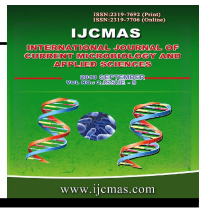
Int.J.Curr.Microbiol.App.Sci (2013) 2(9): 164-173

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 2 Number 9 (2013) pp. 164-173**
http://www.ijcmas.com



Original Research Article

Analysis of Opportunities and Challenges in Patenting of management of sucking pests like aphids, hoppers, whiteflies and thrips in agriculture and horticulture fields

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A B S T R A C T

Sap sucking pests like whitefly, aphids, thrips and leafhoppers are most destructive insect pests on cultivated plants**;** the damage they do to plants has made them enemies of farmers and gardeners the world over. Control of sucking insects with insecticides is often difficult because of the insect's capacity to reproduce rapidly. Also, they may develop resistance to the chemicals. In comparison to chemical pesticides, the potential benefit of using bio-pesticides continues to stimulate the search for new biocontrol agents. Major benefits of using bio-pesticides are less pollution and environmental hazards. Bio-pesticides appear to have fewer problems causing resistance. The objective of the present study is to asses patenting trends of the revolutionary sucking pest management technologies in agriculture. The patent analyses were done using various criteria like patenting trends over the years, assignees playing a major role, comparison of the technology used in different patents and the patenting activity across the sucking pest management. Thus, patent analysis is considered as a useful tool for research and development. Patent analysis also helps identifying and evaluating new and alternate technologies, keeping track with latest technologies for business interests, finding solutions to technical problems and ideas for new innovative trends.

Keywords

Patent databases; Patentable technologies; Patenting trend; Sucking pests; biocontrol agents.

Introduction

Plant pests like sucking pests (whitefly, aphids, thrips and leaf hoppers) cause major losses of food throughout the world, especially in developing countries like India. Losses include direct production or pre-harvest losses and the shrinking of food quality and safety. Plant sucking pests can sometimes be controlled by application of chemicals. Pest control strategies, like many aspects of biological and agriculture sciences, changed greatly due to advances in biological control of pests. This new approach provides opportunity for the management of sucking pest through biological control technologies. In many countries, agricultural plant protection relies heavily on pesticides. While providing effective

control, chemical pesticides created health hazards to humans and animals, destruction of natural biotic control agents and increased resistance of major insect species which resulted in steady increase in insecticide dosages. In spite of more than ten-fold increase in insecticide use since 1940, losses have nearly doubled. This situation accelerated the efforts towards more robust control measures and microbial control proved to be the most efficient. For sucking pests control, bio-pesticides are increasingly used in agricultural and horticultural production. In comparison to chemical pesticides, the potential benefit of using bio-pesticides continues to stimulate the search for new biocontrol agents. Major benefits of using bio-pesticides are less pollution and environmental hazards. Bio-pesticides appear to have fewer problems causing resistance. The objective of the present study is to asses patenting trends of the revolutionary sucking pest management technologies in agriculture.

Materials and Methods

Data Collection

To measure technological innovation, patent analysis was used, because it provides innovative information of individual, organizational, regional and national scientific levels. Patent analysis was also used to map the technological activities at various levels. This article attempts to analyze the patenting activity in the field of management of sucking pests and its various applications for sustainable agriculture and horticulture production. This report also try to highlight the important technological directions and gaps in our knowledge in order to allow further pursue of Research and development, using data from different databases, namely Orbit database, European Patent and trademark office database (EPO), Google patents, Indian patent database (IPO), United States Patent office data base (USPTO), World Intellectual Property Organization (WIPO). All searches and data have been collected from 1981 to 2012 to cover active patenting authorities throughout the world. International search for patents on a specific subject used the following key words: sucking pest management, sucking pest bio-control, aphid management, hopper management, thrips management, whitefly management, etc. Searches were made using ORBIT, WIPO, USPTO, EPO, PCI, IPO, FPO and all electronic database used the advanced search on issuing date, country and international classification number and bibliographical references of all the patents. This was done in order to understand the technical approaches taken by different research groups throughout the world. It also provided an insight into emerging technologies and key areas for Research and Development in bio-controlling of sucking pests.

