In the period 1903-1924 was published a monumental work by Paul and Hans Sydow: *Monographia Uredinearum*. It offers a survey of all so far described rust

species from over the world. For some rust species, most of all in heteroecious ones, very briefly their life cycle was given. These four volumes, in Latin and German, long out of date, still form the indispensable starting point for all serious taxonomic studies of rusts.

The rust fungi are serious pathogens in that they attack economically important crops such as cereals, legumes, coffee, timber etc. The losses on yield and profit amount to millions! With regard to the facts mentioned above rust control is very complicated and difficult. Up to now the most effective method has appeared to be the production of rust resistant cultivars of crops and trees. This aim can be attained only when the total of rust species living in all climatic belts but especially in the subtropics and tropics is thoroughly recognized. This is the objective of rust fungi systematics which must compile the basic knowledge of rust life cycles, their biology, ecology and mutual taxonomic relationships which is very often presented as infraspecific variability. A thorough knowledge of rusts, first of all those being parasites of wild plants, can provide the basis of a technology for controlling on a biological and integrated basis various stubborn weeds in crop plantations.

The first steps concerning the improvement of rust systematics study were made at the rust symposium organised at IMC 2 1977 in Tampa, Florida. Except for the points just mentioned the discussion concentrated on the urgency of international cooperation in preparing lists of uredinologists, major rust herbaria, rust genera and species including illustrations of these and lists of host plants. In addition to this it would be very important to increase the number of rust specialists working on rust taxonomy, phylogeny, ontogeny, and ecology of various important rust species and to interest additional workers to contribute to rust studies by using non-traditional investigation methods such as electron microscopy, cultivation and preservation of rust *in vitro*, molecular analyses etc. Moreover, it was stated that the rust exploration in the subtropics and tropics is completely insufficient and that the preparation of local, regional or subcontinental rust floras should be incited. When preparing such floras all data and experience concerning the geographic distribution and history of both rusts and their hosts and all ecological knowledge on relations of rusts to their environment should be exploited.

At IMC 3 1983 Tokyo not only a rust symposium was organized but also a special workshop for those interested in rust fungus systematics and phylogeny; among others, information was presented on what progress had been made in the questions discussed in Tampa 1977. The conclusion was that little progress had been achieved, if any. In addition the need to unify the terminology of rust life cycles was questioned. This is substantial when studying tropical and subtropical rusts in order to speak the same "language" in terms that cover not only the morphology but also the karyotic states of ontogenetic rust stages.

At IMC 4 1990 in Regensburg another workshop was organized under the title "Present activities and future networking of taxonomic work on Uredinales in the

world". Joe F. Hennen (Purdue, Lafayette, USA) and Yasu Hiratsuka (Edmonton, Canada) are to be praised for the preparation of the meeting. The latter opened the session with the paper "Current studies on taxonomy of Uredinales and future opportunities for world-wide networking". Very suggestive was the paper by M. Kakishima (Univ. Tsukuba, Japan): "Data base of Japan rust fungi"; this is the basic prerequisite for the research project "The rust flora of Japan". The discussion was supported by printed materials prepared by Y. Hiratsuka: List of monographs and descriptive manuals, List of major herbaria containing important rust collections, List of rust taxonomists of the world.

During the next year the aforementioned managers sent away invitations to cooperate on the project "World data base for plant rust fungus species". In addition to the programme earlier mentioned the call stresses the idea that through computer and perhaps videodiscs technology a contemporary work can be created containing descriptive, illustrative, nomenclatural, host, voucher (type) specimen and geographic distribution data on all known rusts. When completed, the work should stimulate further research by locating weaknesses and gaps in biosystematic uredinology.

Through the kindness of Y. Hiratsuka I got recent information on the current state of the project. The call mentioned received a fairly good response of possible cooperation and support. Unfortunately, most uredinologist interested stated that they cannot participate in a significant way because of their professional involvement in other activities. In the following I am giving a joint summary by Y. Hiratsuka and J. F. Hennen who discussed the matter a few times. Although reasonably good regional and national floristic treatments are available in Europe, North America, Japan and several countries in S. America and Asia, sufficient information is lacking in most of S. America, Mexico, Africa, the Carribean Is., the tropical Pacific Is., Southeast Asia and the Middle East. - Several projects using molecular-biological approaches in rust taxonomy and phylogeny are in progress and interesting results have been reported. However, these new approaches need to go hand-in-hand with classical morphology. In connection with this the cooperation of Purdue University (Arthur Herbarium) with the University of California (Berkeley), and Tel Aviv University with the University of Minnesota are encouraging. - Very few graduate students (if any) are now conducting taxonomic work on rusts in the world and few young uredinologists are interested in rust systematics. With the retirement of many active uredinologists in recent years and more to come in the next few years this situation will come critical. - However, with new interest in and emphasis on biodiversity and sustainable development of biota, floristic work on rusts of underexplored areas of the world can be supported well if good initiatives are proposed by strong groups. Several uredinologists in Japan (Kakishima, Ono etc.) are very active in collecting and studying rusts of various areas in Asia. Significant collections were also made in Brazil and other neotropical

regions in recent years. – The biggest problem to pursue the task of compiling world flora of rusts now is the leadership. We need to have strong leaders in major institutions such as Arthur Herbarium, IMI, New York Botanical Garden and some well established institutions who can devote enough time and effort to the project with funds acquired from national and international organizations. Unfortunately, Purdue University does not want manage the Arthur Herbarium in the future. Maybe, however, that a way will be found to move the Herbarium and the curator to another institution.

What to say at the end? Of all large groups of fungi the Uredinales are probably well documented and described. If the aforementioned target and long-term goals should be achieved only one very important condition must be fulfilled: have leaders in relatively rich and major institutions which will manage the international project "World monograph of Uredinales" with funds acquired from national and international organizations.