Seed Times

nsa National Seed Association of India

The National Seed Association of India Magazine

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Domestic & International Seed Trade

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About NSAI

National Seed Association of India (NSAI) is the apex organization representing the Indian seed industry. The vision of NSAI is to create a dynamic, innovative and internationally competitive, research based industry producing high performance, high quality seeds and planting materials which benefit farmers and significantly contribute to the sustainable growth of Indian Agriculture.

The mission of NSAI is to encourage investment in state of the art R&D to bring to the Indian farmer superior genetics and technologies, which are high performing and adapted to a wide range of agro-climatic zones. It actively contributes to the seed industry policy development, with the concerned governments, to ensure that policies and regulations create an enabling environment, including public acceptance, so that the industry is globally competitive.

NSAI promotes harmonization and adoption of best commercial practices in production, processing, quality control and distribution of seeds.

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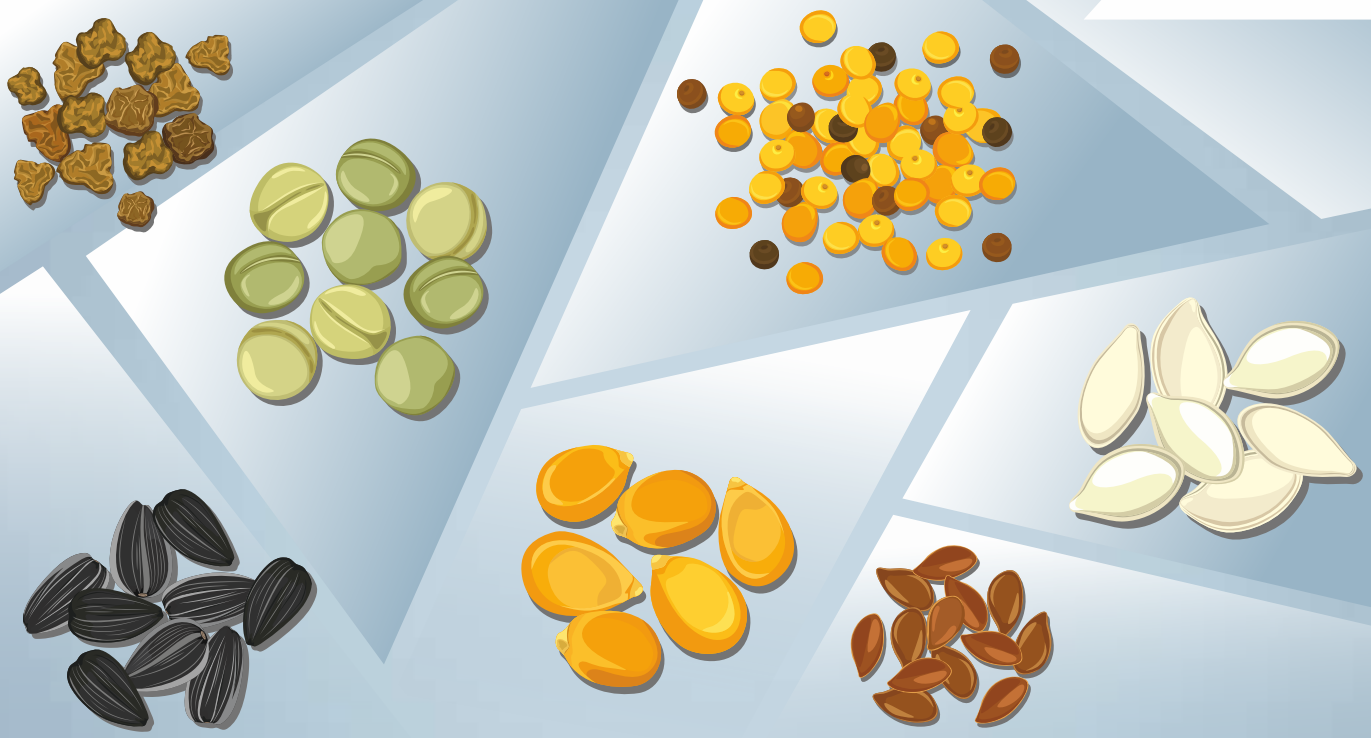

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Message from Desk of President

Dear Readers

We all know that Seed is one of the most critical inputs responsible for boosting agricultural production and productivity. Good quality seeds not only provide food security for the rising population but also ensure nutritional security. In order to encourage farmers for using quality seeds, we would require to provide adequate quantity of seeds, meeting quality standards and suited to different agro-ecological situations, with a reasonable price.

National Seed Association of India (NSAI) is the apex body representing the seed industry of the world's fifth largest seed economy. Our mission is to create a dynamic, innovative, internationally competitive, research based industry producing high performance, high quality seeds and planting materials which benefit farmers and significantly contribute to the sustainable growth of Indian Agriculture. NSAI is also engaged with the seed industry and other stakeholders towards promoting the Seed Export Potential of the country while meeting the food demand of ever expanding population.

The Indian Seed Industry plays an important role by providing best quality seed to the farmers for their growth and fulfills their demand. India has a well developed seed industry, varied agro-climatic conditions, seed production expertise and seed quality management systems. The Indian Seed Industry focuses on the demands of the consumer, innovative R&D initiatives, quick digitization, greater internal and external collaboration for the domestic and international seed trade. Additionally, the nation's seed industry is expanding due to the commercialization of agriculture and the strong cooperation between the public and private sectors.

I am happy to see that this edition of "Seed Times" brought out on the theme **"Domestic and International Seed Trade"** covers the relevant topics like harmonization of phytosanitary requirements and PRA among the countries, standardization of seed quality standards for International seed trade, plant variety protection (PVP) for global seed trade, policies support related to export and import of seeds and exchange of germplasm and planting materials between public and private sector seed companies.

I am sure, the readers would be benefited by the articles from seed experts and industry professionals on these emerging issues.

M Prabhakar Rao

Message from Desk of Executive Director

Dear Readers

The Indian seed sector is growing incredibly each year. Numerous private seed companies with a global presence are actively engaged in seed production in India. Indian government has liberalized and promoted the domestic and global seed trade there through its policies. The Indian seed companies are also looking at expanding to emerging seed market. From partnering with local seed companies/NGOs for domestic seed trade to exporting seeds, to investing in overseas R&D and acquiring local companies, several Indian seed companies are leveraging on this supportive policy environment and harnessing the opportunity to capture international seed markets.

The Seed Times, the most reputed magazine of the seed industry, published by NSAI covers scientific/research papers/articles/review articles/information on various aspects related to seed industry. This magazine is widely circulated to all the stakeholders of seed industry viz., ICAR, SAUs, Central Govt. Agriculture Departments, State Agriculture Departments, National Seeds Corporation, State Seeds Corporations, Private Seed Companies etc.

Now we are bringing out the current issue of Seed Times, January- April, 2023 on the theme **"Domestic and International Seed Trade"** to put before you a bunch of relevant papers for eminent experts and practicing seed industry professionals.

I appreciate NSAI team for focusing on seed trade in this edition of Seed Times which is need of the hour for growth of seed industry of the country. This issue of the Seed Time will provide an excellent opportunity to the readers to broaden their knowledge on Domestic and International Seed Trade.

I hope the readers would find the articles in the magazine of interest to them.

Happy Reading!

R K Trivedi

International Seed Trade: Challenges and Opportunities

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ABSTRACT

The continuation of life is dependent on seed, which serves as a bridge of hope between the present and the future. India has a thriving seed market. The seed business has developed through time in tandem with Indian agriculture. Indian farmers have advanced significantly from the custom of preserving seeds from the previous crop. India's domestic seed market is the sixth-largest in the world, with a value of around 1300 million dollars. However, India only represents about 38 million dollars of the total global trade in seeds (including import and export). Since only cash crops are first prioritized, the challenge for seed exporters is to persuade customs officers of the significance of seed exports. To ensure food security, it is crucial to improve global communication and cooperation as well as allow unfettered international seed trade under close bilateral and multilateral coordination. However, India has agreed to participate in the OECD Seed Schemes for the chosen categories of crops, such as crucifers and other oil or fibre species, Grasses and legumes, and, in order to increase seed exports, vegetables, corn, sorghum, and cereals. If India expands the production of seeds beyond the current rice, maize, and other vegetable crops, the seed export from India could rise and influences the economy in terms of income and employment generation and earning foreign exchange in international market.

Keywords: *Food security, Foreign exchange, Global Trade, OECD, and Seed*

INTRODUCTION

Seed is the fundamental and most critical input for sustainable agriculture. The countless revolutions and changes that have occurred in our nation were all brought about by seeds. In addition, seeds from high yielding wheat varieties that produced good yields served as the foundation for the renowned "Green Revolution" that elevated India's agricultural industry. Positive outcomes were always the result of good seeds. India has achieved considerable expertise in seed production. The seed market in India is approximately US$ 5.5 Billion in 2021 and expanding (Anonymous, 2021). Further, it is reported that total seed consumption by Indian farmers has shown a positive growth rate of 8.52 per cent in the period from 2000-01 to 2017-18 (Pathania et al., 2020).Through years of training and capacity building for farmers in these communities who grow seeds; it has built seed production villages. Gujarat, Tamil Nadu, Andhra Pradesh, Telangana, Karnataka, Maharashtra, and Tamil Nadu produce the majority of hybrid seeds (Anonymous, 2022). Farmers make more money from producing seeds than they do from growing normal commercial crops. According to Chauhan *et al.,* (2013), quality seeds alone can contribute between 15% and 20% of the overall production, depending on the crop, and they can increase that contribution to as much as 45% with effective management of other inputs. The fact that there is more quality seed available has a significant impact on the production of food grains. India has a well developed seed industry, varied agro-climatic conditions, seed production expertise, seed quality management systems and the necessary infrastructure to exploit this opportunity, similar to other countries like Chile, Argentina and South Africa. However, we export less than one billion rupees worth of

seeds every year, whereas, global seed trade is USD 14 billion each year. Therefore, by the year 2028, India most certainly has a chance to take 10 per cent of the market, or $1.4 billion or 10,000 crore (Kaundinya, 2020). Hence, to enhance the seed trade it is also important to understand the challenges and opportunities for International seed trade faced by the Indian seed sector.

CHALLENGES FOR GLOBAL SEED TRADE

India has sixth largest size of domestic seed market in the world, estimated to be at about 1300 million dollars. However, India's share in global trade in seeds (import & export) is of about 38 million dollars only (Fig 01) and ranked 18th in terms of export and 15th for import of seed, respectively in the calendar year of 2020 as shown in Table 01 (International Seed Federation, 2023). It is noted that the international seed trade had grown by a factor often in the past two decades. Though governments in many countries had declared farm inputs, including seeds, as essential items and thus exempt from broader restrictions, there are major challenges faced for international seed trade:

- Challenge seed exporters are facing is to convince customs officials the importance of seed exports, as initially only cash crops are prioritized.
- Seed trade and export regulation was much debated during the World Seed Congress 2017 in Budapest with deliberations focusing on ways to ease seed trading and exports. The legislation' failure to keep up with professional problems and advancements that the industry must manage is the other problem. African governments that require inspections for hypothetical seed illnesses or regulations that are outdated in terms of their requirements for quality control are two examples of this. For seed enterprises coping with logically absurd obligations from the workplace, assistance is available in Europe. On the other hand, Israel still adheres to several obsolete regulations that may have a negative impact on the future of the sector.
- Low SRR (seed replacement rate), which is another issue with seeds, has a considerable negative impact on crop yield, particularly in the case of pulses, where SRR in India is as low as 3-4 per cent compared to the ideal SRR of 12-15 per cent.
- Varietal Replacement Rate is yet another significant issue with the seed supply chain (VRR). Despite the fact that there are more than 4500 variants that have been notified and made available, only a few kinds are used for basic seed and subsequent multiplication. Due to inadequate extension initiatives, many improved varieties that are site-specific and resistant to biotic and abiotic stressors may not have been developed. Therefore, improving VRR needs to receive special attention because it undoubtedly opens the door for higher productivity levels that manifest as greater production.
- The quality of seeds at the sale locations cannot be effectively controlled by any monitoring system. The dealers even sell those seeds whose samples have failed in the laboratory tests by SSCs. Once the product has been sold, the seed-producing and marketing organizations have no further control over the product's creation. This is mostly due to the fact that it is neither practical nor cost-effective to

control the sale of seeds.

- Seed testing and product release process in importing countries is usually long, restrictive, unclear or unpredictive.
- Uncertainty in India's export regulations for agricultural commodities unintentionally has an impact on seed exports. Global trade is also faced with significant obstacles from the BDA's ban on the export of pre-release seed material for testing reasons and from the absence of uniformity in SPS laws.

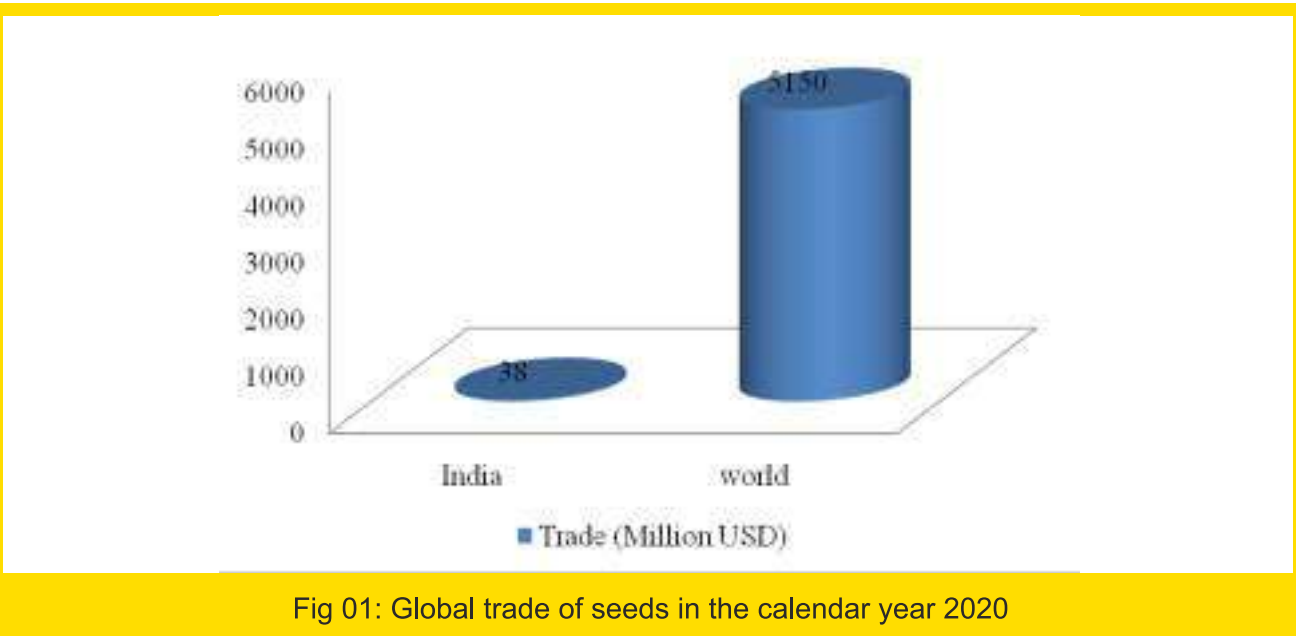

Fig 01: Global trade of seeds in the calendar year 2020

Table 01: Top ten countries of world in seeds export and import in the calendar year 2020

Rank	Country	Export Value (Million USD)	Rank	Country	Import Value (Million USD)
I	Netherlands	3193	I	France	1,156
II	France	2293	II	Germany	1,031
III	Germany	1103	III	Italy	785
IV	Denmark	829	IV	Belgium	567
V	Italy	514	V	China	485
VI	Hungary	513	VI	Mexico	474
VII	Austria	461	VII	Canada	353
VIII	Poland	341	VIII	Austria	322
IX	Spain	311	IX	Japan	301
X	Canada	309	X	Hungary	281
XVIII	**India**	**181**	**XV**	**India**	**143**