Results and Discussion

The data was examined with respect to (i) trends in the growth of patenting activity (ii) organizations/industries active in research, and (iii) the focus of research relevant to present conditions. The analysis has been used to indicate the emerging technological opportunities and trends by high lighting the important technological directions and gaps. The essence of results obtained from the analysis is presented here.

Patent Analysis

Patent analysis is a unique management tool for addressing strategic management

of a technology and product or service development process. Analytical tools are used for searching patent and associated with scientific literature to show the gap in research areas. Translating such data into competitive intelligence allows estimating its current technical competitiveness, to forecast technological trends, and to plan for potential competition based on new technologies. Patents are earliest discoveries of new technology and are first published 18 months after filing the initial application. The majority represents technical change and few are economically significant and vary in scope, purpose and ultimate value. Patents are granted for discovery of new technologies for the biological controlling of sucking pests in agriculture field, have been analyzed in order to get an idea about their status in the world.

New bio-agents and their effect on sucking pests

The patents claiming novel controlling agents and stains includes US4942030, US5413784**,** PT73671A19811001, RU2004121732, ZW13881A119810902, RU2460289 (Method of biological control of sucking pests of agricultural crops), RU2434939 (*Bacillus thuringihnsis* BIOS-1), RU2192745 (Fungus strain *Entomophthora thaxteriana* Petch (Zygomycetes: Entomophthorales) no.19 (viz.,) for bio-preparations preparing and more describes the management and control of sucking pest by systematic manner. For example one Indian patents viz., Patent number IN2006MU01827 covers invention of herbal formulation for the control of Aphid, White fly, and major assignee is Society for Research & Initiatives for Sustainable Technologies & Institutions. Patent number US6150156, explains the invention of Bacillus thuringiensis isolates active against sucking insects and the assignee is Calgene, Inc. and US4942030 and EP-459975 patent numbers describes the biological control of whiteflies and other p ests with a fungal pathogen and the patent number WO200984900 describes the sticky trap using color contrast and method for controlling insects using the same is non-toxic to humans, animals, and the environment, and is thus environmentally-friendly, and keeps the density of target pest insects below an acceptable economical loss level in spite of reduced spray frequency of pesticides.

Patenting Activity across the four important sucking pests (Hoppers, whiteflies, thrips, aphids)

Patenting activity across different insects of sucking pests was studied across various controlling methods and summarized in Figs. (1, 2, 3 and 4). The management of sucking pest is effective against aphids have the maximum number of patents, followed by hoppers, whiteflies and thrips. There is however a limited number of patents from India that describes the management of sucking pests. Thrips are the most important group of sucking pest in agricultural and horticultural crops, and it is becoming increasing urgent to find new methods to control them. Some of the bioagents has been used for decades as a biological control agent against thrips, but its potential to control of important sucking pests like thrips has been largely ignored. Analysis of patenting trend across the management of different sucking pests revealed that it is limited to some particular pests. This basic information helps in identifying the research gaps and brings out a scope for generating intellectual property through focused

Fig.1A Patenting activity in the field of pest management of whitefly trend over the years (1982-2011)

