ICRISAT
Public Disclosure

ICRISAT has adopted the CGIAR IA Principles[1] which require that CGIAR Centers carefully consider whether to register/apply for (or allow third parties to register/apply for) patents and/or PVP over the CGIAR Centers' respective Intellectual Assets. Under the policy, as a general rule, such applications will not be made unless they are necessary for the further improvement of the Intellectual Assets or to enhance the scale or scope of impact on target beneficiaries, in furtherance of the CGIAR Vision. This disclosure is in fulfilment of the CGIAR IA Principles to provide justifications for the patent applications filed by ICRISAT.

Title of Patent application	**Molecular markers for the determination of fertility restorer lines**
Type of filing	Indian Application
Date of filing	Provision application was filed on April 24, 2017 (Application No: 201741014402). Complete specification was filed on April 23, 2018.
Name of applicant	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Name(s) of inventor(s)	1. Rachit K Saxena 2. Rajeev K Varshney 3. Kul Bhushan Saxena 4. Chanda Venkata Sameer Kumar
Territory of protection	India
Current status	Yet to be examined by the Patent Office.
Online access to patent application	http://ipindiaservices.gov.in/PublicSearch/PublicationSearch/ApplicationStatus

Background

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important grain legume which is globally cultivated in more than 6 million hectares in the tropical and sub-tropical regions of the developing countries. The dehulled split grains of pigeonpea constitute a major supplement in the diets of a huge proportion of the population. In spite of extensive research and development activities, the yield levels have remained stagnated in pigeonpea. Hybrid development has contributed immensely to the dramatic advances in the quality and quantity of crops produced, which includes combination of desirable characteristics. Hybrids exhibit heterosis, whereby the hybrid progeny exhibit superior growth characteristics than parental lines.

However, in cases of self-pollinated plants, there is a requirement of manual emasculation, i.e, removal of stamens or anthers which results in immense increase in labor cost. Therefore, cytoplasmic genetic male sterility (CGMS) systems in plants are being exploited to facilitate commercial hybrid seed production because of the following advantages:

- Avoidance of enormous manual work of emasculation and pollination
- Potential for large-scale production of F1 seeds
- Potential for speeding up hybridization program

[1] https://www.cgiar.org/wp/wp-content/uploads/ 2018/03/CGIAR-IA-Principles.pdf

The use of CGMS system in developing hybrids is only possible when effective maintainer lines and restorer lines are identified. There are several challenges in identifying fertility restorer lines required for the development of fertile hybrid seeds, especially for pigeonpea. Since pigeonpea is an annual crop species, it takes two years to identify fertility restorer lines on traditional bases - first, crossing known male sterile lines with tester lines and harvest crossed seeds is to be done, followed by the field sowing of crossed seeds and subsequently pollen viability test of plant in the second year.

To overcome these costly delays, ICRISAT scientists developed molecular markers that can be used to identify/differential fertility restorer lines from non-restorer lines. Once identified through use of the markers, the restorer lines can be used immediately, without the need for crossing and phenotyping, thereby saving [two years] of time and associated costs. As part of this invention, ICRISAT scientist developed primers (that can be used to amplify genomic segments associated with fertility restoration in pigeonpea) for accelerating the process of identification of fertility restorer lines of pigeonpea.

Typically, ICRISAT publishes its molecular markers associated with breeding traits of interest so they are available as an international public good. A patent application has been sought exceptionally in this instance as they are associated with a restorer lines that comprises of material component of a CGMS breeding system over which ICRISAT seeks to secure IP protection on the grounds indicated below.

1. With IP protection on this invention, ICRISAT will make sure the free flow access of this invention to the public research
2. With IP protection on this invention, ICRISAT will attract more private partners in HPRC (license can be supplied with no additional cost) and subsequently will enhance their confidence in pigeonpea hybrid technology3.
3. The invention would enable rapid development of hybrids of pigeonpea with enhanced traits. Consequently, the invention would have a direct effect on increasing the yield and quality of pigeonpea production which would increase the standard of living of farmers across the world. Further, the invention would have an impact on improvement in nutritional content of food consumed.

Origin of genetic material from which the innovation is derived

The pigeonpea lines used for the subject invention were acquired by the ICRISAT Genebank prior to year 1993 (before the Biodiversity Act was enacted) from India. Also, India's Biological Diversity Act exempts the crops, from amongst those listed in the Annex-I of the ITPGRFA, for the purpose of utilization and conservation for research, breeding and training for food and agriculture.

The subject invention involves usage of ICPA 2039 and ICPL 87119 as parental lines of mapping population lines obtained from the ICRISAT Genebank that were used for development of the primers.

The invention is related to molecular markers for the identification of the fertility restorer lines in pigeonpea that were selected from the primer sets 1 and 2. One F2 mapping population was developed by crossing CMS line (ICPA 2039) with fertility restorer line (ICPL 87119). ICPA 2039 was developed by crossing ICPW29, an accession of *C. cajanifolius*, a wild relative of pigeonpea, and a short-duration cultivar ICP 1150, both of them are in-trust materials of Indian origin. ICPL 87119 was developed from ICP 1, which is in-trust Indian origin material and in the process ICP 1 was selfed and sixth plant was selected, in subsequent year seeds from sixth plant were planted and plant number 1 was selected to cross with C 11.

The patent on the primers will not restrict the free flow of genetic material which had been used for discovery. The patent application does not extend in any way to the use of those lines; only to the markers that ICRISAT developed using those lines.

Rationale for this patent
This patent is defensive i.e. to prevent companies from capturing the invention and thus allow ICRISAT to keep it open for public use.

As a CGIAR institute, ICRISAT has a responsibility to strengthen the NARS breeding programs. Since the hybrid technology in pigeonpea at NARS institutes is still in early stages, sharing this invention with them will certainly help to enhance their own efforts to develop new high yielding hybrids, with benefits in increased yields, income, food security for farmers.

Dissemination strategy
The markers will be shared at no additional cost to private sector partners involved in ICRISAT's Hybrid Parents Research Consortium (HPRC), as a complementary tool for developing their own breeding program for hybrid development (ICRISAT's HPRC model is fully compliant with the CGIAR IA Principles). This will enhance the confidence of private sector in pigeonpea hybrid technology and would attract more consortium partners.

The markers will also be made available to public sector organizations [e.g., Indian Council of Agricultural Research (ICAR)] for research and development and for emergency use.

In-line with the strategy on protecting ICRISAT's research products approved by its Governing Board in Sep 2016, ICRISAT is committed to follow a prudent IP protection decision-making process and strategic use of IP rights as stated above.

In order to promote accessibility and use of the innovation by third-parties, we have already published this invention as a research article entitled "Molecular mapping and inheritance of restoration of fertility (Rf) in A4 hybrid system in pigeonpea (*Cajanus cajan* (L.) Millsp.). Theoretical and Applied Genetics 131: 1605–1614. Further as mentioned above this invention can also be offered to private sector through HPRC. By providing the access to this invention to public and private sectors, efficiency of their breeding programs will increase and subsequently result in high yielding hybrids in a short time to the farmers.

Compliance with national laws
All our existing and proposed activities would strictly be in-line with the Indian Biological Diversity Act. We are also seeking approval from the National Biodiversity Authority (NBA), India, as the Act states that any person who intends to obtain IPRs for any invention based on any biological resource obtained from India has to seek prior approval. Unless and until this approval is submitted to the Indian Patent Office, they will not even consider the patent application for examination. In addition, the NBA approval and Patent Grant would trigger the specific ABS compliance requirements. ICRISAT adheres to these requirements completely.