Source: International Seed Federation, 2023; Calendar Year 2020

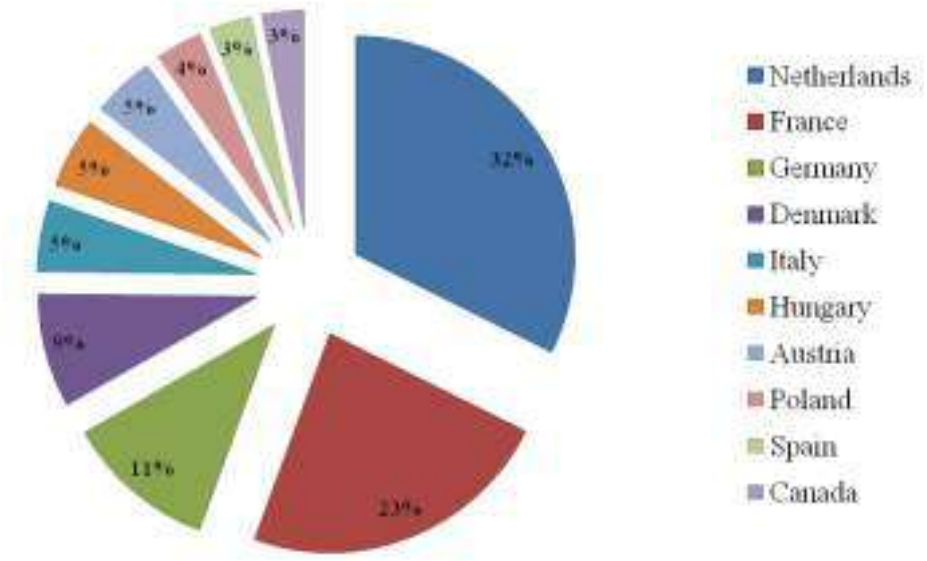

Fig 02: Top ten exporters of seeds in the calendar year 2020

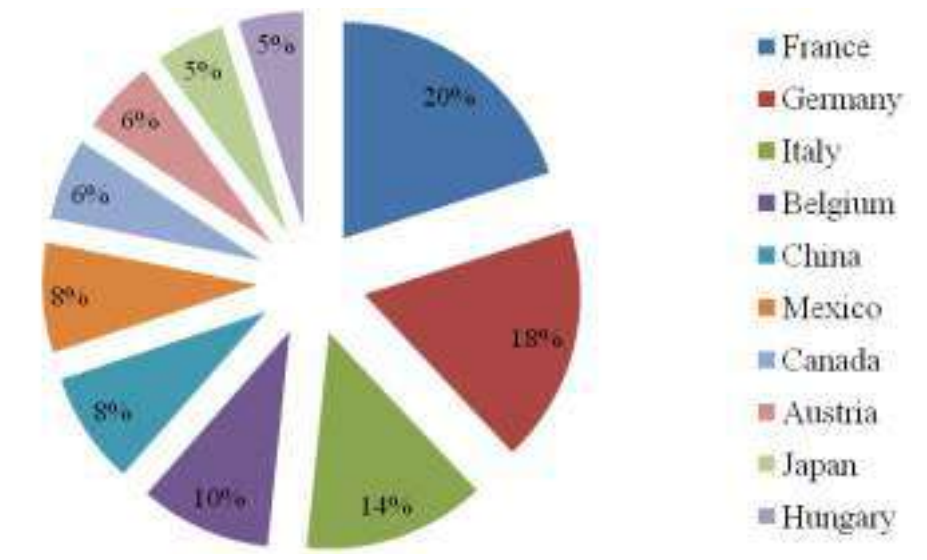

Fig 03: Top ten importers of seeds in the calendar year 2020

KEY OPPORTUNITIES

India will lead the world population past the 9 billion mark by 2050, meaning that each farmer will have to produce more food with dwindling land and water resources. Seed research is the key to releasing the potential of technologies at the cusp of climate change. There are ample key opportunities to enhance

the trade in seed sector given below:

- In the Indian context, farm-saved seed has traditionally provided the majority of farmers' seed needs; according to Vision 2050, Directorate of Seed Research, 65 per cent of farmers still use their own saved seed or seed that has been distributed to them. Instead than production itself, the bigger problem is making excellent seed available at the correct moment. Seed replenishment should be given top priority because seed is the main factor influencing productivity.
- India's share in global trade in seeds (import & export) is of about 0.74 per cent (ISF, 2023). Therefore, to give a boost to seed export, India has decided to participate in OECD Seed Schemes for the selected categories of crops i.e. Grasses and legumes, Crucifers and other oil or fibre species, Cereals, Maize and sorghum and Vegetables.
- Seed industry has positive influence in the economy in terms of income and employment generation and earning foreign exchange in international market (Nagesh, 2018). To ensure food security, it is crucial to improve global communication and cooperation as well as allow unfettered international seed trade under close bilateral and multilateral coordination.
- If India expands the production of seeds beyond the current rice, maize, and other vegetable crops, the seed export from India could rise. There are three different types of seed exports that are feasible, and each one requires a different kind of policy backing:
    - ✓ **Custom Production:** An organization based outside of India that provides parent seed for production in India and places production orders with an Indian seed company. The production is returned to them by the Indian firm. This will be conceivable if varieties for custom production are exempted from registration, which will be required under the new Seed Act as they are only intended for export. Some nations, including South Africa, produce GM seeds to order. India should also have a separate category of GEAC clearance with minimal data requirements for such GM seeds. India needs to offer IP protection for parent seed that is imported for use in custom manufacture in order to promote it. Without providing the company placing the purchase with this assurance, the custom seed production will not take place.
    - ✓ **Export-oriented production:** These are cultivars created in India by domestic businesses exclusively for export. These kinds can be sold in different tropical markets across the world. Such a seed transfer from India will need to be approved by the National Biodiversity Authority, and this authorization needs to be secured promptly and without hiccups. Additionally, export papers and procedures should move quickly and without incident. A significant possibility exists to create outside markets for the export of Indian-developed vegetable seeds.
    - ✓ **For both markets:** These are cultivars created in India or elsewhere for both domestic and international trade. They fall into the standard group of cultivars that the new Seed Act requires to be registered. The NBA's time-limited clearance process for the export of Indian seed types is the only help required in this situation.

- For improved seed quality assurance and simple access to the global seed trade, several seed testing procedures now used in India need to be enhanced in accordance with international standards of seed testing such as ISTA, AOSA, and OECD. The use of biochemical and molecular markers, such as protein electrophoresis, isoenzyme analysis, and DNA fingerprinting using first- and second-generation markers, may be used in addition to conventional genetic purity testing to determine the distinctiveness of varieties.
- With representatives from the national and provincial governments, business, seed technologists, and other groups, a National Seed Export Promotion Council may be established to work toward making India a hub for seed exports and accelerating the process of reaching an export revenue target of $10,000 billion by 2028 or earlier.
- Financial incentives and funding support can be provided for seed exporters which will help country in competing with Chile, Argentina, South Africa and other major exporters.
- The Ministry of Agriculture can establish a specific unit that handles export promotion, efficient import and export permission disposal, and pest risk analysis.

CONCLUSION:

A key component of agriculture, seed is traded both domestically and internationally. The exchange of improved seeds among nations is crucial for the expansion and improvement of agriculture as well as for meeting the demands of a growing world population for food, fibre, fuel, and other necessities. Due to various political, trade, and seed-related restrictions, the export seed sector is not completely utilized. These issues need to be resolved in order to fully realize the enormous potential of the global seed trade. India has a highly developed seed industry, a range of agro-climatic conditions, knowledge of seed production, systems for managing seed quality, and the requisite infrastructure to take advantage of these opportunities.

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Protection of Plant Varieties (PVP) for Seed Trade

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Dr. T. K. Nagarathna *currently working as a Professor and Scientific Officer to Vice Chancellor at University of Agricultural Sciences, Bangalore, served as a Registrar of Protection of Plant Varieties and Farmers Rights Authority (PPVFRA), Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi from 2017 to 2022 dealing with registration of plant varieties on pan India basis. She holds Ph.D in Crop Physiology from UAS, Bangalore and PDF on Crop Modeling & Climate Change from University of Florida, USA.*

During her tenure as a Registrar, she was involved ingranting Intellectual Property Rights to more than 2000 plant varieties developed by breeders and farmers, framing new guidelines in collaboration with agricultural institutions for Distinctiveness, Uniformity & Stability testing criteria for more than 20 new crop species. As a nodal officer at PPV&FRA, played a keen role in organizing international conferences, seminars, joint workshops, webinars etc. under Indo-German Bilateral Cooperation on Seed Sector Development.

In her 25 years of service, she has more than 120 publications in national and international journals, served as a Principal Investigator for externally funded projects and a recipient of several awards.

INTRODUCTION

Post World War-II in 1945, like-minded 44 nations joined hands together to find mutually acceptable solutions to the chaos that was caused by World War-II. So that they bring back trade and economy back on the track. So as a solution, they decided to form World Bank which can take care of financial aspect and funding, ITO (International Trade Organization) which subsequently became WTO to formulate trading guidelines and policy between countries and IMF (International Monitory Fund) which can take care of financial support to developing and least developed countries.

In 1995 WTO was established by replacing GATT. India is one of the founder members of WTO which was established through Marrakesh Agreement. Many documents with legal ground rules for international commerce are in Marrakesh Agreement and TRIPS Agreement is one among them. TRIPS Agreement became binding from 2005 onwards to India to make the domestic legislation compatible with TRIPS. Earlier India did not have any legislation to protect plant varieties and India did not feel the need for it. After India became signatory to TRIPS, and Art 27 (3) (b) of TRIPS required member countries to provide protection of plant varieties. Section 3 (j) of Indian Patent Law excludes plants from patentability. Hence, India opted for sui generis system and took one advanced step by adding Farmers Rights (FRs) in its Act.

PLANT VARIETY PROTECTION IN INDIAN SYSTEM

Seed sustains all forms of life on earth. Intellectual Property Rights (IPRs) over seeds assume great significance in the current era of integration of agriculture with markets and globalisation. In response, India has adopted Plant Variety Protection and Farmers Rights Act, 2001 which is not only the youngest IPR of India, but holds great significance in the context of vast extent of land under agriculture and forestry. It finds greater support and rationale in India from Government of India's Biodiversity Act, 2002. Our country is known for its biodiversity richness, accounting for 7 percent of the global wealth. The Indian law of plant variety protection is unique with no parallel in the world.

After India became signatory to TRIPS in 1994, a legislation was required to be formulated. As per Article 27.3(b) of this Agreement, the member-countries were supposed to provide protection to plant varieties either by way of Patent or by an effective *sui generis* system or by any combination thereof. Since the already existing Indian Patent Act, 1970 did not provide for patenting of agriculture and horticultural methods of production, and in consideration of its socio-economic context, India opted for *sui generis* system by integrating the rights of breeders, farmers and researcher. The Parliament adopted the Act in 2001, and Rules there under were formulated in 2003. Consequently, the PPV&FR Authority was initiated in 2005,and this went full steam in 2006. With notification of just a few crop species in that year, the list has grown impressively by now and includes 180 crop species for registration.

UNIQUE FEATURES OF INDIAN PLANT VARIETY SYSTEM

1. The plant breeder's right is a statutory right meaning that it can be obtained only by registration, and to this extent it is similar to Patents that need mandatory registration. However, it stands apart from other IPs like Trademark and Copyright, which bestow such a right based on use or by publication, requiring no mandatory registration. The breeders and farmers would, therefore, do well to register

their varieties immediately on its development, and before commercialization.

2. Another unique feature of India's Plant Variety Protection law is, that not only does it protect the new varieties but also offers protection to the extant varieties, which implies protection of existing varieties. Nowhere in the world is there a legislation protecting extant varieties. The country's option for a *sui generis* system is a conscious decision taken with a view to protect its rich agro-biodiversity and traditional varieties. It also places the farmer-breeder on par with the scientist-breeder. This approach that bestows rights to the general farmers brings respect to them, in a way that was only reserved for highly qualified scientist-breeders. It thereby co-opts people at the farm level into responsible ownership and management of the country's vast resources. Simultaneously, it may be noted that public domain varieties are not registered, as they constitute the gene pool for development of new varieties.
3. Among several of the important and unique features of our Law, the absence of time restriction on registration of new varieties is a very progressive provision. It enables 'any time' registration, except in case of extant varieties. In relation to the latter, the Authority will not be re-opening the window that is now available for registration for a certain fixed time period. The Authority is barred by the Act itself from exercising such a power. Hence, maximization of registration of extant varieties is in the common interest of our breeders including farmer-breeders, the country and bio-diversity.
4. Unlike other IPRs, where registration dates back to the date of filing of application, in case of plant varieties it takes effect from the date of grant of certificate of registration, which is 15 years in case of field crops and 18 years in case of trees and vines. In case of extant varieties notified under Section 5 of Seeds Act, 1966, it takes effect from the date of notification under the said Act. The Act also facilitates provisional protection of the interest of breeders from the date of filing of application upto the date of grant of certificate of registration.
5. During the process of registration, the field testing for distinctiveness, uniformity and stability (DUS) is mandatory for registration of both new and extant varieties, except in case of extant varieties notified under Section 5 of Seeds Act, 1966. This is done to record the DUS characters from standing crops. In case of trees and vines, it provides for on-site DUS testing. On account of the gestation period for registration of plant varieties being longer than that of other IPRs, the crops stand at a relative disadvantage. Further, unlike other IP laws a live biological specimen is handled which is sown in land and DUS characters of standing field crops are recorded live.It would be good to remember always, that '*while seed is the subject matter of the application, registration is the object of the application'*.

CHALLENGES OF PVP SYSTEM IN INDIA

The Plant Varieties Registry is in its teens, and hence it faces several challenges, which can be converted into opportunities. Some challenges are;

1. The first and foremost challenge is that Indian law of plant variety protection is internationally isolated when compared to other IP forms like Trade Marks, Copyrights and Patents. The major reason for

this is misinterpretation of Indian law and misconstruction and misconception of Indian law by international and Indian community. The registration of extant varieties and misconstruction of farmers rights are the major reason for international community not entering into treaties and conventions with India. This is being clarified to the International Community at various levels. The registration of extant varieties in many economically important crop species will end shortly in the next few years, and thereafter registration of new varieties will continue forever. This should remove the mistrust of international community in our Law.

2. Majority of farmers in India are engaged in sustenance farming, unlike in western countries where large scale and commercial farming is practised. Hence, farmers' rights should be understood and interpreted in the light of socio-economic condition of our farmers and the context of Indian agricultural structure.

FOOD GRAIN PRODUCTION IN INDIA

Green revolution in India led to the increased agricultural production from 82.02mt (1960-61) with the introduction of seeds of high yielding varieties (Nelson et al, 2019) reaching record production in 2020-21 with 315.51 million Tonne (Table 1) with five times increase in the last six decades.

Table 1: Food grain production over the years since independence

Year	Food production (mt)	Year	Food production (Million Tonne)
1950-51	50.8	2009-10	218.11
1960-61	82 .02	2010-11	244.5
1970-71	108.42	2011-12	259.3
1980-81	129.6	2012-13	255.13
1990-91	176.4	2013-14	264.77
2000-01	196.81	2014-15	252.23
2001-02	212.85	2015-16	251.6
2002-03	174.77	2016-17	272
2003-04	213.2	2017-18	285
2004-05	198.36	2018-19	285.2
2005-06	208.6	2019-20	297.5
2006-07	217.28	2020-21	315.51
2007-08	230.78	2021-22	316.06 (advance estimate by DA&FW, GoI)
2008-09	234.47		

**Source: Ministry of Agriculture and Farmers Welfare, Government of India*

During the era of green revolution, public sector played a pivotal role in seed production with the establishment of National Seed Corporation (NSC) in 1963 with a mission of quality control and training in seed production. Later on, in 1969, another national agency, States Farms Co-operation of India Limited (SFCL) was formed to produce breeders', foundation and certified seeds of high yielding varieties. To regulate the seed industry, Government enacted The Seeds Bill in 1966.

Private seed industry slowly emerged in 1960's and 70's in providing quality seeds. Market size of the industry in early 2000's was USD 500 million (Gadwal, 2003) reaching USD 5.5 billion in 2021. And expected to reach US$ 11.3 Billion by 2027 (IMARC report, 2022).

During 1960-61 to 1998-99, the rate of food grain production increased at 2.68 percent per annum and it was 1.6 percent increase during 2021-22 compared to the previous year.

Table 2: All India seed requirement & availability (in lakh quintals)

Year	Requirement	Availability	Surplus
2014-15	343.56	351.77	+8.21
2015-16	337.09	343.52	+6.43
2016-17	353.49	380.29	+26.80
2017-18	371.38	419.41	+48.03
2018-19	353.55	398.87	+45.32
2019-20	387.31	431.01	+43.70
2020-21	443.16	483.66	+40.50
2021-22	465.36	498.83	+33.47

**Source: Ministry of Agriculture and Farmers Welfare, Government of India*

India has consistently maintained surplus food grain production which gave a scope for export of agricultural commodities (Table 2). The share of agriculture and allied exports is around 12% and declined in 218-19 to 11.9% mainly exporting rice, spices, sugar, cotton *etc* (Table 3). As per data on exports of principal commodities (RBI, 2022) it is Rs.1.85 lakh crores in 2016-17 with a jump to Rs.2.52 lakh crores in 2019-20. Import of agri and allied commodities decreased from 5.6% (2015-16) to 3.8% (2018-19) and the reasons for this decrease may be many. However, since India is self-sufficient in agriculture commodities (except vegetable oils), depending on other countries has been drastically declined over the years. Currently, India has become a hub for seed export as it has well organized seed industry.