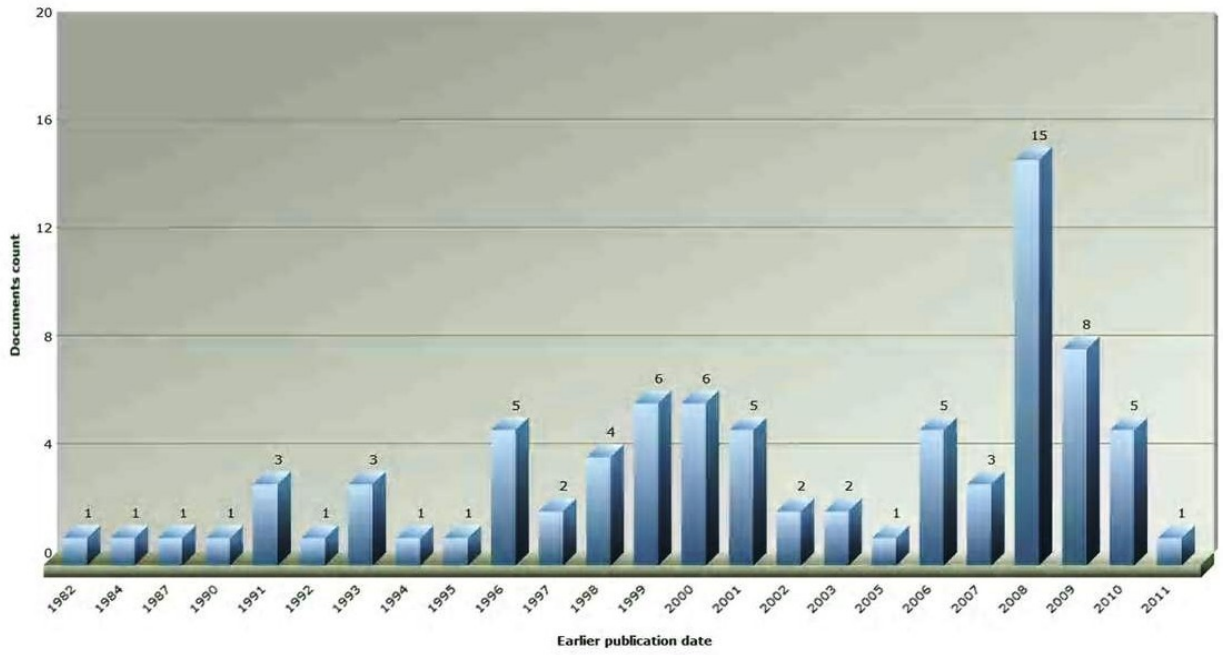


Fig.1B Whitefly and their management of patenting analysis using Boliven patent analysis search are limited to patents per year and top assignees.

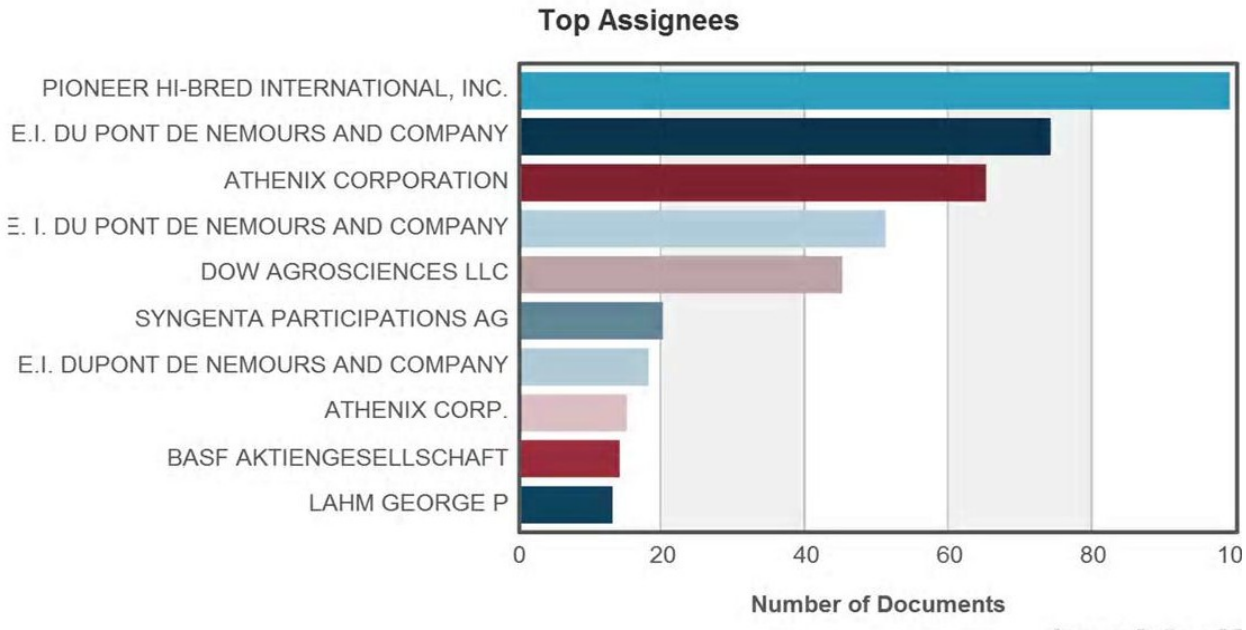


Fig.2A Patenting activity in the field of pest management of thrips trend over the years (1974-2010)

