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Arthropod Germplasm Information System in India

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Abstract **- Arthropod Germplasm Information System (AGIS) – an online software tool has been developed for the first time in the country for storage of information related to live arthropod genetic resources maintained at different institutions in India. AGIS would cater to the needs of the entomologists working on agriculturally important insects. Presently, passport information on hosts, parasitoids and predators; silkworm resources and arthropod vectors is being maintained at National Bureau of Agriculturally Important Insects (NBAII), Central Sericultural Germplasm Resources Centre (CSGRC) and Indian Veterinary Research Institute (IVRI), respectively, which can be accessed through this software. The AGIS has been developed using PHP (server side scripting language) and MySQL database technology which will execute on browsers in any operating system. This software is based on the client–server architecture in which many clients can make requests simultaneously to access the database. The information provided by the AGIS software will be useful for scientists from various organizations who are involved in the development of live arthropod germplasm database. Institutions can register their live arthropod germplasm accessions by accessing the link through http://www.nbaii.res.in/germplasm/index.php.**

Keywords: Database; Passport information; Arthropod genetic resources; Germplasm collection; Insects; Agriculture

Introduction

Germplasm is a term used to describe a collection of genetic resources for an organism. Insect conservation aims at saving both endangered species and ecosystem processes with a multitude of approaches targeted at different scales (Kim,1993). The United States' National Plant
Germplasm System (NPGS) has been developed by the Germplasm Resources Information Network
and plant germplasm information have been maintained in the form of centralized national information repository and it provides information about plant genetic resources to users at no cost (Shands, 1995; Shands, *et al*., 1989). The Asian Vegetable Research and Development Center (AVRDC) Vegetable Genetic Resources Information System provides direct web-based access to information pertaining to the accessions in the genebank (Ebert, 2011). Germplasm repositories at the World Vegetable Research Center (AVRDC) and United States Department of Agriculture (USDA) possess number of genotypes of pepper resistant to insect pests, nematode, fungi, bacteria and virus diseases (Sarath Babu, 2011). The chile database (Chile Database, 2010) highlights the exemplary utilization of germplasm and development of large number of cultivars and hybrids resistant to most diseases and nematodes around the world. In 1996, two internet based databases covering insect pathogens were posted on the World Wide Web: the Ecological Database of the World's Insect Pathogens (EDWIP) and the Viral Diseases of Insect in the Literature database (VIDIL) (Braxton, 2003).

National Bureau of Plant Genetic Resources (NBPGR) is the nodal organization in India for acquisition and management of indigenous and exotic plant genetic resources for food and agriculture. It also acts as nodal agency for collection, quarantine, exchange, conservation, evaluation and the systematic documentation of plant genetic resources. In India, the National Bureau of Agriculturally Important Insects (NBAII) acts as a nodal organization for collection, characterization, documentation and conservation of insects and related arthropods for commercial
and research purposes. NBAII being the national repository for live arthropod germplasm collection and maintenance, the present database aims to promote the discovery, understanding and availability of the arthropod fauna. Arthropod germplasm is essential in agriculture. Accessibility to the germplasm information like location of availability and characteristics of these arthropod organisms is necessary for the researchers in the form of web based database.

Documentation of information on Plant Genetic Resources is imperative for planning and implementing activities related to their conservation, sustainable utilization and sharing of benefits accrued from their use. The need for countries to develop, maintain and exchange such information is specifically recognized in Articles 7d, 17 of the Convention of Biological Diversity (CBD, 1993) and the priority activities 17 and 18 of the Global Plan of Action (FAO, 1996). Microbial germplasm is essential to agriculture and global ecosystems. Documentation of microbial germplasm is a global issue. Hence, Microbial Germplasm Database has been developed using the World Wide Web and custom software to provide easy intuitive access to this information (Hanus, 1997). As a source of species diversity, arthropods far outstrip their terrestrial plant and animal counterparts. Wilson (1988) reports that arthropods make up just over one-half of the 1.4 million

species described to date. Now-a-days, many factors cause the loss of diversity and genetic erosion. Conservation of genetic resources is an important aspect for the restoration of biodiversity. Keeping these in view, Arthropod Germplasm Information System (AGIS) – an online software tool has been developed in the country for the first time for the storage of information about the live arthropod genetic resources maintained at different organisations in India. The arthropod germplasm collections are unique because scientists maintain them by continuously rearing live specimens and they serve as genetic resources. The website address for this resource is http://www.nbaii.res.in/germplasm/index.php. The home page of the AGIS is as depicted in Fig 1.

