

Patenting Activities in Agriculture from India

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Received 10 May 2005, revised 16 June 2005

An attempt has been made to study the trends of patenting activity in the field of agriculture with reference to India using data from various databases, such as, USPTO, EPO, PCT and Gazette of India Part III Section 2. The study covers the data from the period 1 January 1995 to 31 December 2004 (WTO era), where in 415 patents exclusively related to agriculture have been taken for analysis. The study indicates the focus of research of different organizations /industries in specific areas of agriculture and highlights the important technological directions and gaps for further pursuing R&D in agriculture.

Keywords: Indian patent, agriculture, patent activity

Agricultural research has expanded rapidly to new frontiers, such as, biotechnology, vaccines and diagnostics with a special focus on farming in dry lands and un-irrigated areas. India is self-sufficient in wheat and paddy, but deficient in legumes and oilseeds production. Farming has to be diversified into areas, such as, horticulture, floriculture, etc. Boosting agricultural growth through agricultural diversification and development of agro-processing is one of the objectives of National Common Minimum Programme (NCMP) of United Progressive Alliance (UPA)¹.

With the emerging intellectual property rights regimes under new and upcoming legislations, in conformity with the global developments and intergovernmental agreements, there is a need to protect the intellectual property developed in the research institutions and industries for not only commercial gains but also to support further research and development in agriculture.

This article is an attempt to analyse Indian patenting activity in the field of agriculture using data from various databases, namely, USPTO, EPO, PCT, and Gazette of India Part III Section 2 from the period 1 January 1995 to 31 December 2004 (WTO era). The aim of the study is to analyse the focus of research of different organizations/industries in specific areas of agriculture and to highlight the important technological directions and gaps for further pursuing R&D in agriculture.

Data Collection

The data was collected from various patent databases; namely, US patent database (USPTO)², European patent database (EPO)³, PCT database⁴ and Gazette of India Part III Section 2⁵. Since the International Patent Classification (IPC)⁶ is used by virtually all the active patenting authorities in the world and particularly by all the authorities of the major industrialized nations as a common means of classifying the patent specifications they publish, it is possible to carry out an international search for patents on a specific subject using IPC as a key. The search by IPC code A01 for agriculture was made for all the Indian patents issued since 1 January 1995. The searches were made in the USPTO, EPO, and PCT electronic databases using the advanced Boolean search on issuing date, country and international classification number and bibliographical references of all Indian patents. A manual search was also made in the Gazette of India. After removing overlaps, a set of 415 patents comprising of 60 patents from EPO, 38 from USPTO, 29 from PCT and 288 from Gazette of India Part III Section 2 was taken for analysis; which exclusively related to patenting activity in the field of agriculture.

Results and Discussions

The data was examined with respect to: (a) trends in the growth of patenting activity, (b) individuals and organizations/industries active in research, and (c) the focus of research. The analysis has been used to indicate the emerging technological opportunities and trends by highlighting the important technological directions and gaps.

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Trends in Patenting Activity

From Table 1, it can be seen that there is a gradual increase in the number of patents during 1995-2004. The number of patents reached a maximum of 79 in 2002 and after that there is a slight decline in 2003 (74 patents) and 2004 (63 patents).

The analysis of data indicates that 138 applicants were granted 415 patents. Out of 138 applicants, 21 are organizations, 58 industries and 59 individuals. Out of the 58 industries, 33 are public and 25 private industries. Of the 59 individuals, 47 are single inventors and 12 joint inventors., Notably, CSIR individually, held the maximum number of patents among R&D organizations as well as industries. The technologies that had been patented by CSIR cover a wide range, such as, the process for preparing biocides and plant growth regulators, developing new varieties of plants, agricultural tools, devices for storing, improved cultivation methods, methods of plant reproduction, improved processes for dairy products, pest repellants, silkworm rearing, fisheries, and medicinal preparation from plants, etc. University of Delhi, IIT, College of Pharmacy, National Institute

of Immunology, and Tea Research Association, etc. are among academic institutions that have technologies related to methods for obtaining new plants. Patenting activity in Indian Council for Agricultural Research (ICAR), New Delhi, was very low. The technologies patented by industries relate to the process for preparing herbicides, fungicides, bactericide, insecticide, and herbal preparations. The major players among industries were: United Phosphorus Ltd, Sulphur Mills Ltd and Dalmia Centre for Biotechnology. The technologies patented by individuals cover agricultural tools, harvesting, biocides, insect repellants, etc.