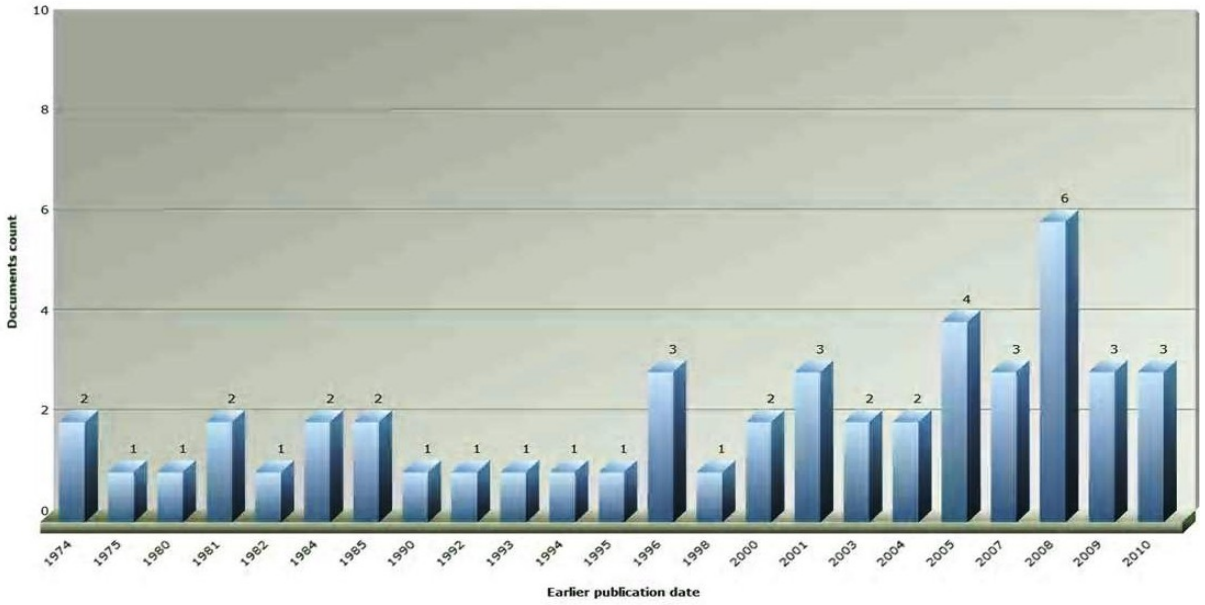


Fig.2B Thrips and their management of patenting analysis using Boliven patent analysis search are limited to patents per year and top assignees