Fig 1. Home page of Arthropod Germplasm Information System

Presently, passport information is available for silkworm genetic resources maintained at Central Sericultural Germplasm Resources Centre (CSGRC), Hosur, Tamil Nadu, veterinary pests maintained in the entomology laboratory of Indian Veterinary Research Institute (IVRI), Bareilly, UP and for host insects, parasitoids and predators maintained at National Bureau of Agriculturally Important Insects (NBAII) through this online software tool. An Institute Accession Number and a National Accession Number are the unique identification numbers for each germplasm registered. The passport information for the silkworm germplasm includes voltinism, race name, donor, origin, class, parentage, egg color, yolk color, larval pattern, eye spot, cresent, star (Faint/Present/Absent), cocoon color and cocoon shape. Passport information for veterinary pests includes scientific name of the veterinary pest, systematic position, origin, common name of the veterinary pest, common name of the host animals and locality details. The passport information for the predatory insects maintained at NBAII includes systematic position, target pest details, host plant, locality details and theirs utility for biocontrol. The passport information for parasitoids includes systematic position, target pest details, host plant, locality details and information on how they could be utilised for biological control of pests. The passport information of host insect include systematic position, common name of the host insect, the stage of the insect that could be supplied, locality details, etc.

The entomologists can register their live arthropod germplasm accessions by accessing the following link http://www.nbaii.res.in/germplasm/index.php.

2. MATERIALS AND METHODS

2.1 Network Architecture

AGIS has been developed based on two tier client–server architecture in which multiple client requests can be processed at the same time to access the germplasm database. The volume of data on arthropod germplasm is enormous and needs a dedicated data server on this aspect and the server is located at NBAII, Bangalore, India. The two-tier architecture of the client-server technology is depicted in Fig. 2.

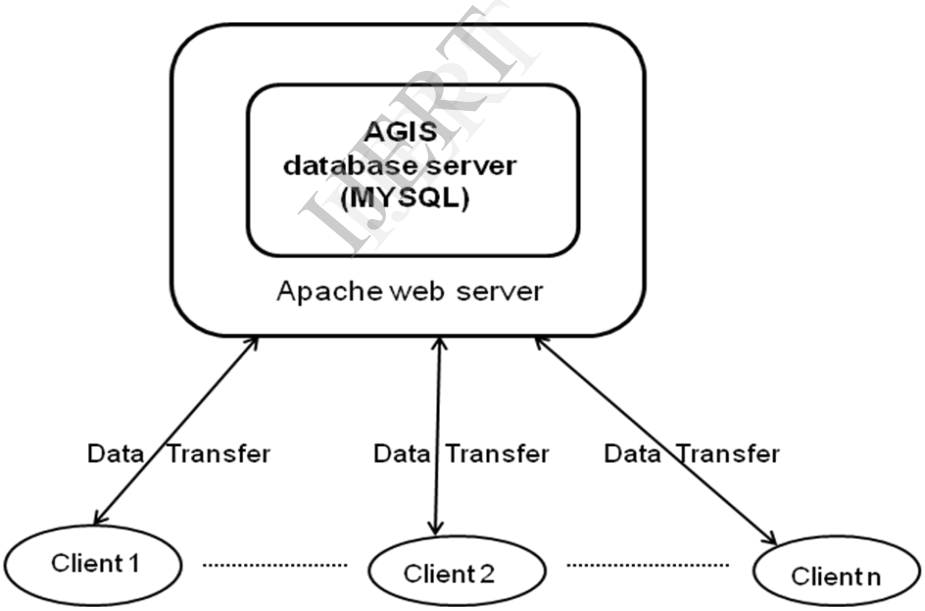

Fig 2. Two – tier architecture of Arthropod Germplasm Information System database

The database has been developed in MYSQL in Linux environment with Apache 2 web server as an interface between the user and the server. PHP has been used for developing programs for AGIS services like Home, Germplasm Information, Germplasm Registration, Downloads, Contact Us, Admin Login and User Login. The database tables developed are Users and Administrative users, Insect germplasm, Insect_accession_numbers, separate tables are created for each group of insects *viz*., host insects, parasitoids, predators, veterinary pests and silkworm germplasm.