According to Ministry of Consumer Affairs, Food & Public Distribution, Government of India, has sufficient food grain buffer stocks to meet the demand of growing population and the press release dated 17th December 2022 also mentions about 159 Million Tonnes of Wheat and 104 Million Tonnes of rice will be available as on 1stof January 2023 which is more than the requirement of the nation. An estimated 507 grams of Food grain was available per person for each day in fiscal year 2021 (Statista Research Department, 2023).

Table 3: Export and import of agriculture and allied commodities

Year	% share to total export	% share to total import
2015-16	12.6	5.6
2016-17	12.2	6.4
2017-18	12.9	5.1
2018-19	11.9	3.8

**Source: Annual Report of DA&FW, Government of India, 2019-20*

The increase in food grain production and export of agriculture commodities is due to introduction of several new high yielding varieties and new era of science and technology led to new research findings in India. Hence, there is a need to protect the new varieties legally by providing equal rights to breeders and farmers of the country.

It is still a challenge for PPVFRA to stimulate R&D investment and also to play a major role in seed trade including domestic and international market though India has a diversified seed industry given the number of plant varieties registered in India other than farmers' varieties. It is not only the Authority, but the agriculture institutions and seed industry have to work for a common goal in collaborative efforts to strengthen the R&D in the country to enhance the growth of agriculture sector in India.

The Economic Survey research (2021) shows that every rupee spent on agricultural research and development, yields much better returns. Increasing R&D spending on agriculture is, therefore, not only a vital necessity for ensuring food and nutritional security, but also important from the socio-economic point of view.

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Exchange of Germplasm and Planting Materials between Public and Private Sector Seed Companies

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ABSTRACT

National Bureau of Plant Genetic Resources acts as a single window system for exchange, collection, conservation, characterization and evaluation of plant genetic resources through a network mode. It facilitates the breeders/researchers working under public/private organizations for efficient utilization of germplasm conserved at National Genebank under the terms and conditions of Material Transfer Agreement. Access of germplasm conserved under National Genebank by private companies have strengthened the research and development under the umbrella of private sector. For accessing the germplasm the Indian private seed companies are required to submit an undertaking on stamp paper that they are wholly Indian and do not fall under Section 3 (2) of BDA, 2002. Further, they are required to submit DSIR Recognition Certificate for recognized R & D of the company. However, access of germplasm by private seed companies that fall under Section 3 (2) of BDA, 2002 are required to take permission of the National Biodiversity Authority (NBA) for access to any of genetic resources that occur in India. ICAR-NBPGR has shared more than 2500 accessions of different crops with 22 seed companies that are wholly Indian under the MTA approved by ICAR-DARE since 2017 till 2022. The private sector breeders were given access to germplasm by ICAR- NBPGR through field day selections. However, the need for transparency was always felt on feedback on utilization of the plant genetic resources accessed from NGB at ICAR-NBPGR.

Keywords: *Access, Germplasm, MTA, NBPGR, Private, Sharing*

INTRODUCTION

ICAR- National Bureau of Plant Genetic Resources (NBPGR) has the mandate for exchange, collection, conservation, characterization and evaluation of plant genetic resources (PGR) through a network mode. ICAR- NBPGR encourages the breeders/researchers in the country to make use of germplasm conserved by ICAR-NBPGR and National Active Germplasm Sites (NAGS) conserved in medium term storage (MTS) modules or field gene banks for their effective utilization. Reiterating the fact that exchange of PGR is important for food and nutritional security and for their better utilization, facilitating their exchange is providing best services to the nation. Being signatory to the Convention on Biological Diversity (CBD), Govt. of India enacted the Biological Diversity Act, 2002 (BDA, 2002) and also notified the Biological Diversity Rules, 2004. As per BDA, 2002 all non-Indian entities [classified in Section 3 (2) of the Act] are required to take permission of the National Biodiversity Authority for access to any genetic resources "occurring in India". That term has lot of interpretations and is ambiguous such as 'does occurring in India also mean germplasm introduced earlier by private companies, proprietary material of individuals, or does it mean only "*in-situ*" material occurring in India, developed in India, protected in India by any IPR' etc.

ICAR-NBPGR is continually exchanging germplasm and planting materials with public and private sector seed companies as per the mandated activities. With the enactment of the BDA, 2002, the constitution of

companies is interpreted as per Clause 3(2) and classified mainly in two categories i.e, wholly Indian or multinational companies (merging and demerging everyday), their status changes accordingly as per the Indian law.

As per BDA, 2002 all non-Indian entities [classified in Section 3 (2) of the Act] are required to take permission of the National Biodiversity Authority for access to any genetic resources "occurring in India".

Non-Indian Entity can be defined as

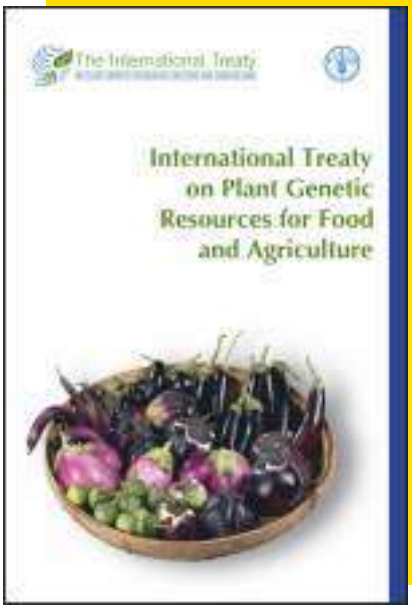
- Not Citizens
- Non-Resident Indians (NRI)
- Companies not registered in India
- Companies with foreign collaborators/share in foreign capital or management

PROCEDURES FOR ACCESSING PLANT GENETIC RESOURCES BY PRIVATE SEED COMPANIES WHICH ARE NON-INDIAN AS PER THE ACT

The sharing of germplasm with non-Indian entities private seed companies (multinational private seed companies) thus is now regulated by the Act. The non-Indian entities with recognized R & D by the Department of Scientific and Industrial Research (DSIR) can access germplasm under defined collaborative programmes/ collaborative agreements/ joint evaluation/utilization projects approved by State Governments/Government of India seeking exemption under the provisions of Section 5 of BDA, 2002. Alternatively, the private seed companies defined as non-Indian as per the BDA, 2002 can access germplasm with the approval of National Biodiversity Authority (NBA) and few examples are there where companies have accessed germplasm under this provision.

Access to PGR for the purpose of research, breeding and training shall be provided under the terms and agreements of proposed Indian Material Transfer Agreement. The intellectual property protection or benefit sharing in respect of derivatives of the material(s) received/accessed, where applicable, shall be as per the Indian IPR/Biological Diversity laws. Development of any commercial product based may be undertaken with the prior consent of ICAR/DARE, Government of India. Modalities of undertaking any such work will be worked out before its conduct, and in case of commercialization of any product a separate Memorandum of Agreement (MoA) shall be entered into with conditions of mutually agreed benefit sharing with the owner/ developer of the material. A provision for payment of minimal charges towards handling and processing fee is also being considered.

Access to plant genetic resources for food and agriculture (PGRFA) under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), 2001 for the crops mentioned in Annex 1 of ITPGRFA shall be provided under the conditions of Standard Material Transfer Agreement (SMTA). Access is however again only for the purpose of research, breeding and training. SMTA instrument is adopted by Governing Body (GB) of the Treaty and is under notification by the Government of India. Salient provisions of the SMTA ensure that the material accessed under treaty shall be freely available to others for use in research, breeding and training provided the third and subsequent parties are bound by the same conditions of the SMTA.



PROCEDURES FOR ACCESSING PLANT GENETIC RESOURCES BY PRIVATE SEED COMPANIES WHICH ARE WHOLLY INDIAN

For private companies that do not fall under Section 3 (2) of BDA, 2002 and are wholly Indian, they need to submit an undertaking on stamp paper that they do not fall under Section 3 (2) of BDA, 2002 and are wholly Indian. Further, they are required to submit DSIR Certificate that R & D of the company is recognized by DSIR. For accessing any germplasm of agri-horticultural crops from PGR stored/maintained by NBPGR/NAGS, the applicant is advised to submit the request in prescribed requisition proforma for supply of seed/ planting material (GEX01) to the Director, NBPGR, Pusa Campus, New Delhi, alongwith duly filled and signed Material Transfer Agreement (MTA).

MATERIAL TRANSFER AGREEMENT (MTA) / STANDARD MATERIAL TRANSFER AGREEMENT (SMTA)

MTA is a document which describes the conditions under which the transfer of material is made for specific use, Addresses various issues such as ownership of the transferred material and its derivatives, Liability, Confidentiality, legally binding. Thus, they are contractual agreements used for transfer or acquisition of material. Transfer of germplasm from one party to another involve Issues of ownership, Access, Use, Equitable sharing of benefits, Intellectual Property Rights thus MTA/MAA defines the rights of the provider and the recipient with respect to transfer of material. SMTA is a contract with standard terms and conditions approved by the Governing body of the Treaty and ensures that the provisions of the Treaty are followed by providers and recipients of PGRFA. Four forms of SMTA are in use namely click wrap, easy, shrink-wrap and hard copy MTA. Under the Multilateral System of the Treaty, the contracting parties agree to take measures in order to achieve commercial benefit-sharing, through the involvement of the private and public sectors in activities, through partnerships and collaboration, including with the private sector in developing countries and countries with economies in transition, in research and technology development.

Material Transfer Agreement for Research Use within Country for Public and Private Entities

PREAMBLE

Being signatory to the Convention on Biological Diversity, 1993[1] (CBD), the Government of India enacted the Biological Diversity Act, 2002 (BDA) hereinafter referred to as BDA, 2002 and notified the Biological Diversity Rules, 2004. The access to biological resources of India is now regulated by BDA, 2002.

Whereas, the National Bureaux of Genetic Resources under the aegis of Indian Council of Agricultural Research2 hereinafter called ICAR have the mandate for collecting, conservation, characterization, evaluation and exchange of genetic resources (GR) in a network mode, the Bureaux encourage the researchers in the country to make use of germplasm for their effective utilization. Reiterating the fact that GR are the essential raw materials for all improvement programmes and hence, extremely important for food and nutritional security, their exchange and utilization need to be prompted in accordance with national laws and regulations and in compliance with international agreements.

Emphasizing the fact that the purpose of supply of GR under this agreement would be solely for research and no deviation from the proposed objectives is permitted. Access shall be provided for the germplasm available with the National Agricultural Research System (NARS), which is duly designated by concerned institute/National Active Germplasm Sites (NAGS). Such exchange shall be done under the conditions of the following Material Transfer Agreement (MTA). The private entities falling under Section 3 (2) of BDA, 2002[2] can access germplasm after signing the MTA, subject to approval of National Biodiversity Authority (NBA)[3]

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SHARING OF GERMPLASM WITH INDIAN PRIVATE SEED COMPANIES

With the MTA approved by ICAR-DARE, ICAR-NBPGR has shared more than 2500 accessions of different crops with 22 Indian private seed companies (Annexure 1). However, it is desired that feedback information on the performance and utilization of the introduced material is supplied regularly. The feedback information help keeping up reciprocal exchange of germplasm with foreign sources. Along with the feedback information it is also desired that multiplied seeds of the introduced material be deposited in National Genebank at NBPGR (2000 to 4000 seeds per accession).

The Act has categorically defined that the germplasm collected from all over India and conserved in the National Genebank is held in trust and must be shared with caution. The private sector breeders were given access to germplasm by ICAR- NBPGR through field day selections or others before the enactment of the law. However, the need for transparency was always felt on utilization and its acknowledgement. For the purpose a series of meetings and brainstorming sessions were organized by ICAR- NBPGR and were discussed with eminent experts in the area including legal experts. The idea of sharing germplasm specially the PGR for research and utilization, although has been welcomed by the private sector but contributions were not received to the satisfactory level may be the sector is hesitant to open up their minds during such deliberations as also there is loss of trust and competition instead of synergy.

CHALLENGES AND OPPORTUNITIES

With BDA 2002 coming into existence germplasm flow from ICAR- NBPGR to private sector almost ceased as Sec 3 (2) regulation required non-Indian entities to take permission from NBA for accessing any germplasm occurring in India. To facilitate the flow, National Advisory Board on Genetic Resources Management (NABMGR) constituted in 2010 included in its agenda to consider and restart the process. The Board deliberated on various issues and considered to revise the existing MTAs to re-start the process of sharing plant genetic resources with the private sector breeders and seed companies that do not fall under Section 3 (2) of BDA, 2002. However, multiplication of germplasm requires continuous resources for maintenance of active collections. Only demands makes it unsustainable process, thus feedback on utilization and supply of multiplied seed material back to National Gene Bank may strengthen the process of sharing. For this constant dialogues are effective means.

CONCLUSIONS

The exchange of plant genetic resources with private seed companies can bring a number of benefits, it can help to ensure the conservation of a wide range of plant genetic diversity, and it can also facilitate the development of new crop varieties that are better adapted to local conditions and resistant to pest and diseases. For better exchange relations we encourage the industry to come forward with focused germplasm evaluation programmes, where both ICAR- NBPGR and the Industry can work together in a transparent and equitable manner that takes into account the interests of all stakeholders for development of better crops and for the benefit of the Indian Farming Community.

Annexure 1

S. No.	Name of the Seed Company	Crops supplied
1	Acsen Hyveg Pvt. Ltd, Gurugram	Cucumber, Chilli, Tomato, Onion, Carrot, Cauliflower
2	Ambrocia Seed Producer Company Ltd., Bhopal	wheat
3	Ananya Seeds Private Limited, Ambala	Brinjal, Tomato, Chilli
4	Arizona Seeds Private Limited,Patiala	Tomato
5	Arjuna Natural Extracts Ltd, Research & Development Laboratory, Alua-Kerala	Amaranth
6	Basant Agro Tech (I) Ltd., Kaulkhed, Akola	Soybean
7	Daftari Agro Bio-tech Pvt. Ltd., Nagpur	Brinjal, Bitter gourd, Brassica carinata

S. No.	Name of the Seed Company	Crops supplied
8	Eagle Seeds & Biotech Ltd, Indore	Wheat
9	Goldking Biogene Private Limited, Sabarkantha	Okra, mungbean
10	Mali Agri Tech Private Limited, Nadia	Brinjal Mustard, Tomato
11	Mansoon Crop Science LLP,Nashik	Chilli Tomato
12	Noble Seeds Private Limited, Delhi	Okra , Ridge gourd
13	Nuziveedu Seeds Limited,New Delhi	Mustard , Wheat
14	Pahuja Seeds Private Limited, Delhi	Cucumber
15	Rasi Seeds Private Limited, Coimbatore & Salem	Mustard, Rice, Wheat, Cotton
16	Seed Works International Pvt. Ltd., Telangana	Mustard, Chilli
17	Shreeoswal Seed and Chemical Ltd., Neemuch (Madhya Pradesh)	Mustard, wheat
18	Somani Kanak Seedz Pvt. Ltd., New Delhi	Bottle gourd, Sponge gourd, Luffa acutangula , Binjal
19	Super Seeds (P) Ltd., Hisar	Maize
20	Tierra Agrotech Private Limited, Hyderabad	Mustard, Rapeseed, Cauliflower
21	UPL Limited, Hyderabad	Cauliflower, Chilli, Tomato , Okra
22	VNR Seeds Private Ltd.,Hyderabad	Brinjal, Tomato, Cucumber , Okra and Bitter gourd

Role of CGIAR in exchanging plant genetic resources between the public and private sector for enhancing the crop diversity

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ABSTRACT

It has become increasingly clear that increased access and utilization of genetic diversity will be crucial for the long-term development of agricultural production systems and their successful response to climatic changes. Crop development programmes depend on the use of plant genetic resources for food and agriculture (PGRFA), and the interconnectedness of these resources among nations mandate. In order to address the issue of food security in terms of access to the plant genetic resources for food and agriculture (PGRFA) as well as for the realization of farmer's rights, the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) was approved in 2001. Therefore, it is crucial to create systems that encourage access between nations. These globalization and privatization tendencies over the past forty years have caused a rapid change in the systems for exchanging genetic material. This article discusses how international and domestic rules, treaties, and agreements impact on the collection, utilization, and distribution of plant genetic resources by the Consultative Group on International Agricultural Research (CGIAR).