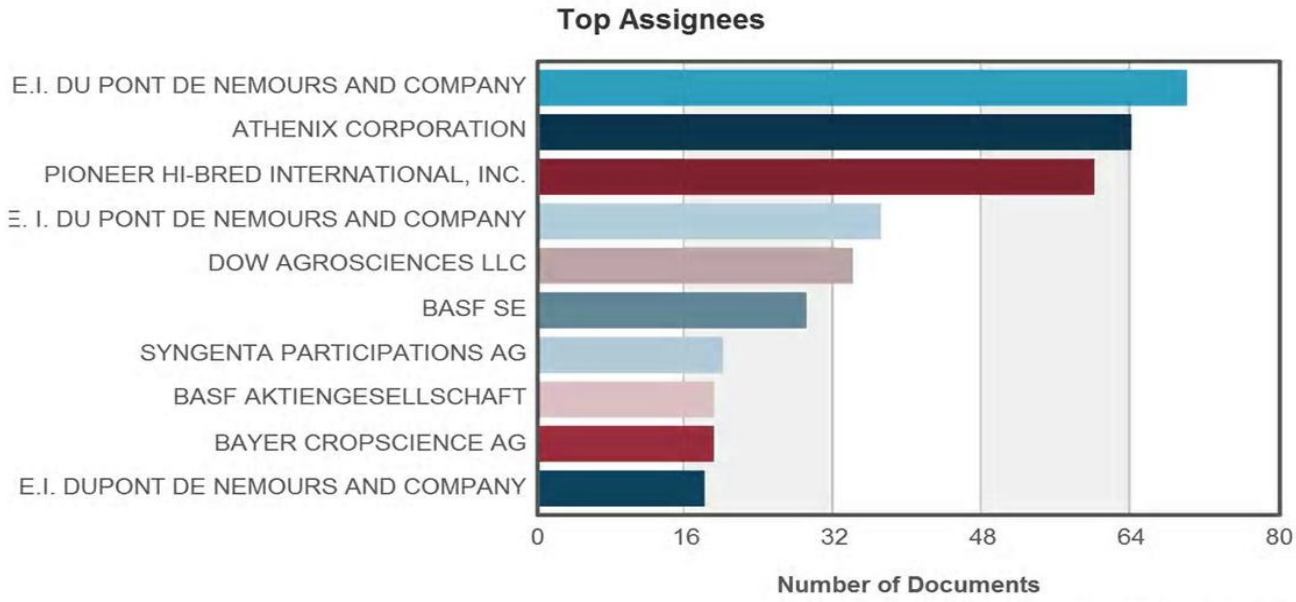


Fig.3 A. Patenting activity in the field of pest management of aphid trend over the years (1969-2012)

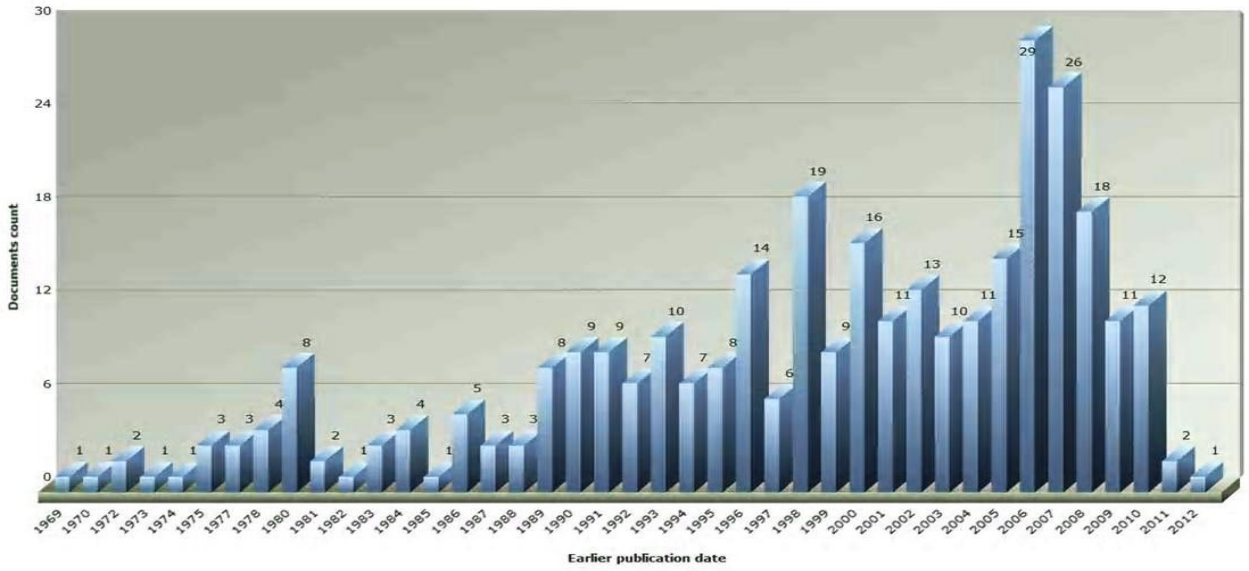


Fig.3B Aphids and their management of patenting analysis using Boliven patent analysis search are limited to patents per year and top assignees**.**