Focus of Research

The research has covered a wide range of subject areas. Most of the cases involve preparation of biocides containing hydrocarbons or carboxylic acid amidines or heterocyclic compounds or extracted from microorganisms or animal or plant material, etc. Devices for loosening soil, machines for harvesting, and tools for sowing or fertilizing, storing agricultural or horticultural produce, cultivation, sowing,

Table 1— Area wise patenting activity during 1995-2004

Area	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Soil working in agriculture or forestry, agricultural machines or implements (A01B)	2		3	3	-	-	-	1	-	3	12
Planting, sowing, fertilizing (A01C)	-	2	1	1	1	2	2	-	-	1	10
Harvesting, mowing (A01D)	3	4	1	2	-	1	-	2	1	-	14
Processing of harvested produce, devices for storing (A01F)	1	-	1	-	-	-	-	-	1	1	4
Horticulture, cultivation, forestry (A01G)	4	2	4	2	3	1	-	4	3	2	25
New plants or processes for obtaining them, plant reproduction (A01H)	-	1	-	3	1	1	5	17	18	13	59
Manufacture of dairy products (A01J)	1	-	1	-	-	-	1	1	-	-	4
Animal husbandry, silk rearing or breeding animals, new breeds (A01K)	-	-	2	-	1	2	2	3	3	3	16
Catching, trapping, apparatus for destruction of noxious animals (A01M)	-	-	1	-	-	1	-	1	2	2	7
Biocides, Pest repellants or attractants, plant growth regulators (A01N)	4	7	30	13	21	20	31	46	43	35	250
Medicinal preparation containing materials from plants (A61K35/78)	-	-	-	-	-	2	2	4	3	3	14
Total	15	16	44	24	27	30	43	79	74	63	415

fertilizing, harvesting, catching, and trapping of insects and, medicinal preparation have also been patented. From the table, it can be inferred that there was low patenting activity in manufacturing of dairy products.

In India, agricultural research including development of new plant varieties has largely been the main area of concern for the government and public sector institutions. After becoming a signatory to the TRIPS Agreement in 1994, such legislation was necessitated. As per Article 27.3 (b) of TRIPS, the protection of plant varieties is either by patent or by *sui generis* system or by combination. Member countries had the choice to frame legislations⁷. India framed its own system for the protection of plant varieties taking care of rights of breeders, farmers, researchers and village people. The Protection of Plant Varieties and Farmers' Rights Act was passed by the Government of India in 2001. The act covers all categories of plants except microorganisms. The act makes it possible to register extant as well as newly developed plant varieties and prevent the unauthorized use of registered plant varieties⁸. Some of the objectives are: to protect the rights of farmers and plant breeders, to stimulate investment for research and development and to facilitate growth of seed industry, to ensure availability of high quality seeds and planting materials of improved varieties to farmers. Many new plant/plant varieties have been developed in the country by farmers and researchers. CSIR has obtained patents for new plant varieties developed by them in USA and Europe.

Analysis of data presented in the table revealed that the patenting activity was restricted to agricultural machines or implements, planting, fertilizing, harvesting, cultivation, horticulture and biocides during 1995-96, while in 1997, it expanded to dairy products, silk rearing, catching and trapping. The work on producing new methods of plant reproduction/plant variety was started in 1996 and a number of patents were granted during 2002-03.

Out of the total 415 patents, 250 patents were granted in the area of biocides, pest repellants and plant growth regulators, while rest of the areas accounted for 165 patents. In these areas, 59 patents in plant reproduction, new plants or processes for obtaining them; 25 patents in horticulture, cultivation and forestry; 16 patents in animal husbandry, silk rearing or breeding animals, new breeds, 14 patents in harvesting and mowing followed by medicinal

preparation containing materials from plants; 12 patents in soil working in agriculture or forestry, agricultural machines or implements; 10 patents in planting, sowing, fertilizing; 7 patents in catching, trapping, apparatus for destruction of noxious animals and 4 patents in processing of harvested produce, devices for storing followed by manufacture of dairy products patents were granted.

