One decade of PPV&FRA’s functioning: Crop and institution wise performance and implications

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ABSTRACT

At the time of this study 2270 varieties were registered (about 18%) by the PPV&FRA out of 12691 the applications filed by research organisations, private companies, farmer groups, NGOs and individuals. Large proportion of registered varieties were Extant-varieties (40%), Farmers-varieties (37%) and Extant varieties-of-common-knowledge (10%) while the proportion of New-varieties and Essentially-derived-varieties was considerably low. About 62% applications were under examination or DUS testing. Public-sector (933), including ICAR (718), led varietal registration followed by farmers (832) and private-sector (505). The ratio of varietal registrations to the filed applications was quite high in case of cereals, pulses, oilseeds and cotton while this ratio was dismally low in case of spices and vegetables. Capacity expansion of PPV&FRA, including the DUS testing centres, was very strongly realized for making functioning of the authority more robust and better.

Key words: DUS testing, Essentially derived varieties, Extant varieties, Plant Variety Registration, PPV&FRA, Varieties of common knowledge.

INTRODUCTION

Indian ‘National Agricultural Research System’ (NARS) evolved as a service provider for very large number of small and marginal farmers. Consequently, the Indian NARS was known for providing intellectual products and services either free of cost or at very nominal price to its takers i.e. farmers (Rana et al., 2016). However, in the course of economic development, people associated with agriculture and related businesses started exploiting freely/ cheaply available agricultural intellectual properties of ICAR for profit making. With the result ICAR adopted a policy of protecting and commercialising its Intellectual Property Rights (IPRs) (ICAR, 2006).

Plant varieties constitute one of the most important group of agricultural intellectual properties in Indian NARS and a need to protect varieties was also realized. Consequently, Protection of Plant Varieties & Farmers’ Right (PPV&FR) Act was enacted in 2001. This act was mainly guided by the article 27.3(b) of Trade Related Aspects of Intellectual Property Rights (TRIPS) having provisions for protection of plant varieties either by patents or by an effective sui generis system or by any combination there of (WTO, 2017). Afterwards the Protection of Plant Varieties & Farmers’ Right Authority (PPV&FRA) came into existence in 2005 and started accepting applications for protection of plant varieties on 21 May 2007. Usefulness and relevance of PPV&FRA to various stakeholders, especially the farmers, has been described by Brahmi et al. (2004); Louwaars et al. (2005); Ravi (2004), Venkatesh and Pal (2013) and Venkatesh et al. (2016). This study was carried out to understand the status and pattern of plant varieties registered under Indian NARS.

MATERIALS AND METHODS

The study is based on secondary data collected from the official websites of PPV&FRA (www.plantauthority.gov.in). However, for comparison of concepts and definitions the website of International Union for the Protection of New Varieties of Plants (UPOV; http://www.upov.int/portal/index.html.en) was also consulted. As per objective of the study the data were organised in order to understand status and pattern of plant varieties registered under PPV&FRA.

Status of filed applications in relation to various stages of their processing was studied. Further, crop-wise status of applications filed and registered plant varieties, was carried out. This analysis was extended to type of plant varieties, category of applicants, year-wise performances, major State Agriculture Universities, private (domestic and international) companies and for ICAR level. In addition to this, direct consultation with experts of authority and experts was also considered in order to have better understanding of nature and extent of various developments related to this study.

RESULTS AND DISCUSSION

Overall status of varietal registration process in India:

During 1985-86 and 2014-15 the area under food grains has showed negative growth rate in India [compound annual
While the productivity growth (CAGR: 1.901) has been positive (Priscilla et al., 2017), the growth rate (CAGR): -0.075. Role of new technologies including varieties is imperative under the scenario. PPV&FRA was established in 2005 and it started receiving applications for protection of plant varieties from 21 May 2007 initially with 12 notified crops. Later on, the number of crop species under the preview of the authority increased and reached 114. So far (31 October 2016), 12691 applications have been filed by research organisations, private companies, farmer groups, NGOs and individuals for registration of plant varieties with the authority (Table 1). It can be observed from the table that out of total 12691 applications seeking protection of plant varieties, 2270 have been registered while 64 applications are in the process of being issued certificates. Distinctness-Uniformity-Stability (DUS) testing is being done for 4143 applications and 3714 are under other stages of examination.

