

STRENGTHENING THE INTELLECTUAL PROPERTY MANAGEMENT AND COMMERCIALIZATION PORTFOLIO OF INSTITUTE POTATO TECHNOLOGIES

Rajender Singh¹, Vinay Bhardwaj^{*}, Baljeet Singh¹, Sukhwinder Singh² and NK Pandey¹

ABSTRACT: An ecosystem of vibrant intellectual property (IP) creation and commercialization will not only promote the culture of creativity and innovation among researchers but also enhance the economic development of the country. The value and economic reward for the owners of IP rights come only from their commercialization and there is need to promote the public sector initiative for IP commercialization. In the recent decade, ICAR-CPRI has made concerted efforts for the creation of IP assets, their maintenance and commercialization. IP protection status of the institute comprises the registration and protection of 22 potato varieties through PPV&FRA, filing of 22 patents, 12 designs and two trademarks. In the last decade, after the establishment of the institute technology management unit (ITMU), the institute has licensed around 16 technologies to more than 75 entrepreneurs & earned revenue of around 22 million INR. More and more entrepreneurship should be encouraged, so that the financial value of IPRs protection may be captured. This study demonstrates the intellectual property management and commercialization status of the institute in the last decade.

KEY WORDS: Intellectual property, commercialization, potato variety, patent, technologies

INTRODUCTION

Agriculture science has been the engine of growth and led to quantum jumps in productivity in the past. The agriculture and allied sector contributes 20.2% share in India Gross Domestic Product (GDP) in 2020-21 (NSO, 2021). Potato came to India nearly 400 years ago and it contributed <1% of the global production till mid 20th Century. In India, the R&D in potato completely changed the scenario in the last 7 decades and potato institute has played an important role to make the country self-reliant in potato production. After the introduction of high yielding potato varieties and development of location-specific crop practices by the institute triggered rapid growth in potato production. India is the second-largest potato producer and presently contributing nearly 12% of global production (51.2%

million tons) (CPRI, 2019). The institute has 5 divisions, six regional stations and 23 All India Coordinated Research Project (Potato) centres in different climatic locations of the country for conducting multi-location testing. Researchers of the institute have contributed immensely to the increased productivity of potato crop by application of conventional breeding and cutting edge biotechnological tools. Beside this, *in vitro* propagation, genomics, proteomics, protoplast fusion, plant diagnostic, high tech seed production, post harvest processing, development of farm machineries and farm practices has strengthened the research output of the institute (CPRI, 2020).

Till date, 66 potato varieties have been developed and released by the institute. All the varieties has been tested for cultivation under diverse agro-climatic conditions of the

¹ICAR-Central Potato Research Institute, Shimla - 171 001, Himachal Pradesh, India

²ICAR-Central Potato Research Institute, Regional Station, Jalandhar - 144003, Punjab, India

*Corresponding author; email: vinaycpri@gmail.com

country, which possesses multiple resistances to different biotic and abiotic stresses and 7 of them are suitable for processing. Prior to establishment of institute technology management unit (ITMU) in 2006, several technologies developed by the institute in last seven decade including seed plot technique, potato varieties etc. were already transferred in public domain to fulfill the national demand pertaining to nutritional and food security (Singh *et al.*, 2018). Growing trends in the creation and filing of IP in recent years has expanded also in agricultural institutions. The awareness of IP management in recent past has also increased among the researchers in national agricultural research system. The R&D pertaining to potato has been an innovative area; much of the IP created remains unprotected. The main cause of poor IP portfolio is lack of awareness among researcher and the perception that IP protection is either not required or that the process to obtain it is unnecessarily complicated. A vibrant intellectual property ecosystem will not only stimulate the economic development in country, but also enhance public welfare by protecting the rights of all creators and innovators in the research organizations. A strong IPR portfolio will play a big role in attracting investment into the country along with boosting local business ecosystem. Indian Council of Agricultural Research (ICAR) has framed the guidelines on IPR in 2006 and recently revised in 2018. These IP guidelines will definitely help to nurture the IP culture in agriculture based organizations. The creators and inventors engaged in this agriculture sector will realize their potential for generating, protecting and utilizing IPRs which would contribute to revenue creation and business development (NIPRP, 2016). This article describes the working framework of ITMU and their role in the IP management and technology transfer/commercialization at institute level.