There was no patenting activity, during 1999-2001 and 2003 in agricultural machines or implements, soil working in agriculture or forestry; during 2002-03 in planting, sowing and fertilizing. In the area of harvesting and mowing, there was no patenting activity during the years 1999, 2001 and 2004. Entrepreneurs are playing main role in this area. In the field of processing of harvested produce, devices for storing agricultural or horticultural produce, there was no patenting activity during 1998-2002. Horticulture, cultivation and forestry are very active areas of research but there was no patenting activity in 2001. Major contribution in this area is of individual inventors. New plant or process for obtaining them, plant reproduction by tissue culture techniques is one of the most active areas of research. There was no patenting activity in 1995 and 1997. CSIR and other academic institutions dominate this area. Very low patenting activity was observed in manufacture of dairy products and half of the patents are held by CSIR. There was no patenting activity during 1995-96 and 1998 in animal husbandry, silk rearing or breeding animals, new breeds. Individual inventors dominated this area. There was no patenting activity during 1995-96, 1998-99 and 2001 in catching, trapping, apparatus for destruction of noxious animals. Individuals hold most of the patents in this area. CSIR contributes more than 25% of patents in biocides, pest repellants or attractants, plant growth regulators. Individual inventors are also playing important role in this area. In the field of medicinal preparation containing materials from plants, there was no patenting activity during 1995-99. CSIR and industries play a major role in this area.

Details of patenting activities in different areas are:

Agricultural Machines or Implements, Soil Working in Agriculture or Forestry (A01B)

Twelve patents were granted in the field of soil working in agriculture or forestry, agricultural machines or implements. Four patents were granted to organizations, such as, CSIR (3) and ICAR (1) for

developing agricultural and gardening tool set, soil pH meter with metallic sensor, method for maximization of artemisinin production by the plant *Artemisia annua*, seed-cum-fertilizer drill. Four patents were granted to individuals for developing human propelled tiller, ploughing-cum-sowing implement, rotary tilling device, shaft driven timing system for internal combustion engines and four patents to industries such as Engineer & Co (2), Narasinha Structomach Pvt Ltd (1) and SAIL (1) for improved plough with a mounted adaptor, adaptor for plough, improved process for manufacturing tractor discs, power operated multi pronged mattock cultivator.

Planting, Sowing, Fertilising (A01C)

In the field of planting, sowing and fertilizing, ten patents were granted, out of which five patents were granted to individuals for air screen cleaner machine, process for preparing *in-situ* compost, machine for cleaning and grading of seeds, methods of fertilizing, groundnut planter, animal driven agricultural apparatus. Industries, such as, Synit Drugs Pvt Ltd, Rashtriya Chemicals and Fertilizers Ltd, and Scitech Centre were granted one patent each, for process for manufacturing a slow release urea fertilizer by nitrification inhibition, sowing device for seed for agriculture and afforestation, and process for the preparation of synergistic fertilization from agricultural waste, respectively. Two patents were granted to CSIR for portable digital soil salinity tester, composition for increasing herbage and essential oil yield in Palmarosa.

Harvesting and Mowing (A01D)

In the field of harvesting and mowing, 14 patents were granted, out of which 8 patents were granted to industries, 5 to individuals, and one to IIT, Kharagpur. Among industries, 4 patents were granted to Walchandnagar Industries Ltd and 2 to Punjab Tractors Ltd for self driven crop orienting three wheeler harvester, two wheeler harvester, machine for harvesting sugarcane, harvester for crops such as sunflower, trimmer. Individuals were granted patents for sugarcane harvesting knife, lawn mover, machine for separating out cotton from cotton pods, while IIT for improved lawn mower.

Processing of Harvested Produce, Devices for Storing Agricultural or Horticultural Produce (A01F)

In the field of processing of harvested produce, devices for storing, four patents were granted, out of

which 3 were granted to industries and one to organization. Bridge & Roof Co, Punjab Tractors Ltd, and T Stanes & Co Ltd were granted one patent each for multicrop thresher, novel container for storage/transportation of vegetables, fruits, grains, storage pot. CSIR was awarded one patent for improved process for the preparation of a pseudobactin useful for increasing the shelf life of stored fruits, vegetables and tubers.