Germplasm_ID is the primary key connecting the tables as shown in Fig. 3 and UserID and Admin ID are the primary keys for Users and Admin table respectively. The database design of AGIS is provided in Fig 3.

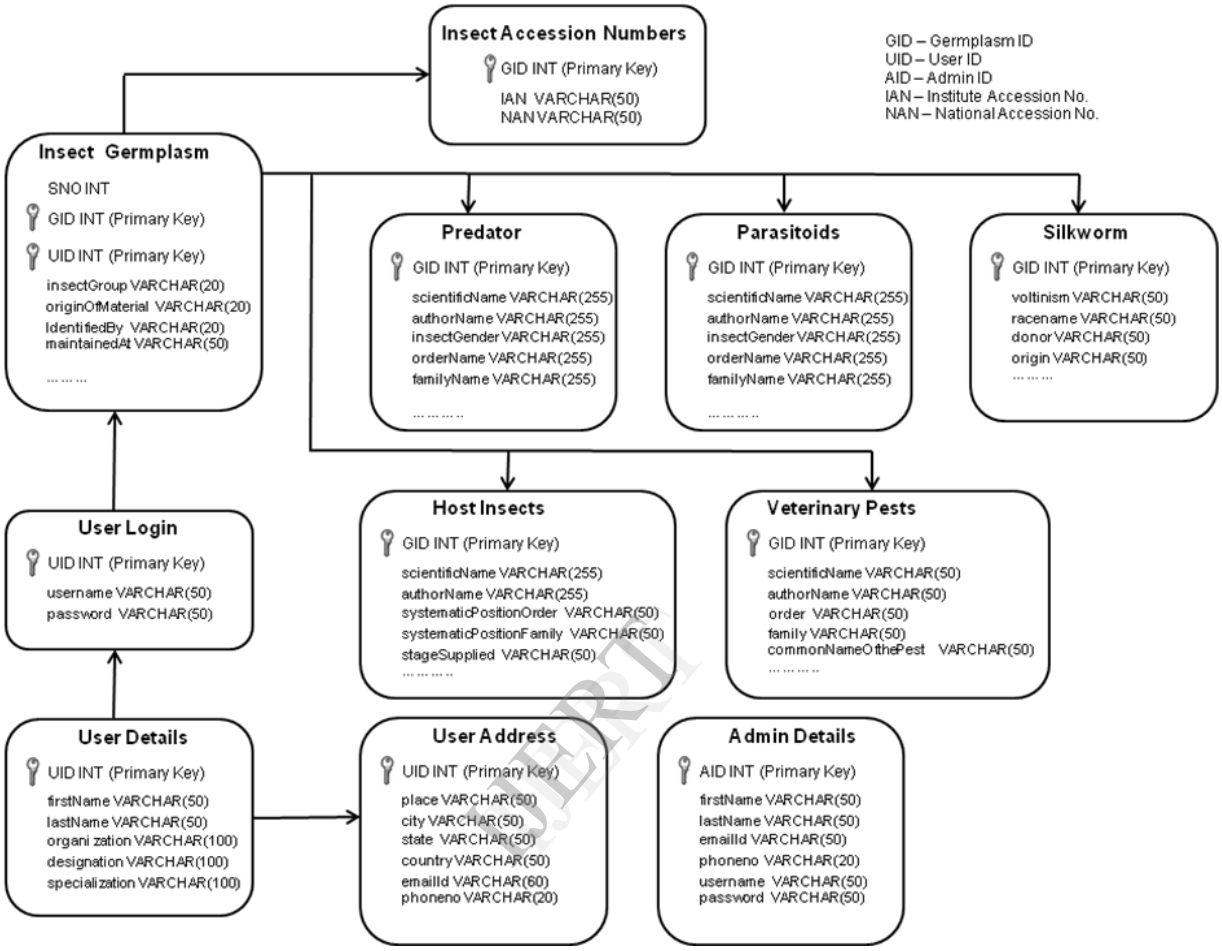

Fig 3. Database design of Arthropod Germplasm Information System

2.2 AGIS services

The AGIS contains the key elements such as Home, Germplasm Information, Germplasm Registration, Downloads, Contact Us, Admin Login and User Login.