Role of national policy for IP management

The 21st century belongs to the knowledge era and is driven by the knowledge economy. A strong IPR regime led to fostering creativity, an innovation that thereby promotes entrepreneurship, enhances socio-economic and cultural development in the country. In India, the national intellectual property rights (IPR) policy was developed the first time by the Ministry of Commerce and Industry, Govt. of India in 2016 with the holistic slogan "Creative India; Innovative India". Public sector R&D working in the country has also developed and revised their IPR guidelines as per the national IPR policy. The ICAR has revised their guidelines in 2018 as per the national IPR policy 2016 (ICAR, 2018 & NIPRP, 2016). Effective implementation of IPRs legislation and related policies led to enhance the significant outputs from R&D in the national agricultural research system.

Structure of IP management & technology commercialization in ICAR

Commercialization strategies involve profiting from IPRs through external exploitation which represents a fundamental avenue for creating IP value for organization. The ICAR has created the channel for management of IPR portfolio and technology transfer/commercialization for its institutions as per the prevailing national IPR and other related laws and policies. ICAR has constituted the intellectual property & technology management unit (IP&TM) at headquarter level to act as the central facilitating decision making body to coordinate and monitor the IP portfolio of its institutes as per the ICAR guidelines for IPM and technology transfer/commercialization, 2018. This unit allocates the budget to each ITMU for IP protection, maintenance and commercialization of developed technologies. The main responsibility of this unit is to

monitor the IP matters and provide necessary advice and support to their institutes. The ICAR has constituted central technology management committee (CTMC) and its secretariat situated at ICAR headquarters and Director General of the council designated as chairman of the committee. At the zone level, zonal technology management committee (ZTMC) has been constituted to take decision for the IP and technology management of the concerned ICAR institutions. The respective director of the zonal institute designated as chairman of the ZTMC. The main role of ZTMC is to advise the institutions which are under their jurisdiction for the matter related to IP, technology management and commercialization (Table 1). The institute technology management committee (ITMC), constituted at institute level and chaired by the director of the respective institute and working as the decision making body for IP related issues or concern at institute level. ITMU act as the secretariat for the respective ITMCs and execute the day to day matters concerned to IP management of the institute (ICAR, 2018).

Components of technology managements & commercialization

Role of institute technology management unit

The main objective for establishment of ITMU in each ICAR institutes is to

create an effective IP environment in order to strengthen the IP portfolio at institute level. This unit also assists in streamlining the institute knowledge and technological products through commercial, cooperative and open public routes. This unit of the institute is playing an important role as facilitator and advises in several techno-regulatory and policy matters related to intellectual property and technology management. The ITMU of the institute acts as catalyst to transform the original innovative research ideas into commercial ventures in real sense. This unit also facilitates the researchers of the institute for effective management of IPRs by availing the services of IP attorneys for drafting, filing, prosecution & maintenance of patents, trademark, design and other IPRs (Fig. 1). This unit ensures effective coordination at all the stages to ensure meeting the stringent time-lines of the procedural activities which are crucial for ensuring successful grant and maintenance of patents and other forms of IPR. The ITMU has played an important role to motivate, promote and facilitates about registration of potato varieties under 'The Protection of Plant Variety and Farmers Right Act, 2001'. This unit also assists the researcher of the institute for drafting, filing and prosecution of potato variety application and their protection in plant variety and farmer rights authority, New Delhi (PPV&FRA, 2001).

Table 1. Structure of intellectual property management and technology commercialization in ICAR-CPRI, Shimla

Secretariat of committees		Types of IP management committees in ICAR		Chairman of committees
Agro-Technology Management Center (ATMC)	←	Central Technology Management Committee (CTMC)	→	Director General, ICAR
↓		↓		↓
Zonal Technology Management Unit (ZTMU)	←	Zonal Technology Management Committee (ZTMC)	→	Director General, ICAR-IIVR, Varanasi
↓		↓		↓
Institute Technology Management Unit (ITMU)	←	Institute Technology Management Committee (ITMC)	→	Director, ICAR-CPRI, Shimla