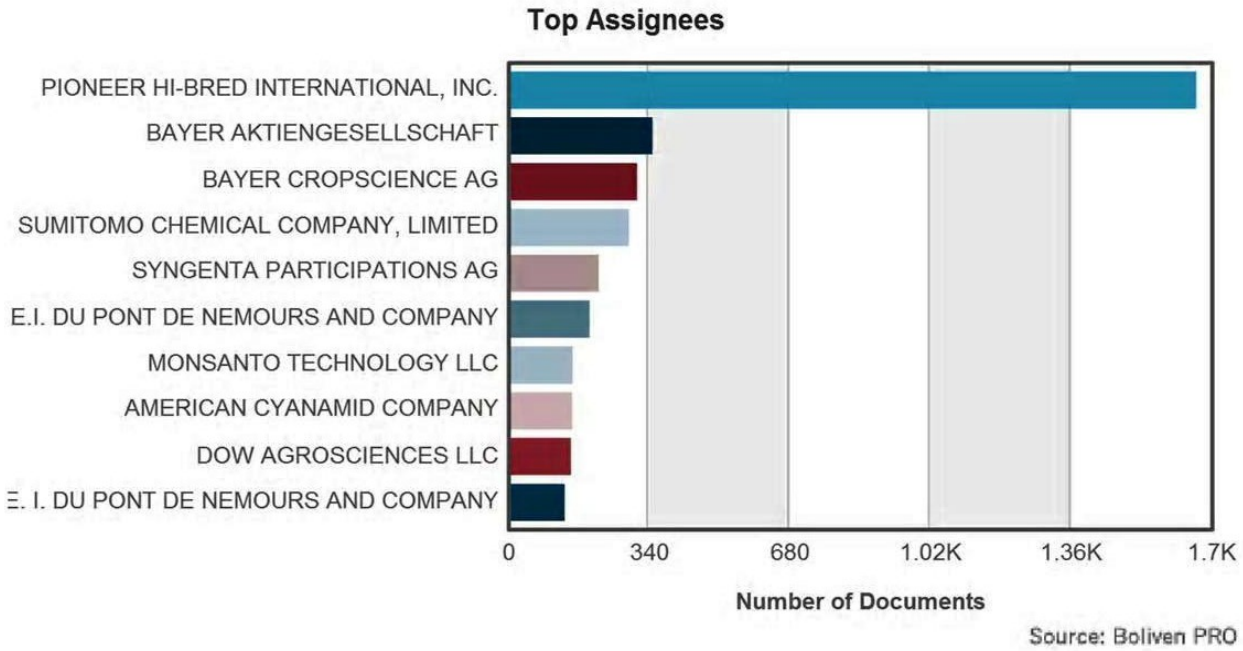


Fig.4A Patenting activity in the field of pest management of hopper trend over the years (1969-2012)