Keywords: PGRFA, ITPGRFA, CGIAR, Plant Genetic Resources

1. INTRODUCTION

PGRFAs are strategic needs for crop development using farmer selection, traditional plant breeding and modern biotechnological approaches. The development of novel foodstuffs and uses, as well as agriculture's ability to respond to biotic and environmental changes, are all made possible by crop improvement. The adoption of improved plant varieties by farmers as well as the utilization of plant genetic resources for crop development could be made possible by supportive policies and laws. ITPGRFA emphasizes the commitment of its member nations to set up laws and policies that make it easier to preserve, trade, and sustainably utilize such resources (Pinstrup-Anderson 2011).

The Consortium of International Research Centers of the CGIAR is a global partnership that connects 15 agricultural research centres and collaborate with partner organizations from the university, the commercial sector, civil society, national and regional research institutes. The CGIAR centers now have additional potential to coordinate global initiatives for the preservation, advancement, and availability of plant genetic resources. Due to their unique location at the intersection of national agricultural research organizations (NAROs), international and national research institutes, the private sector, and civil society organizations, including farmer associations, they are uniquely positioned to contribute to crop improvement in light of current and anticipated challenges such as climate change adaptation, steady population growth, and global competition of food crops market. The perception of CGIAR centres with policy, partnerships, germplasm diffusion, and use strategies may be valuable to a wide range of organizations that work with plant genetic resources and seek efficient answers to address these challenges through improved conservation and use of plant genetic resources. With the assistance of the CGIAR Program on Climate Change, Agricultural and Food Security (CCAFS),by examining how the CGIAR centers' collection, utilization, and distribution of plant genetic resources for food and agriculture may be altering in response to changes in policies, the authors hope to close this "gap." This article begins by outlining the workings of the CGIAR gene banks and breeding programmes, drawing particular emphasis to recent adjustments made to the centers' strategy for developing and disseminating technology.

2. CGIAR: FRAMEWORK OF RESEARCH

The CGIAR centres operate in a larger, external institutional context that includes international and national policies and laws (such as those directly relating to agricultural biodiversity, plant genetic resources, seed systems, trade, technology, and intellectual property rights), as well as funding priorities, donor agency capacities, and programming agendas.

We conceptually segregate our analysis in accordance with the patterns of germplasm flow into, within, and out of the CGIAR centres as shown in a schematic form in Figure 1 for practical reasons. For the purposes of our analysis, we make a distinction between the experiences of breeders, breeding programmes and the experiences of gene banks when they acquire, analyse, conserve, and distribute germplasm.

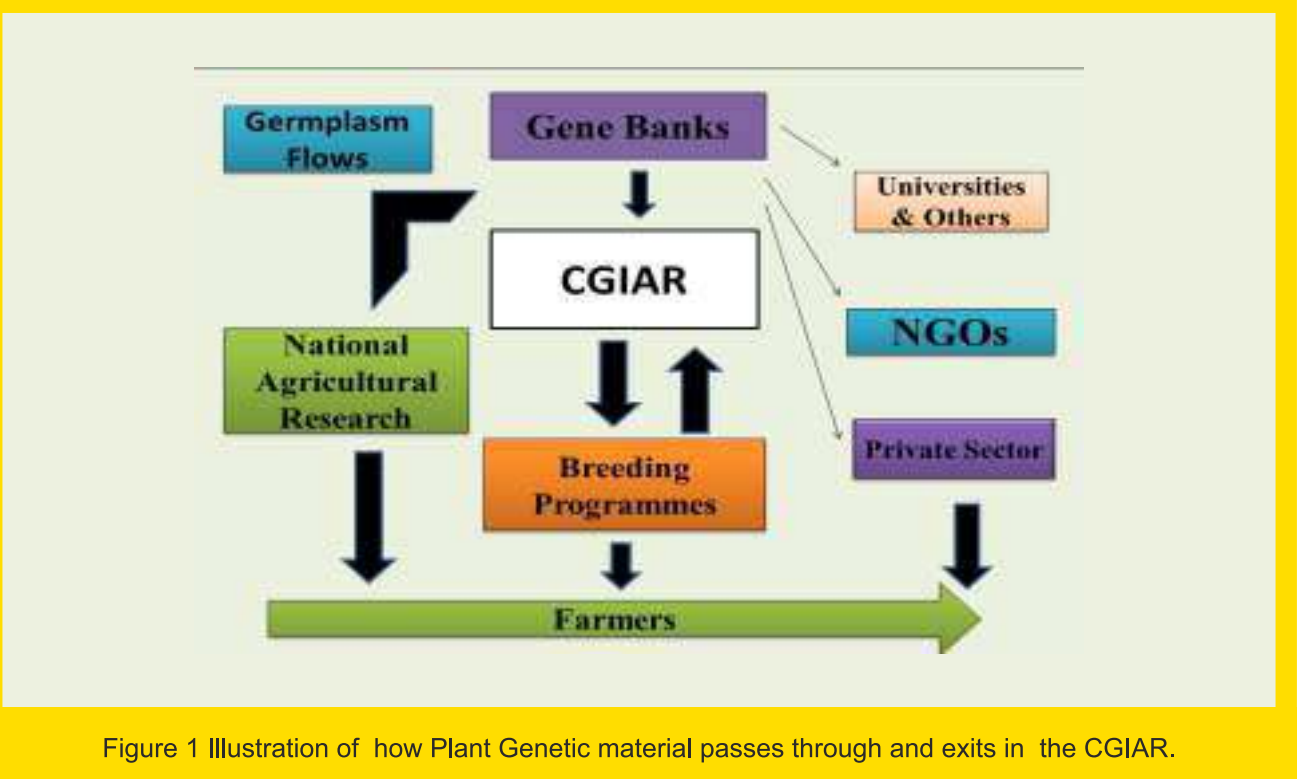

Figure 1 Illustration of how Plant Genetic material passes through and exits in the CGIAR.

3. WHAT ARE THE METHODOLOGY OF CGIAR

The information and data used in this article were compiled from four main sources. In order to provide a framework for the research and to highlight particular themes for further in-depth exploration, the project team first undertook a thorough assessment of both the academic and underground literatures to offer context for the study. The following four key areas were determined to be important: (1) methods and channels for improved germplasm dissemination; (2) determinants of crop technology adoption; (3) effects of intellectual property rights and access the benefit-sharing policies on agricultural research; and (4) partnerships between the CGIAR centres and the private sector (Report CIP, ICARDA, IITA, IRRI).

4. GENE BANKS AT CGIAR

4.1. How the Gene Banks are operated

The majority of the international *ex situ* collections of plant genetic resources that 11 of the CGIAR gene banks are currently conserving were initially utilized as working collections by scientific teams both inside and outside the CGIAR. Over time, and in accordance with generally acknowledged criteria, the centers took on the duty of maintaining the collections on behalf of the global community. They approved to facilitating access to these collections on a global scale for breeding, conservation, and agricultural research and development.

4.1.2. The Status of CGIAR Gene Banks in a Changing International PGRFA Exchange, Conservation, and Use System

Through international legal agreements, the responsibilities and rights of the CGIAR centres with regard to the *ex situ* collections have gradually been established. Twelve international collection centres signed agreements with the Food and Agriculture Organization of the United Nations (FAO) in 1994 committing them to hold designated germplasm in trust for the benefit of the global community and to make samples of the designated germplasm and related information freely available to users or through FAO for the purposes of genetic resource conservation, plant breeding, and scientific research.
In-trust materials may be made available for direct use by farmers, according to the material transfer agreement (MTA) that the centers adopted for distributing in-trust resources. As part of this agreement, the centres agreed to follow the general policy recommendations of the Commission on Genetic Resources for Food and Agriculture (CGRFA) of the FAO with regard to matters pertaining to the management of the in-trust materials.

4.2. CGIAR Breeding Programs

4.2.1. Managing the Breeding Programs

CGIAR breeding initiatives use several operational approaches. The crop, its breeding biology, and its history of improvement, as well as the target location or countries, their phases of agricultural development, and their socioeconomic characteristics, all influence the choices of breeding methodology and partnerships.

4.2.1.2. Integrated Decentralized Breeding with NAROs

If all works as planned, newly released varieties will result from the centres as improved germplasm being blended into regionally targeted variety by national partners. Instead, the centres can also submit highly developed lines to national programmes, which select the most beneficial ones among the offered populations. The International Maize and Wheat Improvement Center (CIMMYT) (maize-breeding

programmes), the International Potato Centre (CIP), the International Centre for Agricultural Research in the Dry Areas (ICARDA), the International Institute of Tropical Agriculture (IITA), the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) may cooperate with public organizations in both Asia and Africa on non-hybrid breeding.

Some CGIAR centers have expertise with extensive forms of participation from their cooperative breeding efforts with NAROs. Participatory Plant Breeding (PPB), Participatory Variety Selection (PVS), and the planning of "open houses" and farmer field days are some of these experiences. PVS involves farmers in the appraisal of materials, often from an early stage, while PPB involves farmers in the decision-making process about breeding priorities and methods (F_2 and F_3 generations).

CIMMYT, ICRISAT, and IRRI are currently working to create hybrid technologies for rice, pigeon peas, sorghum, pearl millet, and maize. Consortia at ICRISAT and IRRI are mostly used to supply improved hybrid lines to private sector businesses, including those in developed nations. The Sorghum, Pearl Millet, and Pigeonpea Hybrid Parents Research Consortia, which were founded in 2000 and 2004 mostly active in India, are the sources of ICRISAT's parental lines. At all stages of growth, public sector organizations can access the parental lines of ICRISAT for free because they belong in the public domain. (Mula, et al. 2007).

4.2.2. Practices for the Development and dissemination of technology

Models generally fall into one of two categories in the field of agricultural technology development, including crop improvement. Models that follow to a traditional, linear, and functionalist approach are included in the first group. In these models, innovations are considered to spread from advanced agricultural research institutions to national agricultural systems, national extension systems, and lastly to farmers. Models in the second category do not presuppose that innovation systems run smoothly in a top-down, linear fashion. Instead, they concentrate on how various factors, such as farmers, community organizations, and non-governmental organizations (NGOs) use various sources of information, relationships, and technologies to actively construct (or hinder) the process of innovation. (Leeuwis 2004 & Snapp et al. 2002).

4.2.3. Dynamic Partnership with the Private Sector

Only 6% of the 3395 organizations that collaborated with the CGIAR centers in 2006 were from the private sector, according to a research done by the Science Council Secretariat of the CGIAR [Report of a Survey; CGIAR 2006]. Due to new cooperative relationships, such as those with manufacturers and processors, the private sector's role in the CGIAR has significantly increased over the past ten years. As a result, it was relatively minor compared to the role of its traditional partners in the public sector (Reddy, et al. 2006). In the stage of technology and germplasm dissemination, the private sector has taken on a more significant role. When it comes to seed production and marketing, the public sector has shown to be ineffective in many developing nations, especially when it comes to meeting the requirements of the smallest and most vulnerable farmers. As irrigated crops and a different range of crops are the emphasis of private enterprise in these places, the CGIAR centres may have no choice but to collaborate with public players.

5. AVAILABILITY OF GERMPLASM FOR CONSERVATION AND BREEDING BY THE CGIAR CENTERS: POLICY ISSUES

5.1. Access and Benefit Sharing Regulated by International and National Laws

Three factors, including what they called "strong" (restrictive) access and benefit-sharing regulations (as a result of the CBD), (2) pressures to enter the international market intellectual property rights through international trade agreements, and (3) a combination of high levels of politicization of genetic resource issues and "inappropriate" policy initiatives, were cited by the majority of gene bank managers and breeders as the reasons for their challenges in gaining access to new genetic diversity.

It is constrained by a lack of funding and personnel necessities to establish effective collaborative research initiatives and the formal and informal networks for the exchange of germplasm.

For some crops, the relative significance of the lack of access to germplasm may be minimized by two factors: (1) the CGIAR gene banks include a sizable number of unexplored germplasm; and (2) breeders have access to a significant amount of enhanced materials. However, gene bank administrators and breeders consistently affirm that there is germplasm in other nations that they would like to access, especially of wild crop relatives.

6. POLICY CONSTRAINTS THAT LIMIT CGIAR GERMPLASM DISTRIBUTION

The CGIAR centres serve an essential role as catalysts in the transfer of germplasm around the world, particularly from their own crop improvement projects and from the international collections of germplasm that they protect and curate. By using the centres, nations can avoid the astronomical (and frequently prohibitive) transaction costs that would otherwise be incurred if they were to independently locate and negotiate a supply of the same genetic resources from each supplier nation. They accomplish this by physically pooling those resources, making them available, and making investments in their preservation. This is especially important because so many countries currently decide not to broadcast much or any PGRFA outside of their own boundaries. If they had not made a prior commitment, many of these countries would not have permitted the centres to conserve and distribute those genetic treasures. These genetic resources are only currently available because of the source countries' earlier, less restrictive policies, as well as because the centres and a selected few countries continue to invest in their conservation and spread.

The following are two closely related open concerns that impact on or go beyond the agreements the centre has with the governing body:

- Whether materials that are distributed by a CGIAR centre gene bank permitted to be used for non-food/non-feed uses (other than those listed in the Treaty), such as biofuels-related research? If so, how may these materials be distributed in terms of access and benefit-sharing?

- Can a central gene bank provide products to farmers for immediate use? The objectives for which resources are made available under the Treaty or the SMTA do not include direct use in

cultivation. If so, how and under what conditions?

The following list contains a summary of some of the most common concerns made by private-sector partners about the SMTA.

- In the case that a product generated from the use of the supplied germplasm is subject to protection and has already been commercialized, the SMTA imposes an obligation to return to a "benefit-sharing fund." Such a need is uncommon legally and is frequently unknown to companies.

- Since the SMTA does not include a time frame, it is more limiting than a patent in terms of longevity. The obligation's expiration date and existence are unclear to companies. Does it last permanently?

- Breeders typically assess the amount of royalties to be paid based on how much of the original material is present in the final product. However, it is thought that there will be no royalties due if the final product has less than 12.5% of the original germplasm. Other "rules" do not sit well enough with breeders.

CONCLUSION

Our article focuses the continued significance of the function that the CGIAR centres have historically performed as hubs for gathering and storing genetic material for use by the global community as well as in creating and disseminating enhanced genetic material. While potentially very important, new partnerships formed by centres, particularly with the private sector, to increase the impact of research results and products (especially for hybrids), have created new challenges in terms of the kinds of licensing agreements the centre should enter into with the recipients of their improved germplasm. The CGIAR Principles on the Management of Intellectual Assets were developed and recently adopted in response to the need to harmonize practices among centres by putting some basic requirements on their ability to grant exclusive rights to commercialize research outputs. A critical evaluation of the CGIAR centers' experiences with informal methods of crop innovation and seed dissemination, such as community seed enterprises and participatory plant breeding, can help nations define practical measures to improve seed regulations to better meet their needs in relation to agricultural development, food security, and climate change adaptation as the CGIAR centres increase their own involvement in technology delivery processes.

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Importance of DNA fingerprinting in PPV & FRA

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INTRODUCTION

Today, the world is witnessing a shift in free exchange, uninterrupted exploitation and controlled access to of plant genetic resources under the umbrella of World Trade Organizations Intellectual Property Rights Agreement (TRIPS). Its become of prime importance to protect intellectual property rights of plant breeder and farmers by adopting patent system. For that India has initiated an act of Protection of Plant Varieties and Farmers' Rights Act (PPVFR) to provide legal framework for plant breeder's and farmer's rights to grant protection to all varieties in terms of Novelty, distinctness, uniformity and stability. Enforcement of this act and increased private sector investment would mean greater ownership related disputes in the future. Therefore, a precise system for identification of varieties, parents of hybrids and specific biodiversity units is the basic requirement to enforce this protection.