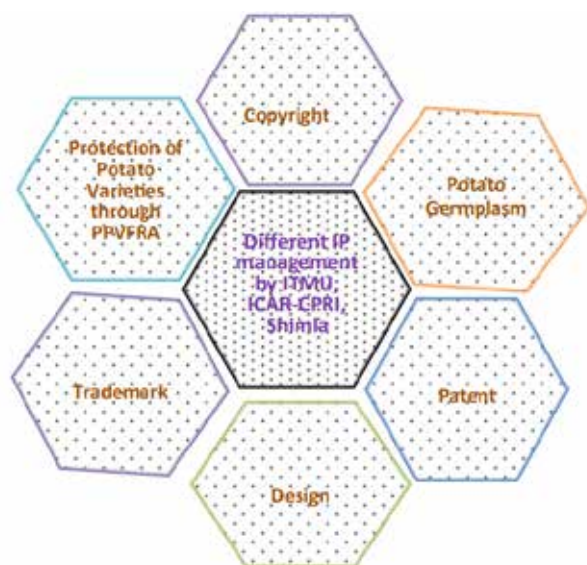


Fig. 1 ITMU deals with the different forms of Intellectual Property Rights

Process of IP management in ITMU:

Intellectual property refers to creation of the mind such as inventions, literary and artistic works, designs, symbols, names and images used in commerce. IPR comprises patent, design, trademark, copyright, geographic indications, trade secrets, integrated circuits, layout design and plant variety protection (WIPO, Geneva). The majority of applications executed by institute ITMU comprise patents, designs, plant varieties protection and trademarks (Fig.1). Patent is an exclusive right granted by patent office after the disclosure of the details of an invention. Patent is also called a techno-legal document granted after fulfilling the important criteria's viz. novelty, non-

obviousness and industrial utility. There are certain non-patentable restrictions under section [3(h) & 3 (j)] of the Patent Act, 1970 related to grant of agricultural & horticulture inventions (The Patent Act, 1970). In India, the patent is granted for 20 years from the date of filing the application in patent office. After the grant of patent, the applicant needs to renew it up to 20 years by paying the prescribed annuities otherwise the patent will supposed to be revoked.

The IP protection and maintenance procedure generally handled & monitored by ITMU of the institute. After creation of authentic research data and to fulfill the above mentioned 3 important criteria's, the inventor needs to submit the information's in prescribed invention disclosure form (IDF) along with prior art search report to the ITMU. On the basis of shared information's by inventor, ITMU conduct the ITMC meeting for review and approval. After approval, ITMU proceed the case by availing the services of IP attorney for drafting and filing the application in patent or IP office which depends upon the type of intellectual property. Beside this, if the inventor utilizes the bioresources of Indian origins in his/her invention are required to seek approval from the National Biodiversity Authority, Chennai (Fig.2).

Methodology involved in commercialization of institute technologies

The inventor of the technology need to share the details with ITMU in the prescribed

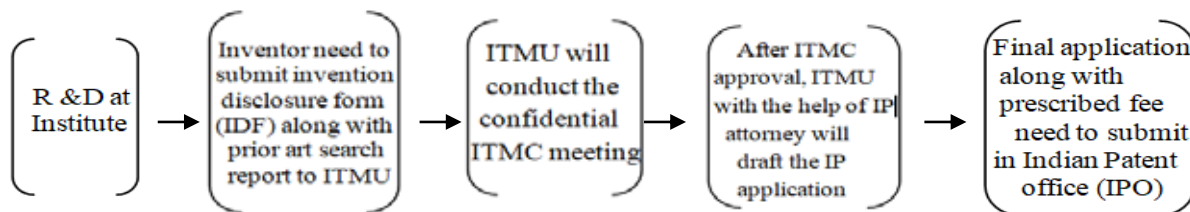


Fig. 2 Flow chart of IP management at institute level

disclosure form along with the costing sheet of technology which comprises the details of budget and manpower involved for generation of respective technology. The ITMU of the institute need to submit the filled technology disclosure form (TDF) and costing sheet in Agrinnovate (AgIn) India Ltd. The AgIn team will fix the technology-commercial assessment committee meeting for assessment & valuation of technology. The commercial assessment committee which comprises director of the concerned institute, inventor of the technology, member secretary of ITMU, commercialization expert, chief executive officer of AgIn and other concerned expert nominated by AgIn. After in-depth deliberation and discussion, the committee will approve the standard terms for licensing the technology and the same are supposed to upload in the web portal of AgIn. After that advertisement, business development and due diligence for clients will be performed by Agrinnovate. The interested party needs to place the online indent for the technology and experts from AgIn signed the tripartite terms of trade (ToT) document. Finally AgIn will draft and sign the tripartite technology license agreement between licensee, concerned Institute and themselves after the deposit of licensing fee as mentioned in ToT (ICAR, 2018) (Fig. 3).