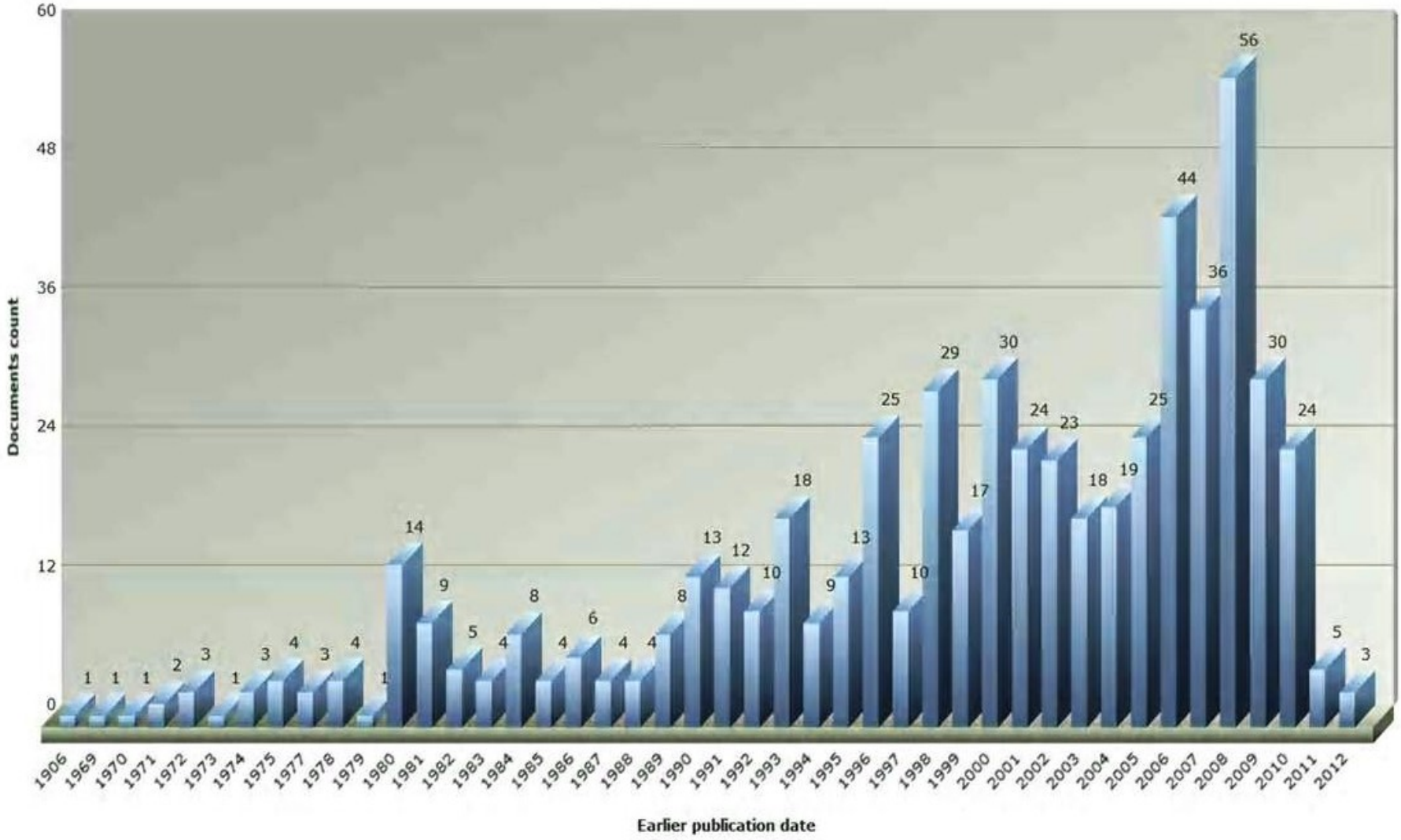
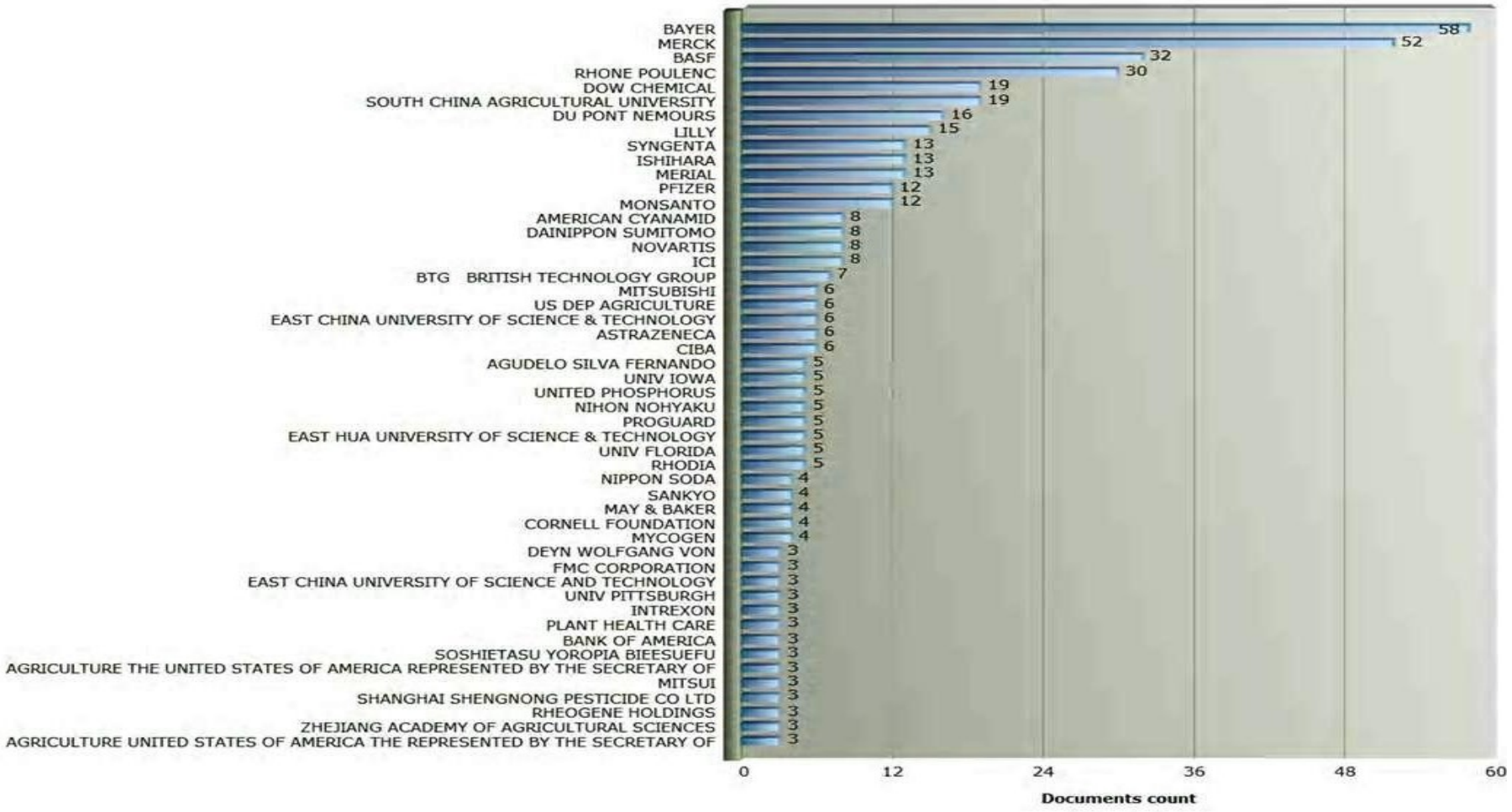