Seeds are the most significant agricultural input in terms of productivity, production and income of the farmer and facilitate the efficacy of other inputs. The quality seed itself contributes about 15–20% to the total crop production and it can be further increased to 45% with proper management of other inputs (1). The authenticity, quality and purity of variety seeds are very significant for better production of crops. Timely production of quality seeds with a good genetic potential at a nominal price is very critical and should be made accessible to the farmers for achieving the agricultural production to its full potential. In India, the private sector own a large-scale seed production and marketing of cultivars.The constant and ever increasing number of improved varieties leads to a narrow genetic base and creates a hiccup in varietal identification since morphological descriptors are limited in their utility when too closely related cultivars are to be distinguished from one other. Apparent identification of varieties is very important for registration and certification of newly released varieties to limit the supply of spurious seed and to avoid the retail of the same variety under different titles by private seed companies and production agencies. The protection of plant breeder's rights across the globe has become critical for generation of data that can distinguish one variety from the other. The distinctness, uniformity and stability (DUS) testing done based on essential morphological traits and employment of biochemical and molecular markers for varietal identification is selective to environmental influence. Molecular markers based DNA finger printing tools are very quick, reliable, environmentally neutral in varietal profiling and purity analysis of crop varieties (2) and are accommodating in the development of unambiguous DNA fingerprints of cultivars (3,4).

MOLECULAR-BASED DNA FINGERPRINTING METHODS

A typical DNA fingerprinting technique generates molecular markers that should be polymorphic in nature to discriminate between cultivars. Fragment markers provide high-resolution qualitative information about sequence variation. Numerous DNA profiling techniques are available; all involve detecting fragments that differ in presence, size, or quantity between accessions. Fragments are generated by either restriction digestion or by polymerase chain reaction. The fragments are separated by agarose or polyacrylamide gel electrophoresis and detected by various approaches. All fragments on the gel are directly visualised by staining with ethidium bromide or any other strainers.

COMMONLY USED DNA FINGERPRINTING TECHNIQUES

AFLP (Amplified Fragment Length Polymorphism), AP-PCR (Arbitrary Primed PCR ASAP Allele Specific Associated Primers), CAPS (Cleaved Amplified Polymorphic Sequences DAF DNA Amplification Fingerprinting), RAPD (Random Amplified Polymorphic DNA), RFLP (Restriction Fragment Length Polymorphism) SCAR (Sequence Characterised Amplified Region), SSCP (Single Strand Conformation Polymorphism) SSR (Simple Sequence Repeats), SSR-SPAR (SSR-Single Primer Amplification Reaction), STMS (Sequence Tagged Microsatellite Loci) and SNP (Single nucleotide polymorphism).

PROTECTION OF PLANT VARIETIES AND FARMER'S RIGHTS ACT, 2001

Purpose of the Act is “to establish an effective system for protection of plant varieties, the rights of farmers and the breeders and to encourage the development of new varieties of plants in consonance with the TRIPS.”

OBJECTIVES OF PROTECTION OF PLANT VARIETIES AND FARMER'S RIGHTS ACT, 2001 (5)

1. To Stimulate investments for research and development both in the public and the private sectors for development of new plant varieties by ensuring appropriate returns on such over investment

2. To facilitate the growth of the seed industry in the country through domestic and foreign investment, which will ensure the availability of high quality seeds and planting material to Indian farmers

3. To recognize the role of farmers as cultivators and conservers and the contribution of traditional, rural and tribal communities to the country's agro biodiversity by rewarding them for their contribution through benefit sharing and protecting the traditional right of the farmers. More importantly this act provides safeguards to farmers by giving farmers' Rights while providing for an effective system of protection of plant breeders' rights. The Act seeks to safeguard researchers' rights as well. It also contains provisions for safeguarding the larger public interest. The farmer's rights include his traditional rights to save, use, share or sell his farm produce of a variety protected under this Act provided the sale is not for the purpose of reproduction under a commercial marketing arrangement. Hence, the act has sufficient provision to balance between farmer's right vs breeder's right.

APPLICATIONS OF DNA FINGERPRINTING IN PPV & FRA

A new variety is registerable under the PPV & FRA Act subject to satisfying the criteria of “novelty, distinctiveness, uniformity and stability”. There are some drawbacks in DUS characterizations based on morphological data provided as morphological expressions are environmental sensitive and may leads to error in scoring and analysis. In addition to this, insufficient variations, lack of knowledge of genetic control of phenotypic traits, long time in case of perennial crops for expressions of traits at required growth stages of crop are the other limitations which realizes the necessity of using other reliable and quick tools to fasten the marker score system. To overcome these issues in fingerprinting, molecular markers-based DNA fingerprinting can be crucial because of high degree of polymorphism, negligible influence of environment, and simple inheritance pattern.

Till date, DNA fingerprinting is not a compulsory component of DUS testing, and even not been accepted is evidence for dispute settlement. The most advanced prototype of plant variety protection, UPOV (International union for protection of new varieties of plants) [http://www.upov.org], also does not recognise DNA fingerprints as evidence yet. But there isa necessity of this technique as highlighted in above paragraph.

The International Association of Breeders (ASSINSEL) [http://www.worldseed.org/~assinsel/assinsel.htm] has conducted model studies in tomato and maize that highlight the utility of molecular data and help resolve statistical issues. The American Seed Trade Association (ASTA) has developed an informal set of guidelines for resolving germplasm identity and ownership that include the use of molecular data. UPOV has sensitised the member countries about the rapidly increasing capabilities of molecular technologies. The UPOV working group on Biochemical and Molecular Techniques (and DNA profiling in particular) (BMT) has been deliberating on development and use of DNA fingerprints in DUS testing. The

sixth session (Angers, France, 1-3 March 2000) discussed new techniques, their merits and limitations; variability within and between varieties; construction and standardisation of DNA profiles of varieties; statistical methods (precision of molecular markers); possibilities and consequences of the introduction of DNA profiling methods for DUS testing; and use of DNA profiling methods by expert witnesses in disputes on essential derivation.

INTELLECTUAL PROPERTY AND BIODIVERSITY PROTECTION

DNA fingerprinting can be useful during the cases of allegations of breach of intellectual property rights. Such cases would occur when i) a registered variety is cultivated/ marketed unauthorizedly under its own or a different name, ii) plant material comprising seeds, flowers, fruits or other plant products are falsely sold under the name of a registered variety, iii) plant material is collected from the wild and commercially exploited without the authorization of biodiversity authority. Proof of infringement in all the above cases would require a rapid and unambiguous method of identification. Use of DNA fingerprinting is, therefore, highly recommended in such cases. Below is a given some examples where DNA fingerprinting has actually helped.

Evidence from DNA fingerprinting tests can be used to determine disputes involving plant varieties, according to a recent decision of the Delhi High Court dated July 1, 2019 in *Pioneer Overseas Corporation* v. *Chairperson, Protection Of Plant Varieties And Farmers Rights And Ors,* MANU/DE/2102/2019, the Delhi High Court (6) was examining allegations of misappropriation of germ plasm protected under the Protection of Plant Varieties and Farmers' Rights Act, 2001 ('the Act').

Pioneer Overseas Corporation ('Pioneer') had applied to register a maize variety, 30V92 in August 2007, while Kaveri Seeds Limited ('Kaveri') had applied to register a maize variety, KMH50 in January 2009. Pioneer first opposed Kaveri's Application by way of an opposition under the Act. Further, Pioneer also filed an application under Section 24(5) of the Act claiming, among other things, that the two varieties were identical, and Kaveri had misappropriated the germ plasm of Pioneer's variety. Additionally, Pioneer also filed an application for a special test (DNA Test) to determine the genetic profile of the two varieties in order to support its claim. But this application for a DNA test was rejected, and the Registrar held that the two varieties complied with the Distinctiveness, Uniform and Stable ('DUS') criteria laid down for plant varieties under the Act. As per the Registrar, the DNA test was only applicable in the cases where varieties failed to satisfy the DUS criteria. Pioneer lost the opposition, and Kaveri's application for registration was directed to be registered. Pioneer challenged these decisions of the Registrar further before the High Court in September 2014. It also challenged a letter dated June 24, 2013 by the Registrar to the Government of India stating that both varieties were distinct and were eligible for registration under the Act.

The decision is likely to change how disputes involving ownership of intellectual property rights in a variety are adjudicated. The acceptance of DNA profiling tests as a means of verifying varieties is a breakthrough in plant variety protection law and practice in India. As a result, the plant variety registry will also have to equip itself for such tests becoming part of the registration and opposition processes that it hears. Stakeholders in this space are likely to benefit overall, as DNA profiling tests can lead to effective adjudication.

OTHER APPLICATIONS OF DNA FINGERPRINTING

Prediction of heterosis

To improve the breeding efficiency and process, heterosis prediction is important. Furthermore, DNA markers remove the drawback of isozyme-based heterosis prediction, which is too limited to be widely used. The genetic distance of the molecular marker was related to the heterosis of boll number and weight in single cotton (Percy et al., 2006) (7).

Genetic purity analysis

For identifying molecular markers for DNA fingerprinting, previous researchers considered three criteria i.e., codominance, polymorphism and allele uniqueness (Lukman et al., 2008) (8). One of the most essential quality control components in hybrid seed development is determining the genetic purity. The traditional field purity test, which examines a variety of plant morphological features, is time consuming, difficult and also results are obtained after the growing period (Asif et al., 2006) (9). Because DNA molecular markers have excellent specificity, selectivity, simplicity, precision, and genetic stability, they may detect changes in DNA levels without causing environmental effects, and hence have significant advantages in seed purity detection (Korir et al., 2013) (10).

Germplasm evaluation and preservation

For germplasm identification, evaluation and preservation, the DNA based molecular marker technology plays a very important role. To screen the important germplasm, preserve and to maintain the breeding population DNA markers are used. The information regarding their DNA level diversity, as well as their origin and evolution relationships would substantially assist us in making better use of the germplasm resources available to us, as well as providing an important source for their protection.

Genetic diversity analysis

To know the gene flow, parental line analysis is done. The role of DNA fingerprinting is to identify genetic relatedness between genotypes/species. As the data is collected from many ecological zones, genetic relatedness also provides useful information on the domestication process (Raj et al., 2019) (11). The hybrid/parental line DNA fingerprinting data could be successfully used for a genetic purity test that examines diverse seed samples to true-to-type control and parental lines. Because two randomly selected alleles from the population were shown to be different among the hybrids/parental lines, the SSR markers were able to detect genetic diversity (Sharma et al., 2014) (12). Plant breeders can use DNA fingerprinting and genetic profiling of breeding material to allocate inbred lines/purelines to distinct heterotic groups and determine the best crossing plan to maximize heterosis (Silva et al., 2020) (13).

Genotyping

DNA fingerprinting is a useful approach for identifying closely related species and varieties, as well as assessing genetic diversity and estimating genetic relatedness (Jamil et al., 2020) (14). DNA fingerprinting aids in the determination of varietal purity, which aids in the prevention of the sale of impure

seed in the market. Plant hybridity testing is another useful application of DNA fingerprinting. The co-dominant character of SSR markers facilitates their use in hybridity testing and, as a result, will be valuable in regulating hybrid seed marketing. DNA markers are also a trustworthy source for identifying the pedigree parentage of new crop varieties, and they will be used to register them under the Plant Breeders Rights Rules to secure plant breeders rights (Jamil et al., 2020) (14). As SSR markers are highly reproducible, they are used for genotyping asexually propagated cultivars. SNP chips are utilized for high-throughput genotyping, and the data is subsequently used to identify several QTLs in the genome (Fujii et al.) (15)

CONCLUSION

With the rapid advancement of molecular biology today, scientists need to apply technologies based on the molecular level to improve the agriculture economy. In the future, DNA fingerprinting has a lot to offer, including variety protection under the Plant Breeders Rights Rules, dispute settlement, and forensic activities to plant sciences, and will aid in the expansion of genetic knowledge a database of several certified crops (Wang et al., 2019) (16). Variety distinctions were made based on morphological characteristics as far back as the nineteenth century. However, as technology progressed, DNA-based markers became available. With the introduction of next-generation sequencing technology in the twenty-first century, DNA fingerprinting has advanced a step further, and genotyping is now done through sequencing. Because of their superior reproducibility, increased polymorphism levels, and high mutation rates, SSR markers are more commonly utilized markers. The transfer of DNA fingerprints into readily available and useful information that can be utilized directly in cultivar identification is critical in order to properly use DNA markers to cultivar identification.

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http://www.upov.org (UPOV site)

http://www.worldseed.org/~assinsel/assinsel.htm ASSINSEL site)

Other Article of Interest related to Agricultural Products

White gold – Quality & Branding need of the hour

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Supima & Giza – World's Superior and most sought-after White Gold Brand. White Gold? Our own humble natural and un-assuming natural fibre called Cotton. This humble, unassuming fibre can be transformed into a strong Brand that would become no less than craved yellow metal (Gold) in terms its value; that's exactly what the USA and Egypt have done and created brand called Supima & Giza respectively. No doubt these two brands of cotton have inherent high quality parameters of cotton measured in terms of staple length, strength and fineness. That's the reason these cottons are called longest, strongest and finest cotton in the world. Having said that quality of our own Suvin, MCU5, DCH-32, Shankar-6, Bunny Brahma varieties should not be undermined; Supima and Giza cotton internationally command a price of USc 290 to 300 a pound and USc 130 to 140 a pound respectively as against Indian equivalent cotton variety get USc 98 to 101 a pound; why then they (Indian Cotton) do not fetch the considerable premium price if not equal to that of Supima & Giza? Is it that the quality of our natural fibre is inferior vis-à-vis the captioned brands? Or are we lagging behind in branding our Cotton? Certainly not; would be the response to former and certainty yes, to the latter. It is therefore high time to showcase our humble natural fibre to the world that what Indian cotton is?

WHY BRANDING?

India is one of the highest producers and 2nd largest exporter of cotton in the world. A 10% of India's agricultural land is under cotton cultivation. A 40% of the world's area under cotton cultivation comes from India and it contribute 25% of world's Cotton production and exports 4.5 million bales (170 kg each). Contributes around 2% of India's merchandise export (Textile & Apparel put together contribute 10% of India's merchandise export). Cotton has been primary raw material for Indian textile industries, the ratio of cotton to other fibre in India is 70:30 (cotton to other man made fibre) whereas the same is 30:70 in the rest of the world. Besides, most importantly, 6 million Indian farmers have engaged themselves in Cotton farming to earn their livelihood and around 65 million peo ple associated indirectly with the industry.

Table-1

Particulars	Supima (the USA)	Egyptian Grade			Indian Grade		
		GIZA45	GIZA87	GIZA93	SUVIN	MCU5	DCH 32
Staple length (mm)	38	36	36	37	37	33	34
Micronaire	3.8	3	3	2.9	2.9	3.2	3
Strength(g/tex)	38	46	47	48	32	33	34
Price USc/lb	300	130 to 140			98 to 101		

The 7th October has been marked as World Cotton Day by the UN to raise the visibility of cotton sector and creating the awareness of its critical role in economic development, international trade and alleviating poverty. Infact the UN added 7th October to its permanent calendar as World Cotton Day. On the occasion of celebrating World Cotton day in 2020, Government of India launched brand “Kasturi Cotton India” & a logo (as shown in the pic) that represents Whiteness, Softness, Purity, Lustre and Indianness with objectives of creating a brand for Indian cotton & giving right value for Indian cotton in global market. The objective is right in its direction in terms of creating brand and concomitant value for Indian Cotton and its farmers in the global market. In addition, Government of India has set up “Textile Advisory Group (TAG), an informal advisory body to deal and address the issues related to cotton textile value chain (CTVC) as whole. Further, with the initiation of Ministry of Textile, Government of India, The Cotton Corporation of India and TEXPROCIL have entered into a MoU to encourage the Trade and Industry to work on the principle of self-regulation by owning complete responsibility of Traceability, Certification and Branding of “KASTURI Cotton India”

THE BRANDING OF INDIAN COTTON;

i. Enables to position “KASTURI Cotton India” as a premium brand and thereby enhance the perception & valuation of Indian Cotton in the Global market.

ii. Enables creating a reliable quality fibre, both in the domestic and

global markets thereby fetching a premium price.

iii. Enables identification of "KASTURI Cotton India" by its specifications and thereby enhancing export opportunities.

iv. The last but not the least, enables Indian Cotton Farmer to command premium price for their produce and enables to achieve the national goal of "Doubling Farmers' Income"(DFI)

WHAT ELSE OTHER THAN BRANDING? – "BSTC"

The endeavour of Branding is incomplete without Sustainability, Traceability and Certification. The aspect of Branding, Sustainability, Traceability and Certification – "BSTC" - has been unambiguously need of the hour amongst all stake holders of Cotton Textile Value Chain (TVC). All these fours aspects of BSTC are inter-connected and are inseparable for Indian Cotton fraternity. Recently there has been a hue and cry among the Cotton Textile and Apparel (T&A) Exporters, as the USA (one of the largest importers of T&A from India) restricted the entry of Indian export consignments into its territory for want of certification that Indian Cotton Textile export consignment to the USA has no Cotton from Xinjiang, China origin. This certification was demanded by the US authority as they have banned use of Xinjiang origin Cotton which is said to have been using a forced labour in Cotton Farming and processing. As a result of impasse of Xinjiang Origin, the stake holders of TVC woke up and realised the importance of Traceability and Certification of origin of Cotton. The Traceability and Certification, going forward, would certainly be the norms of the trade globally which we cannot afford to circumvent. Traceability & Certification is a process through which the Origin of Cotton from Farm to Foreign (5 Fs – Farm to Fibre to Fabric to Fashion to Foreign) is identified and recorded by leveraging the Block-Chain Technology. The endeavour is going to be a game changer for Cotton Textile Value Chain.