Present commercialization status of institute technologies:

Till date, institute has filed 22 patents, 12 designs and 2 trademarks applications in respective IP office. Six patents, 9 designs and one trademark has been granted to the institute by IP office. Out of 34 IP, 16 has been commercialized and still open for licensing to the public, private and industry partners from national and overseas. The ITMU of the institute has licensed the technologies to more than 75 partners and earned around

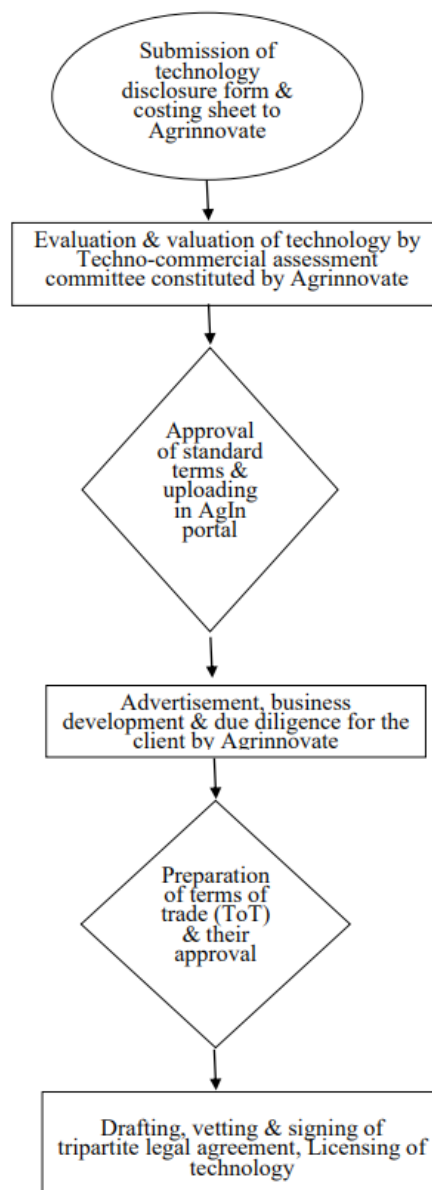


Fig. 3 Standard operating framework for commercialization of ICAR-CPRI technologies

22 million INR revenue to the institute. All the technologies licensed by signing the non-exclusive agreement for 5 years with the provision of royalty and further renewal for same duration. More than 20 non-IP technologies developed in past by the institute has been transferred and available in public domain (Singh *et al.*, 2020; Singh *et al.*,2021) (Table 2).

Table 2. List of technologies developed, IP protection and transfer/commercialization by ICAR-CPRI

S. No.	IP protected technologies of CPRI	Technologies of CPRI available in public domain
1.	Automated hydroponic system for potato microtuber production <i>in vitro</i>	Seed Plot technique
2.	Boifertilizer-cum-biofungicide/ biobactericide composition B5	Evaporatively cooled potato Store
3.	DNA insert plug loading system for pulse field Gel Electrophoresis	Seed treatment with boric acid against seed borne diseases
4.	Aeroponics for potato-seed production & fabrication	An improved heap storage technology
5.	Genetically modified potato with reduced level of reducing sugars and improved cold chipping attribute	Storage of processing potatoes at 10-12°C
6.	Potato custard powder	Computer aided advisory system for potato crop scheduling
7.	Dipstick assay kit for detection of potato viruses at farmers fields	Potato pest manager, Regional level potato acreage and production estimation
8.	Plant holding and lifting system	Seedling transplant crop from TPS
9.	Plant holding unit & Grow box	Seedling tuber production from TPS
11.	Dehydration of tubers	Potato growing season descriptor
12.	Dipstick for estimation of glucose in potato tubers and methods thereof	Late blight forecasting system
13.	Design & development of a tractor drawn cutter bar type of potato haulm cutter	Hi-Tech seed production through micropropagation
14.	Processing of potatoes into chips, French fries and other products	Seed soaking for Phosphorus economy in potato
15.	Modular structure for covering an area	Fertilizer drill cum line marker-tractor drawn
16.	Process for potato daliya, Semolina and Flour	Design development and testing of manually drawn four-in-one implement for potato cultivation
17.	Potato based gluten free cookies	Automatic potato planter-tractor drawn
18.	<i>in vitro</i> plant acclimatization	Passive blade potato digger-tractor drawn
19.	Kufri FryoM	Modified sprayer tractor operated
20.	VEGFAST	Oscillating type potato digger-tractor mounted
21.	Counting Machine	Rubber roller potato grader power operated
22.	Devices for hydroponic culture of plants	
23.	Combine harvester	