2.2.1 Germplasm Information

The *Germplasm Information* option gives passport information regarding the live arthropod germplasm which have been registered like silk worm, host insects, parasitoids, predators and veterinary pests. The user can view the passport information based on their selection. Presently, AGIS contains host insects of 14 accessions, predators of 27 accessions, parasitoids of 91 accessions, silkworm contains 475 accessions and veterinary pests of 2 accessions.

2.2.2 Germplasm Registration

The user can login through the user login button. *Germplasm Registration* button allows the user to submit the details of the arthropod germplasm which he/she wishes to register. The expansions of the abbreviations, for values referred are SC-Scientific; CM-Commercial; AC-Academic and for basis of availability are PR-Published with Peer review; CT-All India Coordinated Trials Data; AR-Institute Annual Report and OT-Any other report.

Before initiating the registration process the user has to choose an option between registration of a new germplasm entry or editing a previous entry. Further, the arthropod group has to be selected (Fig 4).

Fig 4. Screen shot of arthropod germplasm registration page

The basic information required for germplasm registration are: scientific name of the insect, group to which it belongs – *ie*. Pest/Predator/Parasitoid/Veterinary Pest; origin of the material - whether it is indigenous/exotic, person who has identified the accession, germplasm maintained at which place, value referred to like SC (Scientific), CM (Commericial), AC (Academic), basis of eligibility of the germplasm for registration: eg. AR (Institute Annual Report), PR (Published with Peer Review), CT (All India Co-ordinated Trials Data), OT - Any other report, particulars of the Scientist(s) who maintains/developed/collected the germplasm, name and address of the corresponding person (Developer/Depositor), passport information of the germplasm like institute accession no., scientific name of the germplasm, systematic position, host plant, host plant details, host Insect, host insect details, host animal details, place of collection, relevant documents if any related with the germplasm characteristics, duration of maintenance, quantity that can be supplied (Large scale / Nucleus culture). An undertaking form has to be submitted by the organisation seeking registration, which would assure availability of the arthropod genetic material submitted for registration. The user can fill the germplasm registration details online mode and can submit the same by clicking the 'Final Submit' button. The user can attach the two relevant documents related with special characteristics of the germplasm entry since the software allows for two files as an attachment. The user can download the undertaking form, which can be dully filled with details and signature. The submission of undertaking

form as an attachment is mandatory for the submission of germplasm details. Since the user may need time to fill up the details and submit the same with signature from the authority, an Edit option has been provided which helps the user to continue further and can go for final submission.

The arthropod germplasm registration process has been depicted in Fig 5.