An another important link of BSTC is "sustainability", before knowing this particular link of the chain, it is imperative to give some food for thought while doing some number crunching through the data in the table-2:

Table-2

Particular	India	China	USA	Brazil	Australia	World's Total (Including rest of the cotton growing countries)
Area-Cotton cultivation(lakh ha)	130	30	32	16	3	330
Production (million bales)	34.2	35.5	18.23	14.7	5.5	143
Number of farmers in cotton cultivation	65 lakhs	21 lakhs	8103	2651	1155	
Planting system	Traditional wide spacing	HDPS	HDPS	HDPS	HDPS	
Productivity (Kg lint/ ha)	450	1987	975	1524	2002	745
Cultivation cost/ha (US $/ha)	900	3510	1543	2264	2716	

The Country's Trade and Commerce will be efficient and successful, only when the products and services dealt by it will be sustainable socially and economically. All the data points in the table are most favourable for Indian cotton to rule the roost; except productivity which is estimated as 450 Kg a hectare as against global average of 745 Kg a hectare. Hang on, lower productivity should not tantamount to be tumbling block, rather it is a guiding point for us that what exactly the problem is (the legend goes “the problem well defined is the half way towards the feasible solution). To improve yield our Agricultural Scientists have time and again during their extension programs issue advisory for usage of right seed, HDPS (High Density Planting System), best farm practice & post-harvest management. Two decades ago i.e. in 2002, India adopted genetically modified (GM) Bt Cotton (BG II Bt Seed) when the yield of cotton was 190 kg/ha, with the adoption of Bt Cotton, the yield of cotton went up to 520 kg/ha by 2016-17, however, in subsequent year it is stagnated to around 450 kg/ha. The issue of stagnated yield could be addressed by adoption of improvised BT Cotton like HT-BT (Herbicide Tolerant-Bt), however, the conduciveness of HT-BT for commercial cultivation is presently being evaluated by GEAC (Genetic Engineering Appraisal Committee). Let's wait and watch whether the history repeats itself with adoption of improvised seed after two decades? If so, it is not arduous task for us to match global average yield of 750 kg/ha and is quite doable. The outcome of improved productivity will in turn put India in world's map as the largest Cotton producer as well as exporters.

ELS Cotton (Extra Long Staple) whose fibre length is beyond 32.5 mm has a demand of around 20 lakh bales (170 kgs each) per year from Indian Textile Industry as against which the production of ELS cotton in India is estimated about only 5 lakh bales a year, the gap is being fulfilled by imported cotton. Suvin, DCH 32, MCU5 are being Indian ELS cotton, the attention is required to scale up the production of these varieties of cotton to meet the Indian Textile Value Chain requirement and preserving concomitant foreign exchange thereof.

All the stakeholders of Cotton TVC has a job in hand – BSTC- to scout Indian Cotton's economic potential and enunciating them in such a way that all members of value chain are benefited and more so our cotton farmers. And the endeavour in this direction would be TVC's contribution to the national goal of “ Doubling Farmers' Income” (DFI).

Seed Sector's attention needed for products with GI Tag

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A doctorate in Agriculture Seed Technology from TNAU, Dr. V. Sankaran is a legendary personality with over 57 years of professional experience in the Indian seed industry. He had a bright academic career with a Gold Medal in Post-graduation from TNAU. Having joined the premier seed organisation of the country, the National Seeds Corporation (NSC) in the initial inception period - 1965 itself, he held various positions in the organisation, with significant devotion towards the performance of the corporation and also the seed sector development in the country. During his tenure with the Krishidhan Seeds, Jalna (Maharashtra) as Vice President (Tech), Director and also as Mentor from 2007 to 2015, he contributed significantly in standardising and applying the technical norms and procedures in the company.

He has been Member of a number of committees, core groups and seed study missions, to quote a few, Technical assistance to the Govt. of India's Seed Review Team [1968], supporting the Member of the Seed Group of the National Commission on Agriculture [1976] and in the two Member NSC's Seed Certification Consultancy Team for the GOI in 1980. He also extended his consultancy support to the Govt. of India in finalizing the National Seed Mission Document during October 2009 to September 2010. Dr. Sankaran is a Founder Member of Indian Society of Seed Technology [ISST] since inception in 1971

and has served as Councillor, Editor, President and Fellow during different periods.

Dr. Sankaran also has to his credit 45 papers including 4 books as co- author, the latest being NSC publication "NSC's Journey in the Service of Farmers- August, 2020" released by the Hon'ble Union Minister of Agriculture, Shri Narendra Singh Tomer on the 28th January, 2021. After getting relieved of the formal organizational engagement with Krishidhan Seeds in 2015, he is still actively sharing his knowledge and experience on honorary basis through seed related trainings, especially for the next generation of seed professionals, advisory support to the seed industry and also with number of articles for development of seed sector in the country.

Under the Indian Geographical Indications (GI) Act (1999) effective from 15th September 2003, some selected Products are given GI tags in the country based on one or more of their unique features / specialties. Darjeeling Tea was the first to get the GI tag. From 2004-05 until March '22, so far 420 Products have been granted the GI Tags .The Products are broadly classified as Agricultural, Handicrafts, Manufactured, Food Stuff etc. A complete list of all the 420 Products with the merit of GI Tag is in Table-1.

In this context, from out of the 'Agricultural ' category, a separate list of about 50 Products with GI recognition has been prepared covering 15 crops viz Rice, Wheat, Jowar, Redgram, Brinjal, Chilli, Cucumber, Rajma, Onion, Turmeric, Ginger, Kalajeera, Litchi, Guava, and Others which have so far figured in the GI exercise. The said list is presented in Table-2. Many Products with GI Tag bear traditional – local 'category /group names. One or more of the varieties released from the public / private research systems may fit into the ' categories/groups ' with GI Tag. A perusal of the List will inspire one in the Seed Sector to consider the scope / need to produce and make available quality seed of crop varieties fitting into the category of the types / groups with the merit of GI Tag. In fact, for reaping maximum benefit from the GI recognition, the Seed Sector has an important role to play by way of producing and supplying quality seed leading to not only increased productivity of the commercial crop and its GI product but also in enhancing the ' unique value ' for which the GI Tag has been granted. Some / many of them have high export potential as such or after conversion into a consumable item, implying a boost in turn to the Seed Program in GI Products. This opens up a new "Speciality Area" for the Seed Sector.

In the light of the foregoing, it is earnestly hoped that the subject matter presented here will generate interest among the Indian Seed Sector (both public and private) to move towards launching**" Special Seed Program for GI Products"** with some recognized /prominent varieties in typically seed propagated crops ie Rice ,Wheat, Jowar, Redgram, Brinjal, Chilli, Cucumber, Rajma, and Onion. If this activity is taken up, the seed organization(s) involved in the activity will be contributing significantly to the production and availability of the ultimate 'GI Product'; and thereby boosting the economic gains for all those involved in the activity.

Table 1: REGISTRATION DETAILS OF GEOGRAPHICAL INDICATIONS

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
FROM APRIL 2004 – MARCH 2005				
1	1 & 2	Darjeeling Tea (word & logo)	Agricultural	West Bengal
2	3	Aranmula Kannadi	Handicraft	Kerala
3	4	Pochampalli Ikat	Handicraft	Telangana
FROM APRIL 2005 – MARCH 2006				
4	5	Salem Fabric	Handicraft	Tamil Nadu
5	7	Chanderi Sarees	Handicraft	Madhya Pradesh
6	8	Solapur Chaddar	Handicraft	Maharashtra
7	9	Solapur Terry Towel	Handicraft	Maharashtra
8	10	Kotpad Handloom fabric	Handicraft	Odisha
9	11	Mysore Silk	Handicraft	Karnataka
10	12	Kota Doria	Handicraft	Rajasthan
11	13 & 18	Mysore Agarbathi	Manufactured	Karnataka
12	15	Kancheepuram Silk	Handicraft	Tamil Nadu
13	16	Bhavani Jamakkalam	Handicraft	Tamil Nadu
14	19	Kullu Shawl	Handicraft	Himachal Pradesh
15	20	Bidriware	Handicraft	Karnataka
16	21	Madurai Sungudi	Handicraft	Tamil Nadu
17	22	Orissa Ikat	Handicraft	Odisha
18	23	Channapatna Toys & Dolls	Handicraft	Karnataka
19	24	Mysore Rosewood Inlay	Handicraft	Karnataka
20	25	Kangra Tea	Agricultural	Himachal Pradesh
21	26	Coimbatore Wet Grinder	Manufactured	Tamil Nadu
22	28	Srikalahasthi Kalamkari	Handicraft	Andhra Pradesh
23	29	Mysore Sandalwood Oil	Manufactured	Karnataka
24	30	Mysore Sandal soap	Manufactured	Karnataka
25	31	Kasuti Embroidery	Handicraft	Karnataka
26	32	Mysore Traditional Paintings	Handicraft	Karnataka
27	33	Coorg Orange	Agricultural	Karnataka
FROM APRIL 2006 – MARCH 2007				
28	34	Mysore Betel leaf	Agricultural	Karnataka
29	35	Nanjanagud Banana	Agricultural	Karnataka
30	37	Madhubani Paintings	Handicraft	Bihar
FROM APRIL 2007 – MARCH 2008				
31	44	Kondapalli Bommallu	Handicraft	Andhra Pradesh
32	47	Thanjavur Paintings	Handicraft	Tamil Nadu
33	53	Silver Filigree of Karimnagar	Handicraft	Telangana
34	54	Alleppey Coir	Handicraft	Kerala
35	55	Muga Silk of Assam	Handicraft	Assam
36	65	Temple Jewellery of Nagercoil	Handicraft	Tamil Nadu
37	69	Mysore Malligae	Agricultural	Karnataka
38	70	Udupi Malligae	Agricultural	Karnataka

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
39	71	Hadagali Malligae	Agricultural	Karnataka
40	17	Navara Rice	Agricultural	Kerala
41	36	Palakkadan Matta Rice	Agricultural	Kerala
42	63	Thanjavur Art Plate	Handicraft	Tamil Nadu
43	76	Ilkal Sarees	Handicraft	Karnataka
44	73	Applique (Khatwa) Work of Bihar	Handicraft	Bihar
45	74	Sujini Embroidery Work of Bihar	Handicraft	Bihar
46	75	Sikki Grass Products of Bihar	Handicraft	Bihar
47	49 & 56	Malabar Pepper	Agricultural	India (Kerala, Karnataka & Tamilnadu)
48	50	Allahabad Surkha Guava	Agricultural	Uttar Pradesh
49	52	Nakshi Kantha	Handicraft	West Bengal
50	60	Ganjifa Cards of Mysore	Handicraft	Karnataka
51	61	Navalgund Durries	Handicraft	Karnataka
52	62	Karnataka Bronzeware	Handicraft	Karnataka
53	77	Molakalmuru Sarees	Handicraft	Karnataka
54	85	Monsooned Malabar Arabica Coffee	Agricultural	India (Karnataka & Kerala)
55	114	Monsooned Malabar Robusta Coffee	Agricultural	India (Karnataka & Kerala)
56	72	Alleppey Green Cardamom	Agricultural	India (Kerala & Tamilnadu)
57	78	Coorg Green Cardamom	Agricultural	Karnataka
58	95	East India Leather	Manufactured	Tamil Nadu
59	94	Salem Silk known as Salem Venpattu	Handicraft	Tamil Nadu
60	93	Kovai Kora Cotton Sarees	Handicraft	Tamil Nadu
61	92	Arani Silk	Handicraft	Tamil Nadu
FROM APRIL 2008 – MARCH 2009				
62	83	Bastar Dhokra	Handicraft	Chattisgarh
63	84	Bastar Wooden Craft	Handicraft	Chattisgarh
64	91	Nirmal Toys and Craft	Handicraft	Telangana
65	59	Maddalam of Palakkad	Handicraft	Kerala
66	58	Screw Pine Craft of Kerala	Handicraft	Kerala
67	64	Swamimalai Bronze Icons	Handicraft	Tamil Nadu
68	82	Bastar Iron Craft	Handicraft	Chattisgarh
69	87	Konark Stone carving	Handicraft	Odisha
70	88	Orissa Pattachitra	Handicraft	Odisha
71	90	Machilipatnam Kalamkari	Handicraft	Andhra Pradesh
72	110	Eathomozhy Tall Coconut	Agricultural	Tamil Nadu

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
73	57	Brass Broidered CoconutShell Crafts of Kerala	Handicraft	Kerala
74	66	Blue Pottery of Jaipur	Handicraft	Rajasthan
75	67	Molela Clay Work	Handicraft	Rajasthan
76	68	Kathputlis of Rajasthan	Handicraft	Rajasthan
77	97	Leather Toys of Indore	Handicraft	Madhya Pradesh
78	98	Bagh Prints of Madhya Pradesh	Handicraft	Madhya Pradesh
79	100	Sankheda Furniture	Handicraft	Gujarat
80	101	Agates of Cambay	Handicraft	Gujarat
81	102	Bell Metal Ware of Datia and Tikamgarh	Handicraft	Madhya Pradesh
82	103	Kutch Embroidery	Handicraft	Gujarat
83	51	Kani Shawl	Handicraft	Jammu & Kashmir
84	79	Chamba Rumal	Handicraft	Himachal Pradesh
85	80	Dharwad Pedha	Food stuff	Karnataka
86	81	Pokkali Rice	Agricultural	Kerala
87	86 & 108	Pipli Applique Work	Handicraft	Odisha
88	89	Budithi Bell & Brass Metal Craft	Handicraft	Andhra Pradesh
89	96	Thanjavur Doll	Handicraft	Tamil Nadu
90	104	Santiniketan Leather Goods	Handicraft	West Bengal
91	105	Nirmal Furniture	Handicraft	Telangana
92	106	Nirmal Paintings	Handicraft	Telangana
93	107	Andhra Pradesh Leather Puppetry	Handicraft	Andhra Pradesh
94	111	Malda Laxman Bhog Mango	Agricultural	West Bengal
95	112	Malda Khirsapati (Himsagar) Mango	Agricultural	West Bengal
96	113	Malda Fazli Mango	Agricultural	West Bengal
97	46	Kashmir Pashmina	Handicraft	Jammu & Kashmir
98	48	Kashmir Sozani Craft	Handicraft	Jammu & Kashmir
99	109	Naga Mircha	Agricultural	Nagaland
100	116&117	Nilgiri (Orthodox)	Agricultural	Tamil Nadu
101	115 &118	Assam (Orthodox)	Agricultural	Assam
102	119	Lucknow Chikan Craft	Handicraft	Uttar Pradesh
103	124	Virupakshi Hill Banana	Agricultural	Tamil Nadu
104	126	Sirumalai Hill Banana	Agricultural	Tamil Nadu
105	120	Feni	Manufactured	Goa
106	122	Uppada Jamdani Sarees	Handicraft	Andhra Pradesh
FROM APRIL 2009 – MARCH 2010				
107	121	Tirupathi Laddu	Food stuff	Andhra Pradesh
108	125	Mango Malihabadi Dusseheri	Agricultural	Uttar Pradesh