Status of CPRI technologies in Agrinnovate India Ltd.:

The AgIn will operate with functional autonomy and flexibility to facilitate the IP management and technology transfer/commercialization pursuits of ICAR. It will efficiently liaise with ICAR technology users in private, cooperative, non-governmental and public sectors. The AgIn will execute technology disclosure shared by respective institute and its processing for commercialization, valuation, pricing,

licensing, patent/IP watch, market watch, preventive and legal action to safeguard/defend the IP. It will also facilitate in licensing of proprietary research tools and explore licensing of ICAR's IP abroad. Presently, 7 technologies pertaining to ICAR-CPRI are now available in the web portal of AgIn. All the above mentioned potato technologies developed in this institute viz. Kufri FryoM, Aeroponic technology, Dehydration of tubers, Modular structure for covering an area with a net, *in vitro* plant acclimatization,

Device for hydroponic culture of plants, Advanced potato processing hybrids are open for licensing to entrepreneurs of national and overseas. These technologies have been commercialized to more than 12 entrepreneurs/clients through tripartite licensing agreement on non-exclusive basis and some of them are in the process of licensing. The value and economic reward for the owners of IP rights comes only after their commercialization. It is necessary to interlink the investors and IP creators so that the entrepreneurship can be encouraged to capture the financial value of IPRs.

Protection of institute potato varieties:

The Govt. of India enacted The Protection of Plant Varieties & Farmers Rights (PPV&FRA) Act in 2001 & adopted *Sui generis* system. Indian legislation is not only in conformity with international union for the protection of new varieties of plants (UPOV, 1978), but also have sufficient provisions to protect the interest of public sector breeding institutions and farmers. To implement the provisions of the Department of Agriculture, Cooperation and Farmer Welfare, Ministry of Agriculture and Farmer Welfare, GoI has established the Protection of Plant Varieties and Farmers Right Authority on 11th Nov. 2005 in New Delhi. The constitution of PPV&FRA, a statutory body created by an Act of Parliament by Ministry of Agriculture and Farmers welfare, Govt. of India. The PPV&FRA will provide an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants. It has been considered necessary to recognize and protect the right of the farmers in respect of their contribution made at any time in conserving, improving and making available plant genetic resources for the development of the new plant varieties. Moreover, to accelerate agricultural growth & to stimulate

investment in R&D, it is necessary to protect plants breeders' right for the development of new plant varieties. A variety is eligible for registration under the act if it fulfils the criteria of distinctiveness, uniformity and stability (DUS). The candidate variety must be distinguishable by at least one essential characteristic from all varieties of common knowledge in any country at the time of filing the application. Further candidate variety should have sufficiently uniform in expression of its essential characteristics which would remain unchanged even after repeated propagation. The variety should also have a single and distinct denomination (PPV&FRA, 2001).

PPV&FRA categorizes the varieties i.e. new, essentially derived variety (EDV), extant notified, extant variety of common knowledge (VCK) & farmer's variety. Till date, ITMU has facilitated the inventors of the institute to file 22 applications of potato varieties in PPV&FRA, New Delhi. Out of 22 applications, 20 have been granted and 2 are under examination and in the process of DUS testing. Two varieties of potato have been registered as new variety, 18 registered as extant notified variety and 2 are as extant VCK variety (Table 3). The actual journey of potato varietal development by institute started in year 1958 with the release of Kufri Kisan, K. Kuber, K. Kumar, K. Kundan, K. Red and K. Safed in India (Bhardwaj *et al.*, 2017; Singh *et al.*, 2018). The numbers pertaining to varieties development have significantly improved over the years. After the establishment of potato institute, it has developed 68 varieties of potatoes for the different agro-climatic conditions of the country.