Horticulture, Cultivation and Forestry (A01G)

A total of 25 patents were granted in the field of horticulture, cultivation and forestry, out of which, 5 were granted to industries, 6 to organizations and 14 patents to individuals. Among organizations, 4 were granted to CSIR for a device for separating stigma and style from the pistal of flowers, improved process for cultivation of algae, method for inducing improved seed germination in *Podophyllum hexandrum*, improved process for the preparation of a growth medium for the growth of edible fungus, and one patent to ICAR for a method for preparing mushroom growth promoting agent. NRDC got one patent for a process for the preparation of activated zinc sulphide. Among industries, Ecomax Agrosystem Ltd, ACL Chemicals Ltd, Finolex Plastro Plasson Ltd were granted 3,1,1 patents respectively for novel medium for the production of betacarotene and other carotenoids from *Dunaliella salina*, automatic device for soil irrigation and system for irrigating shallow rooted agricultural farms/gardens, automatic device for soil irrigation and system network for underground subsoil irrigation, improved dripper, tractor for use in horticulture operations in an orchard. Among individuals patents were granted for automatic drip irrigation system, rain guard for a latex yielding tree, khurpa for gardening and sowing; blade changeable rubber wrapping knife, device for supporting latex collection receptacle, cutting and gripping device, secateur, device for channeling rainwater away from the tapping zone of a latex yielding tree, water candle for lifting water from lower container for automatic watering of plant from root side, apparatus for irrigating plants at root zone.

New Plants or Processes for obtaining them, Plant Reproduction by Tissue Culture Techniques (A01H)

In the field of new plants or processes for obtaining them, plant reproduction, 59 patents were granted, out of which, 49 patents were granted to organizations, 8 to industries and 2 to individuals. Among

organizations, 42 patents were granted to CSIR for developing opiumless and alkaloid free non narcotic opium poppy variety sujata, Gladiolus hybrid plant, mint plant, Aglaonema plant, *Lippia alba*, rose scented Geranium *Pelargonium graveolens*, plant safal, Chrysanthemum plant, *Cymbopogon flexuosus*, *Mentha arvensis*, *Brassica napus* plant line, methods for clonal propagation of Vanilla, media composition for faster propagation, nutrient medium composition for enhancing shoot sprouting and multiplication from mature bamboo species from excised embryo-axis of cotton, transgenic tea through biolistic using leaf explants, transgenic plants with enhanced chlorophyll content and salt tolerance. One patent was granted to Department of Atomic Energy for process for preparing products such as banana juice and banana powder from ripe banana. Department of Biotechnology received one patent for a process for preparation of DNA-protein gold precipitate for transformation of plant/tissue, and International Centre for Genetic Engineering and Biotechnology for transplastomic plant. University of Delhi received 5 patents, out of which, 2 patents in collaboration with National Dairy Development Board, and one patent with Dhara vegetable Oil and Food Co for new process for male sterile *Brassica napus*, *Brassica campestris*, *Brassica oleracea* and the method of producing such plants, regulation of lethal gene expression in plants. Among industries, 4 patents were granted to Avestha Gengraine Technologies Pvt Ltd for novel blue copper protein gene isolation from rice combating salinity stress, rice conferring resistance to environmental stress, cytoplasmic male sterile line in rice, DNA sequencing for environment tolerant crops, one patent to Hindustan Lever Ltd for preparation of cold extruded composition and an apparatus for carrying out such process, one patent to Dhara Vegetable Oil and Food Co and National Dairy Development Board for *Brassica napus* plant line, and one patent to Southern Petrochemical Industries Corporation for method for enhancing nodulation activity and grain yield in legumes. Individuals were granted 2 patents for Aglaonema plant, named, Jewel of India and a process for genetically modified pearl millet.

Manufacture of Dairy Products (A01J)

Only four patents were granted for manufacture of dairy products, 2 patents to CSIR for process for the production of immobilized milk clotting protease, continuous production of cheese free from aspartic

protease and one patent to Greaves Foseco Ltd for forming butter and one patent to individual for manufacturing paneer.