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
109	128	Puneri Pagadi	Handicraft	Maharashtra
110	99	Banaras Brocades and Sarees	Handicraft	Uttar Pradesh
111	127	Tangaliya Shawl	Handicraft	Gujarat
112	130 & 141	Vazhakulam Pineapple	Agricultural	Kerala
113	131	Devanahalli Pomello	Agricultural	Karnataka
114	132	Appemidi Mango	Agricultural	Karnataka
115	133	Kamalapur Red Banana	Agricultural	Karnataka
116	138	Santipore Saree	Handicraft	West Bengal
117	144	Cannanore Home Furnishings	Handicraft	Kerala
118	43	Peruvian Pisco	Manufactured	Peru
119	147	Sanganeri Hand Block Printing	Handicraft	Rajasthan
120	152	Balaramapuram Sarees and Fine Cotton Fabrics	Handicraft	Kerala
FROM APRIL 2010– MARCH 2011				
121	142	Bikaneri Bhujia	Food Stuff	Rajasthan
122	143	Guntur Sannam Chilli	Agricultural	Andhra Pradesh
123	123	Nashik Valley Wine	Manufactured	Maharashtra
124	137	Gadwal Sarees	Handicraft	Telangana
125	149	Kinnauri Shawl	Handicraft	Himachal Pradesh
126	170	Kasaragod Sarees	Handicraft	Kerala
127	179	Kuthampully Sarees	Handicraft	Kerala
128	134	Sandur Lambani Embroidery	Handicraft	Karnataka
129	148	Hand Made Carpet of Bhadohi	Handicraft	Uttar Pradesh
130	150 & 153	Paithani Sarees and Fabrics	Handicraft	Maharashtra
131	154	Mahabaleshwar Strawberry	Agricultural	Maharashtra
132	193	Hyderabad Haleem	Food Stuff	Telangana
133	140	Champangne	Manufactured	France
134	146	Napa Valley	Manufactured	United States of America
135	163	Central Travancore Jaggery	Agricultural	Kerala
136	172	Champa Silk Saree And Fabrics	Handicraft	Chhattisgarh
137	186	Wayanad Jeerakasala Rice	Agricultural	Kerala
138	187	Wayanad Gandhakasala Rice	Agricultural	Kerala
139	191	Kota Doria (Logo)	Handicraft	Rajasthan
140	165	Nashik Grapes	Agricultural	Maharashtra
141	171	Surat Zari Craft	Handicraft	Gujarat
142	190	Cheriyal Paintings	Handicraft	Telangana
143	194	Pembarthi Metal Craft	Handicraft	Telangana
144	6	Payyannur Pavithra Ring	Handicraft	Kerala
145	27	Phulkari	Handicraft	India (Punjab, Haryana & Rajasthan)

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
146	136	Khandua Saree and Fabrics	Handicraft	Odisha
147	129	Byadagi Chilli	Agricultural	Karnataka
148	151	Scotch Whisky	Manufactured	United Kingdom
149	164	Prosciutto di Parma	Food Stuff	Italy
FROM APRIL 2011 – MARCH 2012				
150	183	Bagru Hand Block Print	Handicraft	Rajasthan
151	189	Venkatagiri Sarees	Handicraft	Andhra Pradesh
152	185	Gir Kesar Mango	Agricultural	Gujarat
153	192	Bhalia Wheat	Agricultural	Gujarat
154	201	Villianur Terracotta Works	Handicraft	Pondicherry
155	202	Tirukanur Papier Mache Craft	Handicraft	Pondicherry
156	230	Cognac	Manufactured	France
157	174	Kachchh Shawls	Handicraft	Gujarat
158	199	Udupi Mattu Gulla Brinjal	Agricultural	Karnataka
159	173	Baluchari Saree	Handicraft	West Bengal
160	176	Dhaniakhali Saree	Handicraft	West Bengal
161	181	Kashmir Paper Machie	Handicraft	Jammu & Kashmir
162	182	Kashmir Walnut Wood Carving	Handicraft	Jammu & Kashmir
163	203	Bobbili Veena	Handicraft	Andhra Pradesh
164	204	Khatamband	Handicraft	Jammu & Kashmir
165	213	Kinhal Toys	Handicraft	Karnataka
166	225	Chendamangalam Dhoties & Set Mundu	Handicraft	Kerala
167	226	Porto	Manufactured	Portugal
168	227	Douro	Manufactured	Portugal
169	167	Gopalpur Tussar Fabrics	Handicraft	Odisha
170	188	Siddipet Gollabama	Handicraft	Telangana
171	228	Ganjam Kewda Rooh	Manufactured	Odisha
172	229	Ganjam Kewda Flower	Agricultural	Odisha
FROM APRIL 2012 – MARCH 2013				
173	197	Maheshwar Sarees & Fabrics	Handicraft	Madhya Pradesh
174	207	Dhalapathar Parda & Fabrics	Handicraft	Odisha
175	208	Sambalpuri Bandha Saree & Fabrics	Handicraft	Odisha
176	217	Bomkai Saree & Fabrics	Handicraft	Odisha
177	219	Habaspuri Saree & Fabrics	Handicraft	Odisha
178	220	Berhampur Patta (Phoda Kumbha) Saree & Joda	Handicraft	Odisha
179	180	Bhagalpur Silk	Handicraft	Bihar
180	198	Mangalagiri Sarees and Fabrics	Handicraft	Andhra Pradesh
181	238	Madurai Malli	Agricultural	Tamil Nadu

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
182	243	Tequila	Manufactured	Mexico
183	195	Pattamadai Pai ("Pattamadai Mat")	Handicraft	Tamil Nadu
184	196	Nachiarkoil Kuthuvilakku ("Nachiarkoil Lamp")	Handicraft	Tamil Nadu
185	200	Chettinad Kottan	Handicraft	Tamil Nadu
186	214	Narayanpet Handloom Sarees	Handicraft	Telangana
187	135	Toda Embroidery	Handicraft	Tamil Nadu
188	209	Thanjavur Veenai	Handicraft	Tamil Nadu
189	211	Bangalore Blue Grapes	Agricultural	Karnataka
190	233	Agra Durrie	Handicraft	Uttar Pradesh
191	234	Farrukhabad Prints	Handicraft	Uttar Pradesh
192	236	Lucknow Zardozi	Handicraft	Uttar Pradesh
193	237	Banaras Brocades and Sarees (Logo)	Handicraft	Uttar Pradesh
FROM APRIL 2013 – MARCH 2014				
194	205	Kalanamak Rice	Agricultural	Uttar Pradesh
195	232	Patan Patola	Handicraft	Gujarat
196	386	Orissa Pattachitra (Logo)	Handicraft	Odisha
197	387	Bastar Dhokra (Logo)	Handicraft	Chhattisgarh
198	388	Bell Metal Ware of Datia and Tikamgarh (Logo)	Handicraft	Madhya Pradesh
199	242	Kaipad Rice	Agricultural	Kerala
200	383	Kullu ShawL (Logo)	Handicraft	Himachal Pradesh
201	384	Muga Silk of Assam (Logo)	Handicraft	Assam
202	155	Firozabad Glass	Handicraft	Uttar Pradesh
203	157	Kannauj Perfume	Manufactured	Uttar Pradesh
204	159	Kanpur Saddlery	Handicraft	Uttar Pradesh
205	161	Moradabad Metal Craft	Handicraft	Uttar Pradesh
206	184	Saharanpur Wood Craft	Handicraft	Uttar Pradesh
207	215	Dharmavaram Handloom Pattu Sarres And Paavadas	Handicraft	Andhra Pradesh
208	239	Warli Painting	Handicraft	India (Maharashtra, Gujarat, Dadara & Nagar Haveli, Daman Diu)
209	240	Kolhapur Jaggery	Agricultural	Maharashtra
210	244	Thewa Art Work	Handicraft	Rajasthan
211	371	Shaphee Lanphee	Handicraft	Manipur
212	372	Wangkhei Phee	Handicraft	Manipur
213	373	Moirang Phee	Handicraft	Manipur
214	381 & 413	Kangra Paintings	Handicraft	Himachal Pradesh
215	385	Nagpur Orange	Agricultural	India (Maharashtra & Madhya Pradesh)

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
FROM APRIL 2014 – MARCH 2015				
216	399	Leather Toys of Indore (Logo)	Handicraft	Madhya Pradesh
217	212	Bangalore Rose Onion	Agricultural	Karnataka
218	389	Meerut Scissors	Manufactured	Uttar Pradesh
219	178	Khurja Pottery	Handicraft	Uttar Pradesh
220	374	Naga Tree Tomato	Agricultural	Nagaland
221	375	Arunachal Orange	Agricultural	Arunachal Pradesh
222	376	Sikkim Large Cardamom	Agricultural	Sikkim
223	377	Mizo Chilli	Agricultural	Mizoram
224	382	Joynagar Moa	Food Stuff	West Bengal
225	397	Banaras Gulabi Meenakari Craft	Handicraft	Uttar Pradesh
226	435	Assam Karbi Anglong Ginger	Agricultural	Assam
227	436	Tripura Queen Pineapple	Agricultural	Tripura
228	479	Chengalikodan Nendran Banana	Agricultural	Kerala
229	434	Ratlami Sev	Food Stuff	Madhya Pradesh
230	438	Tezpur Litchi	Agricultural	Assam
231	465	Khasi Mandarin	Agricultural	Meghalaya
232	466	Kachai Lemon	Agricultural	Manipur
233	405	Makrana Marble	Natural Goods	Rajasthan
234	457	Varanasi Wooden Lacquerware & Toys	Handicraft	Uttar Pradesh
235	458	Mirzapur Handmade Dari	Handicraft	Uttar Pradesh
FROM APRIL 2015 – MARCH 2016				
236	437	Memong Narang	Agricultural	Meghalaya
237	459	Nizamabad Black Pottery	Handicrafts	Uttar Pradesh
238	145	Basmati	Agricultural	India (Punjab / Haryana / Himachal Pradesh / Delhi / Uttarkhand / Uttar Pradesh / Jammu & Kashmir)
239	505	Bagh Prints of Madhya Pradesh (Logo)	Handicrafts	Madhya Pradesh
240	507	Sankheda Furniture (Logo)	Handicrafts	Gujarat
241	509	Kutch Embroidery (Logo)	Handicrafts	Gujarat
242	510	Karnataka Bronzeware (Logo)	Handicrafts	Karnataka
243	511	Ganjifa Cards of Mysore (Logo)	Handicrafts	Karnataka
244	512	Navalgund Durries (Logo)	Handicrafts	Karnataka
245	513	Thanjavur Art Plate (Logo)	Handicrafts	Tamil Nadu
246	514	Swamimalai Bronze Icons (Logo)	Handicrafts	Tamil Nadu

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
247	515	Temple Jewellery of Nagercoil (Logo)	Handicrafts	Tamil Nadu
248	470	Ajara Ghansal Rice	Agricultural	Maharashtra
249	472	Mangalwedha Jowar	Agricultural	Maharashtra
250	474	Sindhudurg & Ratnagiri Kokum	Agricultural	Maharashtra
251	508	Agates of Cambay (Logo)	Handicrafts	Gujarat
252	210	Guledgudd Khana	Handicrafts	Karnataka
253	224	Udupi Sarees	Handicrafts	Karnataka
254	402	Kuthampally Dhoties & Set Mundu	Handicrafts	Kerala
255	476	Waghya Ghevada	Agricultural	Maharashtra
256	477	Navapur Tur Dal	Agricultural	Maharashtra
257	489	Vengurla Cashew	Agricultural	Maharashtra
258	491	Lasalgaon Onion	Agricultural	Maharashtra
259	516	Maddalam of Palakkad (Logo)	Handicrafts	Kerala
260	517	Brass Broidered Coconut Shell Craft of Kerala (Logo)	Handicrafts	Kerala
261	518	Screw Pine Craft of Kerala (Logo)	Handicrafts	Kerala
262	490	Sangli Raisins	Agricultural	Maharashtra
263	351	Parmigiano Reggiano	Manufactured	Italy
264	398	Banaras Metal Repouse Craft	Handicrafts	Uttar Pradesh
265	494	Beed Custard Apple	Agricultural	Maharashtra
266	495	Jalna Sweet Orange	Agricultural	Maharashtra
267	520	Uttarakhand Tejpat	Agricultural	Uttarakhand
268	471	Waigaon Turmeric	Agricultural	Maharashtra
269	500	Purandar Fig	Agricultural	Maharashtra
270	501	Jalgaon Bharit Brinjal	Agricultural	Maharashtra
271	502	Solapur Pomegranate	Agricultural	Maharashtra
272	527	Kashmiri Hand Knotted Carpet	Handicrafts	Jammu & Kashmir
273	221	Jamnagari Bandhani	Handicrafts	Gujarat
274	503	Prosecco	Manufactured	Italy
275	532	Mysore Silk (Logo)	Handicrafts	Karnataka
276	177	Varanasi Glass beads	Handicrafts	Uttar Pradesh
277	349	Asiago	Food Stuff	Italy
278	473	Bhiwapur Chilli	Agricultural	Maharashtra
279	478	Ambemohar Rice	Agricultural	Maharashtra
280	493	Dahanu Gholvad Chikoo	Agricultural	Maharashtra
281	498	Jalgaon Banana	Agricultural	Maharashtra
282	499	Marathwada Kesar Mango	Agricultural	Maharashtra

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
283	390	Karvath Kati Sarees & Fabrics	Handicrafts	Maharashtra
284	537	Applique (Khatwa) Work of Bihar (Logo)	Handicrafts	Bihar
285	539	Molela Clay Work of Rajasthan (Logo)	Handicrafts	Rajasthan
286	433	Bandar Laddu	Food Stuff	Andhra Pradesh
287	439	Joha Rice of Assam	Agricultural	Assam
288	522	Udayagiri Wooden Cutlery	Handicrafts	Andhra Pradesh
289	525	Bardhaman Sitabhog	Food Stuff	West Bengal
290	526	Bardhaman Mihidana	Food Stuff	West Bengal
291	536	Sikki Grass Products of Bihar (Logo)	Handicrafts	Bihar
292	538	Sujini Embroidery Work of Bihar(Logo)	Handicrafts	Bihar
293	540	Blue Pottery of Jaipur (Logo)	Handicrafts	Rajasthan
294	541	Kathputlis of Rajasthan (Logo)	Handicrafts	Rajasthan
FROM APRIL 2017 – MARCH 2018				
295	241	Banaganapalle Mangoes	Agricultural	India (Telangana & Andhra Pradesh
296	562	Pochampally Ikat (Logo)	Handicrafts	Telangana
297	531	Gobindobhog Rice	Agricultural	West Bengal
298	481	Durgi Stone Carvings	Handicrafts	Andhra Pradesh
299	482	Etikoppaka Toys	Handicrafts	Andhra Pradesh
300	530	Tulapanji Rice	Agricultural	West Bengal
301	542	Chakshesang Shawl	Handicrafts	Nagaland
302	426	Mahabalipuram Stone Sculpture	Handicrafts	Tamil Nadu
303	533	Banglar Rasogolla	Food Stuff	West Bengal
304	534	Lamphun Brocade Thai Silk	Handicrafts	Thailand
305	543	Nilambur Teak	Agricultural	Kerala
306	453	Bankura Panchmura Terracotta Craft	Handicraft	West Bengal
307	519	Pokaran Pottery	Handicraft	Rajasthan
308	521	Adilabad Dokra	Handicraft	Telangana
309	523	Warangal Durries	Handicraft	Telangana
310	524	Allagadda Stone Carving	Handicraft	Andhra Pradesh
311	551	Bhagalpuri Zardalu	Agricultural	Bihar
312	553	Katarni Rice	Agricultural	Bihar
313	554	Magahi Paan	Agricultural	Bihar
314	555	Ghazipur Wall-hanging	Handicraft	Uttar Pradesh
315	556	Varanasi Soft Stone Jali Work	Handicraft	Uttar Pradesh

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
316	563	Bengal Dokra	Handicraft	West Bengal
317	564	Bengal Patachitra	Handicraft	West Bengal
318	565	Purulia Chau Mask	Handicraft	West Bengal
319	566	Wooden Mask of Kushmandi	Handicraft	West Bengal
320	567	Madur kathi	Handicraft	West Bengal
FROM APRIL 2018 – MARCH 2019				
321	378	Jhabua Kadaknath Black Chicken Meat	Food Stuff	Madhya Pradesh
322	558	Boka Chaul	Agricultural	Assam
323	350 & 577	Grana Padano	Manufactured	Italy
324	139	Alphonso	Agricultural	Maharashtra
325	380	RajKot Patola	Handicraft	Gujarat
326	552	Shahi Litchi of Bihar	Agricultural	Bihar
327	496	Sangli Turmeric	Agricultural	Maharashtra
328	585	Pethapur Printing Blocks	Handicraft	Gujarat
329	169	Kolhapuri Chappal	Handicraft	India (Karnataka & Maharashtra)
330	584	Silao Khaja	Food Stuff	Bihar
331	604	Coorg Arabica Coffee	Agricultural	Karnataka
332	605	Wayanaad Robusta Coffee	Agricultural	Kerala
333	606	Chikmagalur Arabica Coffee	Agricultural	Karnataka
334	607	Araku Valley Arabica Coffee	Agricultural	India (Andhra Pradesh & Odisha)
335	608	Bababudangiris Arabica Coffee	Agricultural	Karnataka
336	432	Himachali Kala Zeera	Agricultural	Himachal Pradesh
337	464	Sirsi Supari	Agricultural	Karnataka
338	468	Himachali Chulli Oil	Manufactured	Himachal Pradesh
339	557	Chunar Balua Patthar	Natural	Uttar Pradesh
340	231	Erode Manjal (Erode Turmeric)	Agricultural	Tamil Nadu
341	613	Marayoor Jaggery (Marayoor Sharkara)	Agricultural	Kerala
342	480	Thirubuvanam Silk Sarees	Handicraft	Tamil Nadu
343	611	Jeeraphool	Agricultural	Chhattisgarh
FROM APRIL 2019 – MARCH 2020				
344	610	Kandhamal Haladi	Agricultural	Odisha
345	612	Odisha Rasagola	Food Stuff	Odisha
346	616	Kodaikanal Malai Poondu	Agricultural	Tamil Nadu
347	586	Pawndum	Handicraft	Mizoram
348	587	Ngotekherh	Handicraft	Mizoram
349	588	Hmaram	Handicraft	Mizoram
350	550	Palani Panchamirtham	Food Stuff	Tamil Nadu
351	582	Tawlhlohpuan	Handicraft	Mizoram