Agri-business incubation (ABI):

Agri-business incubation program is an initiative of ICAR under its national agriculture innovation fund (NAIF) and one ABI unit has been allotted to CPRI. The ABI is a place where

Table 3. Status of potato varieties protection of ICAR-CPRI in PPV& FRA

Type of variety	Name of variety	Year of filing	Date of certificate issue	Duration of protection	Fees of variety protection for individual entity
New variety	Kufri Garima	2013	22.10.2016	21.10.2031	7,000/each
	K. Gaurav	2013	22.10.2016	21.10.2031	
Essentially derived variety (EDV)	--	--	--	--	--
Extant notified variety	K. Shailja	2011			2,000/each
	K. Sadabahar	2011	21.05.2014	17.07.2023	
	K. Himsona	2011	27.05.2014	25.12.2023	
	K. Pukhraj	2011			
	K. Khyati	2011	27.05.2014	25.12.2023	
	K. Pushkar	2011	27.05.2014	24.04.2021	
	K. Kanchan	2011	27.05.2014	14.11.2016	
	K. Giriraj	2011	27.05.2014	25.10.2014	
	K.Surya	2011	27.05.2014	24.04.2021	
	K. Arun	2011			
	K. Anand	2011	27.05.2014	25.10.2014	
	K. Himalini	2011	27.05.2014	24.04.2021	
	K. Girdhari	2011	27.05.2014	17.07.2023	
	K. Chipsona-3	2011	27.05.2014	24.04.2021	
	K. Chipsona-2	2011			
	K. Chipsona-1	2011	17.01.2020	11.08.2025	
	K. Mohan	2019	17.01.2020	05.12.2031	
	K. Frysona	2019	17.01.2020	11.08.2025	
	Extant VCK variety	K. Elaar	2019	Awaited	
K. Atal		2019	Awaited	Under examination	
Farmers variety	---	--	--	---	--

the process of starting agri-business venture is catalyzed by supporting the entrepreneurs with agriculture technologies, business consultancy, networking with management experts, venture capital funding, infrastructure and other necessary facilities. The objective of ABI is to disseminate technologies and products by creating venture and providing consultancies so that these technologies can be used for creating more and more viable business. The other mandate of ITMU & ABI unit of the institute is to promote entrepreneurship development in potato sector by transfer of technologies to individuals/

end users/corporate. The ABI unit also assists in imparting consultancy and training for nurturing prospective entrepreneurs and creation of skilled manpower. In past 2 years, ABI unit of ICAR-CPRI established in our Jalandhar station is promoting the VEGFAST technology by imparting training and signed around 38 license agreements with incubatees and entrepreneurs.

Successful commercialization of aeroponic system technology- a case study

In order to ensure disease-free planting material, the institute has standardized the

micro-propagation technique for micro-/mini-tubers production. ICAR-CPRI has developed a programmed air mist based potato culturing technique based on aeroponic technology. This technique allows us to grow plants in an air mist environment without the use of soil or any other aggregate medium. This technology has several beneficial features like fast multiplication of high quality initial planting material producing 35-60 minitubers per tissue culture plantlet, easy to operate & can be installed in non-arable and water scarce areas. The minitubers produced by this technique will be free from many soil borne pathogens of potato. The aeroponic system technology has revolutionized potato seed industry in the country and the technology has already been commercialized to 19 private and public partners. Installation of more and more units of aeroponic would expedite multiplication of seeds of potato to meet the rapidly growing demand. This technology is IP protected by institute and presently available for licensing to all private and public partners through Agrinnovate India Ltd. (Bhardwaj *et al.*, 2017) (Fig.4).

CONCLUSION

The role of IPRs is also significant in the protection of the outcome of research. There is need to enhance the awareness campaign among researchers about IP protection & filing which ultimately led to successful transfer/commercialization of novel technologies. A nation-wide program of promotion should be launched with an aim to improve the awareness about the benefits of IPRs and their value to the rights-holders and innovators. Such programs will build an atmosphere where creativity and innovation are encouraged in national agriculture research system. This will ultimately led to strengthen the culture of IP generation, protection and convert into technology



Fig. 4 Aeroponic system for potato mini tuber production; a) plant shoots and b) plant roots under aeroponic conditions.

transfer & commercialization. IP management in agriculture requires broad portfolio management and need to link IPR protection with incubation, licensing, up-scaling and commercialization. IPR are not just up to the grant of the patent alone but subsequent maintenance, prosecution enforcement and commercialization of these rights are equally important. If the post filing and grant efforts when monitored properly and it will help to harvest more benefits from IP. Measures to check counterfeiting and piracy also need to be identified and undertaken. There is need to overcome the technology transfer gap among lab to stakeholders or entrepreneurs for the adoption of new latest technologies developed by the potato institute. Activities related to IP management and their successful transfer and commercialization will definitely

needs to strengthen and this will finally boost the R&D activities for sustainable growth of Indian potato industry.

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