Fig.4B Hoppers and their management of patenting analysis using Boliven patent analysis search are limited to patents per year and top assignees



research, since considerable agricultural crop losses incurred by different insect pest orders where in effective control measures are not available so far.

Patenting Activity over the Years

The patenting activities of pest management of whiteflies, thrips, aphids and hoppers over the years depicted in Fig.1, 2, 3 and 4 respectively. It can be observed that the year 2008-2010, 2008-2010, 2006-2008 and 2006 -2009, has the maximum patenting activity of whiteflies, thrips, aphids and hoppers management respectively. It is also observed that there was increasing trend in the number of patents since 1996 till 2001 of whitefly management, 1996-2008 of thrips, 1996-2000 of aphids and 1996-2010 of hoppers respectively. Overall there was very little patenting activity in the years prior to 1980, even though the management of sucking pests has been studied from so many years. This indicates that the patenting activity has been very recent and that this area has gained importance in recent years.

Assessment of Patenting Activity by the Major Assignees

Patent analysis in terms of level of activity gives general information on companies that are active in R&D of these bio-insecticides. The assignees across the globe are shown. From the Fig.(1)B, Fig(2)B, Fig(3)B and Fig(4)B respectively, the following observations were made Pioneer Hi-breed International have the maximum patents among agricultural universities and research institutions followed by Du Pont DE Nemours company, Pioneer Hi-breed International and Bayer. Most of the assignees concentrate on the controlling of sucking pests through chemical insecticides or pesticides compare to biological controlling methods. In conclusion, the patent analysis was done on management of sucking pests to find industrial trend and to understand the competitiveness across the world. It also provides an insight into emerging technologies and key areas of research and development.

Current and future development

Sucking pests management by biological methods has become the greatest successes reveals that biological management is merely the beginning of a long series of new and safer technologies to augment productivity to bring about more sustainable crop productivity in an eco-friendly manner. Despite significant achievements have been made in development of controlling methods for the management of sucking pests and the patentable technologies were restricted to certain geographical regions. Patent documents related to management of sucking pest in agriculture and horticulture field are affluent source of technical knowledge having commercial application. So, patent analysis is considered as a useful medium for research and development management. Analyzing these patents on various criteria can provide valuable information which can be put into use in different ways and also lead to higher probability of success in new technological attempt. Finally the unambiguous aim of sucking pest management in agriculture and horticulture field of patent analysis is to notice, expand, and recognize new technologies for the secure and effective control of sucking pests, thereby maximizing food productivity. It has also been observed that patenting activities in

the emerging fields of technology are progressively more growing day by day. This helps to emphasize the new promising technologies and fill the gaps in agriculture and horticulture field with respect to the management of sucking pests.

Acknowledgment

The authors are grateful to the Director, National Bureau of Agriculturally Important Insects (NBAII), Bangalore for giving encouragement and technical support. The authors are grateful to ICAR, New Delhi for funding this study under Intellectual Property Rights (IPR) Project.

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