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
352	583	Mizo Puanchei	Handicraft	Mizoram
353	593	Gulbarga Tur Dal	Agricultural	Karnataka
354	641	Tirur Betel Leaf (Tirur Vettila)	Agricultural	Kerala
355	345	Irish Whiskey	Manufactured	Ireland
356	618	Khola Chilli	Agricultural	Goa
357	625	Idu Mishmi Textiles	Handicraft	Arunachal Pradesh
358	400	Dindigul Locks	Manufactured	Tamil Nadu
359	422	Kandangi Saree	Handicraft	Tamil Nadu
360	403	Srivilliputtur Palkova	Food Stuff	Tamil Nadu
361	609	Kaji Nemu	Agricultural	Assam
362	572	Chokuwa Rice of Assam	Agricultural	Assam
363	486	Kovilpatti Kadalai Mittai	Food Stuff	Tamil Nadu
364	602	Chak - Hao	Agricultural	India (Manipur & Nagaland)
365	619	Gorakhpur Terracotta	Handicraft	Uttar Pradesh
FROM APRIL 2020 – MARCH 2021				
366	635	Kashmir Saffron	Agricultural	Jammu & Kashmir
367	423	Thanjavur Netti Works	Handicraft	Tamil Nadu
368	429	Arumbavur Wood Carvings	Handicraft	Tamil Nadu
369	599	Telia Rumal	Handicraft	Telangana
370	658	Sohrai – Khovar Painting	Handicraft	Jharkhand
FROM APRIL 2021 – MARCH 2022				
371	621	Chunar Glaze Pottery	Handicraft	Uttar Pradesh
372	628	Sojat Mehndi	Agricultural	Rajasthan
373	424	Karuppur Kalamkari Paintings	Handicraft	Tamil Nadu
374	431	Kallakurichi Wood Carving	Handicraft	Tamil Nadu
375	589	Bhotia Dann of Uttarakhand	Handicraft	Uttarakhand
376	643	Judima	Manufactured	Assam
377	263	Chios Mastiha	Manufactured	Greece
378	347	Gorgonzola	Food Stuff	Italy
379	366	Brunello Di Montalcino	Manufactured	Italy
380	367	Lambrusco Di Sorbara	Manufactured	Italy
381	368	Lambrusco Grasparossa Di Castelvetro	Manufactured	Italy
382	663	Balaghat Chinnor	Agricultural	Madhya Pradesh
383	660	Kuttiattoor Mango (Kuttiattoor Manga)	Agricultural	Kerala
384	362	Montepulciano D'abruzzo	Manufactured	Italy
385	644	Pithora	Handicraft	Gujarat
386	656	Manjusha Art	Handicraft	Bihar
387	642	Harmal Chilli	Agricultural	Goa
388	662	Edayur Chilli	Agricultural	Kerala

S.No.	Application No.	Geographical Indications	Goods(As per Sec 2 (f) of GI Act 1999)	State
389	648	Uttarakhand Aipan	Handicraft	Uttarakhand
390	651	Munsyari Razma	Agricultural	Uttarakhand
391	652	Uttarakhand Ringal Craft	Handicraft	Uttarakhand
392	653	Uttarakhand Tamta Product	Handicraft	Uttarakhand
393	654	Uttarakhand Thulma	Handicraft	Uttarakhand
394	680	Myndoli Banana	Agricultural	Goa
395	620	Banaras Zardozi	Handicraft	Uttar Pradesh
396	622	Mirzapur Pital Bartan	Handicraft	Uttar Pradesh
397	623	Banaras Wood Carving	Handicraft	Uttar Pradesh
398	624	Banaras Hand Block Print	Handicraft	Uttar Pradesh
399	650	Kumaon Chyura Oil	Agricultural	Uttarakhand
400	655	Goan Khaje	Food Stuff	Goa
401	206	Rataul Mango	Agricultural	Uttar Pradesh
402	590	Tamenglong Orange	Agricultural	Manipur
403	614	Chamba Chappal	Handicraft	Himachal Pradesh
404	645	Mau Saree	Handicraft	Uttar Pradesh
405	647	Lahauli Knitted Socks & Gloves	Handicraft	Himachal Pradesh
406	675	Kanniyakumari Clove	Agricultural	Tamil Nadu
407	592	Hathei Chilli	Agricultural	Manipur
408	640	Naga Cucumber	Agricultural	Nagaland
409	251	Žatecký chmel'	Manufactured	Czech Republic
410	253	Münchener Bier	Manufactured	Germany
411	401	Mahoba Desawari Pan	Agricultural	India (Uttar Pradesh and Madhya Pradesh)
412	355	Toscano	Manufactured	Italy
413	629 & 630	Mizo Ginger	Agricultural	Mizoram
414	636	Dalle Khursani	Agricultural	India (Sikkim and West Bengal)
415	353	Conegliano Valdobbiadene Prosecco	Manufactured	Italy
416	356	Franciacorta	Manufactured	Italy
417	361	Chianti	Manufactured	Italy
418	262	Bayerisches Bier	Manufactured	Germany
419	344	Irish Cream / Irish Cream Liqueur	Manufactured	Ireland
420	467	Narasinghapettai Nagaswaram	Handicraft	Tamil Nadu

Table -2 Agriculture Products with GI Tags (2004-05 to March, 2022)

S. No.	Crop	Agriculture Products with GI Tags
1.	**Rice (18 Types)**	i. Manipuri Black Rice; [1] ii. Assam= Joha Rice, Chokuwa Rice and Boka Chaul; [3] iii. Bihar Katarni Rice; [1] iv. Basmati (Punjab / Haryana / Himachal Pradesh / Delhi / Uttarakhand / Uttar Pradesh / Jammu & Kashmir);[1] v. WB=Gobindobhog Rice and Tulaipanji Rice;[2] vi. Maharashtra= Ajara Ghansal Rice and Ambemohar Rice;[2] vii. Kerala=Navara Rice,Palakkadan Matta Rice, Pokkali Rice, Wayanad Jeera kasala Rice ,Wayanad Gandhakasala Rice, and Kaipad Rice;[6] viii. UP=Kalanamak Rice.[1] ix. TN=Jeeraga Sambha Rice [1]
2.	**Wheat[1]**	Gujarat Bhalia Wheat
3.	**Jowar[1]**	Maharashtra- Mangalwedha Jowar
4.	**Redgram [2]**	KK=Gulbarga TurDal and MS=Navapur Tur Dal
5.	**Chilli [10]**	Kerala Khola Chilli and Edayur Chilli ; AP=Guntur Sannam Chilli; KK=Byadagi Chilli; Goa= Khola Chilli and Harmal Chilli; MS=Bhiwapur Chilli ;Mizo Chilli; Naga Mircha; and Manipur Hathei Chilli.
6.	**Brinjal[2]**	Jalgaon Bharit Brinjal and Udupi Mattu Gulla Brinjal
7.	**Rajma[1]**	Uttarakhand Munsyari Razma.
8.	**Cucumber[1]**	Naga Cucumber.
9.	**Turmeric[4]**	Odisha=Kandhamal Haladi, MS=Waigaon Turmeric and Sangli Turmeric; TN=Erode Turmeric
10.	**Ginger[2]**	Assam Karbi Anglong Ginger and Mizo Ginger.
11.	**Onion[2]**	Bangalore Rose Onion; and MS=Lasalgaon Onion.
12.	**Kalajeera[1]**	Himachali Kala Zeera.
13.	**Guava[1]**	Allahabad Surkha Guava.
14.	**Litchi[2]**	Assam Tezpur Litchi and Shahi Litchi of Bihar.
15.	**Others**	MS=Solapur Pomegranate; Sapota Dahanu Gholvad Chikoo; Nasik Grapes; and Mahabaleshwar Strawberry; Tripura Queen Pineapple, Kashmir Saffron; and Many types in Banana, Mango, Lemon/Orange, Fig, Coconut; Cardamom, Coffee, Tea, Jasmine; etc

Lesser Known facts about Seeds

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1. **Orthodox seeds** are long-lived seeds and can be successfully dried to moisture contents as low as 5% without injury and are able to tolerate freezing. They are therefore, also termed as desiccation tolerant seeds. Their life span can be prolonged with low moisture content and freezing temperatures. Examples are: Most annual and biennial crops and agroforestry species - grains and legumes.The longevity or life span of orthodox seeds may vary from over a year to many hundred years depending upon the particular species and storage conditions. A notable example of a long-lived orthodox seed which survived accidental storage followed by controlled germination is the case of 2000 years old *Judean* date palm seed which was successfully sprouted in 2005. However, the upper survival time limit of properly stored orthodox seeds remains unknown.

2. **Recalcitrant seeds** are remarkably short-lived which cannot be dried to moisture content below 20-30% without injury and are unable to tolerate freezing. They are also termed as 'desiccation sensitive seeds'. Their high moisture content encourages microbial contamination and results in more rapid seed deterioration. Secondly, storage of recalcitrant seeds at freezing temperatures causes the formation of ice-crystals which disrupt cell membranes and causes freezing injury. Therefore, the plants that produce recalcitrant seeds must be stored in growing phase (i.e., as growing plants) rather than as seeds and propagated vegetatively. Examples are: avocado, cacao, coconut, jackfruit, lychee, mango, rubber, tea, some horticultural trees, and several plants used in traditional medicine.The longevity or life span of recalcitrant seeds is remarkably very short. Seeds of *Acer saccharinum, Zizania aquatica, Salix japonica* and *S. pierotti* lose their viability within a week if kept in air.

3. ***Kalanamak*** is one of the finest quality scented rice of India. It derives its name from black husk (*kala* = black; the suffix '*namak'* means salt). This variety has been in cultivation since the Buddhist period (600 BC). It is quite popular in Himalayan Tarai of eastern Uttar Pradesh, India, and is also known as the scented black pearl of Uttar Pradesh. It was also featured in the book 'Speciality Rices of the World' by Food and Agriculture Organization of the United Nations. The crop duration is 6-7 months. It was granted GI (Geographical Indication) Tag in 2012 by GoI with specific areas / locations in 11 districts in UP. The rice produced in the indicated areas alone can be called as *Kalanamak.*

4. **Saffron** is the world's costliest spice. It is obtained by hand-picking the red stigmas from the flowers of *Crocus sativus* (Family: *Iridiaceae*). Each flower gives 3 stigmas. It takes four lakh tiny stigmas to make 1kg Saffron. Iran produces 88% of the world's saffron production. Though India's share is 7%, it is the second largest contributor. Spain and Greece are the other two important

sources. Saffron is propagated by bulbs called corms.

5. The **oldest ^{14}C-dated seed** that has grown into a viable plant was **Judean date palm** (a cultivar of *Phoenix dactylifera*) seed, about 2000 years old, recovered from excavations at Herod the Great's palace at Masada in Israel. It was successfully sprouted in 2005 (Sallon et al, 2008).

6. The **world's smallest seeds**, which have no endosperm and contain underdeveloped embryos, are produced by certain epiphytic orchids (Family *Orchidaceae*) in the tropical rainforest. Some seeds are only 1/300th of an inch (85 micrometers) long, which is below the resolving power of the unaided human eye. One seed weighs only 1/35,000,000th of an ounce (0.81 micrograms). Orchid seeds are dispersed into the air like minute dust particles and come to rest in the upper canopy of rainforest trees, where they eventually germinate.

7. The leaf of a **giant water lily** can support the weight of a small child. Can reach 2.4 m (8') across and is the largest water plant in the world.

8. Some seeds actually **require digestion in order to sprout**. The hard seeds of blackberries (*Rubus* sp- Family-*Rosaceae*), for example, must be abraded/ rubbed in a bird's gizzard (the hind part of the stomach, especially modified for grinding food) in order to break mechanical / physical dormancy. Stomach acids and digestive enzymes of the bird wear down the hard seed coats in the cherries of black berries and make the seeds more permeable to water.

9. ***Bhootjoblika***- (meaning Bhutan pepper in Assamese) Ghost Pepper -is **the hottest chilli** on the planet Earth. It is an interspecific hybrid between *Capsicum chinensis* and *C. frutescens.* In 2007 Guinness Book of World Records certified it as the hottest pepper with the pungency value as - 1041427 SHUs (Scoville Heat Units), named after the American Pharmacist Wilbur Scoville - 1912.The main component for pungency is *Capsaicin* (*8-Methyl-N-Vanillyl-6-nonenamide*) –(C_{18} H_{27} NO_3) an active component of chilli peppers.

10. **Seed Constituents by inheritance** are: Seed Coat- 100% Maternal; Endosperm- 66% Maternal and 34% Paternal; and Embryo – 50 % Maternal and 50% Paternal.

11. **Seed formation, development and maturation** are essential for exploiting the genetic variability, hybridization and varietal development. As Potato flowered and set seed better under Shimla (HP) conditions than anywhere else, the Central Potato Research Institute (CPRI) which was initially set up in Patna in 1949 was shifted to Shimla in 1956. So also , the Sugarcane Breeding Institute (SBI) was located at Coimbatore as early as in 1912 in view of the good flowering and seed set (which are essential for sugarcane breeding) occurring in natural environment under Coimbatore conditions.

12. The concept of **True Potato Seed** (TPS) ie botanical seeds formed by pollination, fertilization, seed development and maturation and raising potato crop from TPS was conceived in India in the early fifties by Dr. S. Ramanujan, the first Director of CPRI (Shimla).

13. **Cryogenic seed storage** is the system in which seed is stored under extremely low temperature of − 196 °C (− 320 °F) brought about by liquid nitrogen ie nitrogen in a liquid state so as to prolong the seed's longevity .

14. The **pollination system** occurring in **Banyan**, Fig etc (*Ficus* sp – Family *Moraceae*) is one of the most complex within flowering plants. In this system, each fig tree species is obligatorily

pollinated by one fig wasp species (*Blastophaga psenes*), and each wasp species can only reproduce in one fig species. Seeds of these species that pass through the digestive system of birds are more likely to germinate and sprout earlier, than the rest.

15. Of an estimated 2,65,000 species of plants only about 7000 have been grown by man in one or the other location for one or the other purpose. Of these, only 20 species supply about 90% of the world's food, and only three crops viz wheat, maize and rice supply more than half of the world's food.

16. Eight genera of *Poaceae* (*Graminae*), seven of *Fabaceae (Leguminosae),* and four from others make up 97% of the major food / feed crops of the world – FAO.

17. "Dahlia" is named after / in honour of Andreas Dahl , an 18th century Swedish Botanist; "Tulip" is from the Turkish pronunciation of the Persian word for *Turban*; and "Dandelion" is from the French *dent-de-lion* ie a lion's tooth.

18. The **remarkable winged seed** of the tropical Asian climbing gourd *Alsomitra macrocarpa* has a wingspan of 5 inches (13 cm) and is capable of gliding through the air of the rain forest in wide circles. This seed reportedly inspired the design of early aircraft and gliders by the Wright brothers.

Remarkable winged seed

19. Seed of **Double Coconut** (*Lodoicea javanica*) , family *Lodoiceae,* weighs around 8 to 15 kg perhaps the largest and heaviest seed known – of course , botanically a fruit ie Drupe.

Seed of Double Coconut

20. The **world's largest seed collection:** Svalbard Global Seed Vault in North Pole -1000km off Norway Coast, at 120 meters depth into the ice rock. 4.5 million seed samples (with about 500 seeds per sample). Stored at minus 180C (naturally prevailing temperature) to conserve valuable genotypes for posterity and the future of humanity.

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