Animal Husbandry, Silk Rearing or Breeding Animals, New Breeds (A01K)

In this field, 16 patents were granted, out of which, a maximum of 9 were granted to individuals, 5 to organizations and 2 to Rajasthan Electronics and Instrument Ltd for devices for weighing and testing fat contents of the milk. CSIR was granted 4 patents for process for extraction of silk enhancing fraction from the aerial parts of the plant *Cassia tora*, feed supplement for silkworm for enhancing the silk production, improved honey processing, process for preparing extract of *Silene vulgaris* used for enhancing silk yield. IIT along with DBT has been granted one patent for method for degumming of silk with a fungal protease. Individuals were granted patents for composition to attract *Apis flora*, chick drinker set, device for storing and feeding poultry feeds, dispensing liquid in poultry farming, developing fishes in flowing water, killing mosquitoes, a sensor for intrusion detection, plastic bee-hive box to breed honey-bees.

Catching, Trapping, Apparatus for Destruction of Noxious Animals (A01M)

In the field of catching, trapping, apparatus for destruction of noxious animals, 5 patents were granted to individuals for coiled fuming set, electronic insect repeller, bird deterrent device, device for attracting trapping and killing flying mosquitoes. ICMR was granted one patent for mechanical mosquito sampler while Reckitt & Colman of India Ltd for mosquito/insect repellent device.

Biocides, Pest Repellants or Attractants, Plant Growth Regulators (A01N)

Maximum number of patents were granted in the field of biocides, pest repellants or attractants, plant growth regulators. Out of a total of 250, 105 patents were granted to organizations as well as to industries and 40 to individuals. Among organizations, 66 patents were granted to CSIR for antiviral agent composition from Indian horse chestnut, fumigant, insect-pest protectant, plant extract from mangrove plant, bactericide, biopesticide against teak defoliator and Epilachna beetle, mosquito repellent, alkaloid from spore *Tedenia anhelans*, nematicide, fungicide and plant growth promoter from *Trichoderma harzianum*, biocide from *Barleria prionitis*,

antifeedent from neem leaves, fermentates from *Zoanthus* sp, antifungal composition for leather articles, azadirachtin from neem plant. DRDO received 9 patents for insecticides for protection of woolen items, and to kill cockroaches. Among industries were United Phosphorus Ltd (12), Sulphur Mills Ltd (11), Rallis India Ltd (7), Montari Industries Ltd (7), Dalmia Center (8) for insecticides, fungicides, bactericide, herbicide, plant growth hormone for neem plant and cotton, azadirachtin from neem plant, spray composition for tissue cultured plants, biocides, pesticides. Individuals were granted patents for acaricide formulation, biocide for preservation of sugarcane plant and rapid action in sugarcane juice, herbicide for *Parthenium hysterophorus*, microfinned neem powder for insect bait and cockroach repellent.

Medicinal Preparation Containing Materials from Plants (A61K35/78)

In this field, 8 patents were granted to organizations, one patent to individual and 5 patents to industries. Among organizations, 6 patents were granted to CSIR for herbal composition for treating asthma, process for the preparation of a herbal formulation useful for controlling sucking insect pests, process for the preparation of alpha-amylase from *Tinospora cordifolia*, composition useful as hepatoprotectants comprising extract of plant *Cryptolepis buchanni* and a method thereof, process for extraction of piperine from *Piper* species, improved process for the preparation of technical grade azadirachtin. Individual was granted patent for oil extracts from Crassulaceae acid metabolism plants.

Among industries were Dalmia Centre (2), Dabur Research Foundation (1), EID Parry Ltd (2). Patents were granted for the process of preparing purified azadirachtin in powder form from neem seeds and storage stable aqueous composition containing

azadirachtin, process for the preparation of a herbal composition for improving mental capabilities, and for composition for treatment of drug resistant bacterial infections and a method of treating drug resistant bacterial infection, process for preparing upgraded azadirachtin containing neem products, composition containing neem seed extracts and saccharide.

Conclusion

Major patenting activity in India is in the area of biocides. The methods to isolate these compounds from various plants have been patented. Among the commercial crops, major patenting activity was in crops like groundnut, sugarcane, sunflower, mustard, neem and cotton. The study indicates that in developing new plants or processes for obtaining them, the private sector or individual has hardly taken any initiative. Collaborative R&D effort is also not significant. Public sector is more active in comparison to private sector. There is a need to promote academic-industry partnership. The industries can pair up with academic and government institutions in a collaborative mode to work on joint R&D projects.

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