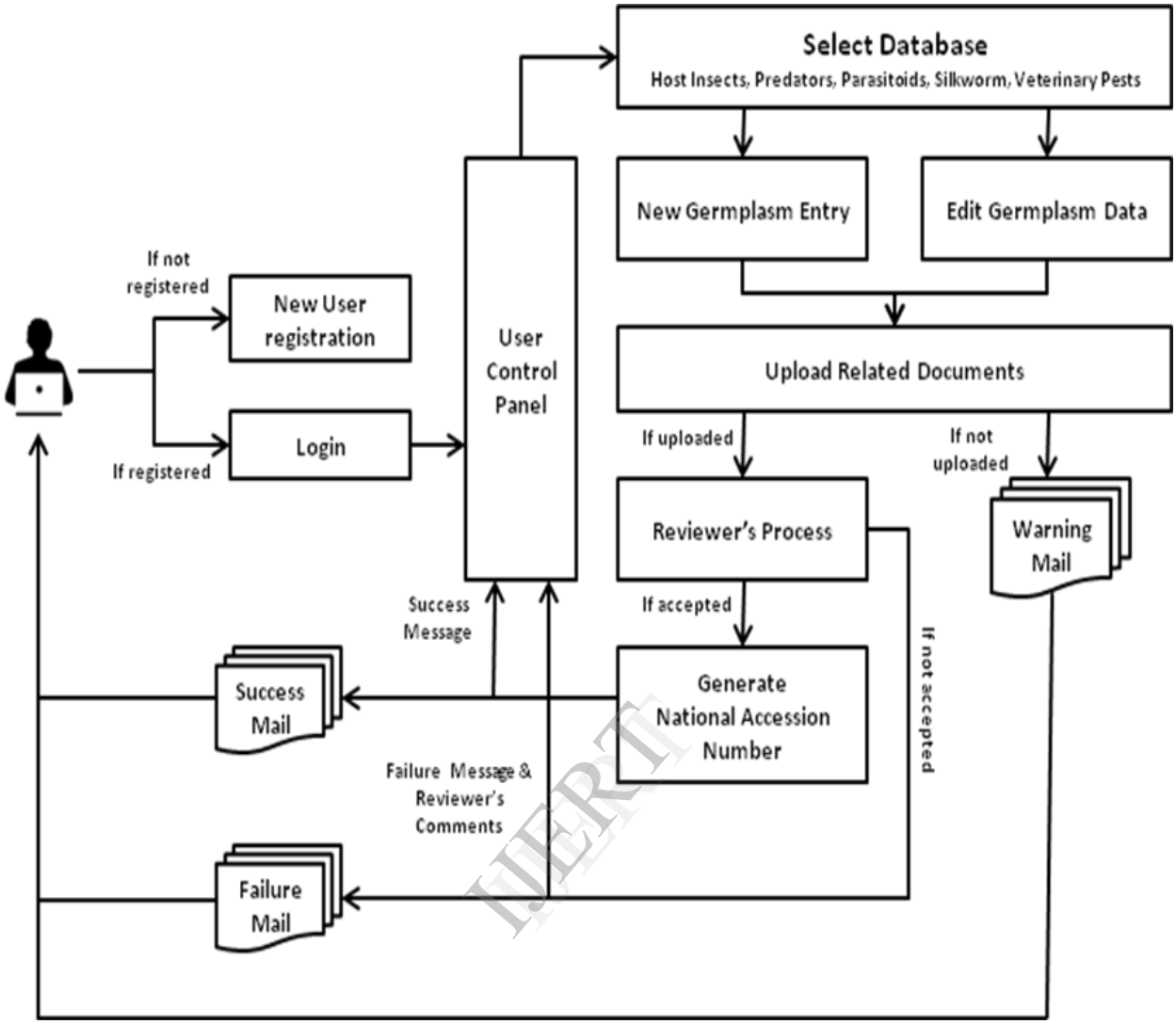

Fig 5. Arthropod germplasm registration process at http://www.nbaii.res.in/germplasm/index.php

User Profile option developed for viewing the entries of the registered germplasm submitted by the user and the user can edit the information if he/she wishes. Computer programs have been developed in PHP, for sending E-mail alerts to the administrative users after the submission of the germplasm entry by an authorised user stating that records are waiting for approval. E-mail alerts will be sent to the users then and there indicating that their submissions have been received for representing the status of the new germplasm registration taken into the database. *Downloads* option developed for downloading the registration form and the guidelines for filling up the registration form. Admin login developed for the administrative users for validating the germplasm entries and after approval the germplasm entries will be updated into the database. The new users can sign up through New User Signup facility by selecting Login button. The authorised users can log into Login page and can access germplasm registration form.

3. RESULTS AND DISCUSSIONS

The AGIS is user-friendly and easy to access for the submission of germplasm entries. The database tables have been developed separately for each users and admin, separately for each insect group for user convenience. Through the primary key Germplasm ID, the tables have been associated with one-to-one and one-to-many relationships. The database has been designed with several tables based on the normalization process and hence the null values and occurrence of redundancy have been avoided in the database (Date, 1999). National accession number will be assigned after approval of each arthropod germplasm entry by the administrative user. The list of live arthropod germplasm entries of host insects, parasitoids, predators, silkworm resources and arthropod vectors maintained at various institutions in

India has been given in this database. There is a possibility to add on live arthropod germplasm accessions like lac, honey bee, etc. The AGIS can lead to future international collaborative projects on bilateral exchange of arthropod resources.

4. CONCLUSION

The aim of this software is to develop, maintain and exchange arthropod germplasm information. The AGIS gives provision for multi-user accessibility with Add/update options and the server is located at NBAII. The information on different groups of arthropod germplasm like silkworm, veterinary pests, host insects, predators and parasitoids can be further updated into the online database AGIS. Researchers from all over the world can log into the website http://www.nbaii.res.in/germplasm/index.php and obtain information on the live arthropod germplasm accessions available in India. The AGIS – online tool is a ready reference for researchers and can also obtain the passport information on the arthropod germplasm culture maintained at different organisations in India.

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