**Table 1**: Status of applications filed for registration of plant varieties under PPV&FRA.

| Particulars                              | No.  |
|------------------------------------------|------|
| Registration certificate issued          | 2270 |
| Application closed (rejected)            | 410  |
| Application withdrawn                    | 113  |
| Certificate to be issued                 | 64   |
| Pending legal issue                      | 25   |
| Issued compliance notice to applicant(s) | 26   |
| Onsite testing                           | 37   |
| Other issues                             | 43   |
| **Under processing**                     |      |
| Preliminary examination                  | 1026 |
| Pre-grant opposition invited             | 518  |
| Under DUS testing                        | 4143 |
| Sent to Gene Bank                        | 2    |
| Under examination                        | 3714 |
| Under examination after DUS test         | 247  |
| Recommended for DUS test                 | 29   |
| Recommended for forthcoming EDV meeting  | 7    |
| Recommendation for EVRC                  | 12   |
| Recommendation for onsite testing        | 5    |
| **Total**                                | 12691|

*Note: One filed variety is excluded due to its non-availability of data.

**Table 2**: Crop-wise status of plant varieties registered in India under PPV&FRA.

| Crops                                 | Registered/ filed | Registration (%) of filed |
|---------------------------------------|-------------------|--------------------------|
| Cereals                               | 1608/7089         | 22.68                    |
| Rice                                  | 1062/5385         | 19.72                    |
| Maize                                 | 187/789           | 23.70                    |
| Wheat [including Durum Wheat=9/20; and Dicoccum Wheat=4/6] | 128/307 | 41.69 |
| Sorghum                               | 124/274           | 45.26                    |
| Pearl Millet                          | 107/334           | 32.04                    |
| 138/805                               | 17.14             |
| Oilseeds [including Indian Mustard (Sarsa=61/182, Karan Rai=2/15); Soybean=23; Rapeseed (Toria=12/51, GobhiSarson=5/13); Castor=6/14; Safflower=6/14; Linseed=5/75; and Sesame=5/171] | 212/825 | 25.70 |
| Sunflower [53/131; Groundnut=33/71; | 78/2178           | 3.58                     |
| Vegetables (including Field Pea=26/210; Potato=15/75; Brinjal=10/420; Tomato=8/1099; Onion= 4/42; Cauliflower=3/71; Bottle Gourd=1/67; and Cabbage= 1/22) | 5/198 | 2.53 |
| Okra/Lady’s Finger=10/172; Tomato=8/1099; Onion= 4/42; Cauliflower=3/71; Bottle Gourd=1/67; and Cabbage= 1/22) | 171/1334 | 12.82 |
| Spices [including Turmeric=2/122; Garlic=2/61; and Small Cardamom=1/15] | 38/313 | 12.14 |
| Jute                                  | 14/42             | 33.33                    |
| Coconut                               | 6/24              | 25.00                    |
| **Total**                             | 2270/12691        | 17.89                    |

Commodity/ crop wise status of variety registration:

Despite the number of notified crop species having increased to 114, however, the actual applications filed for registration of plant varieties under PPV&FR system covered only 92 crop species so far (31 December 2016). It can be observed from the Table 2 that out of 2270 registered varieties, Rice has the highest number of varieties (1062), followed by Maize (187), Tetraploid Cotton (136), Wheat (128) and Sorghum (124). Hence, cereals constitute the group of food commodities having the highest number of registered varieties (1608). Cotton is another major crop after Rice and Maize in terms of registration of varieties (171) under two categories viz. Tetraploid Cotton (136) and Diploid Cotton (35) (Table 2). Similarly, the registered Diploid Cotton varieties belonged to main categories of Extant Notified-Typical Varieties (16) and Extant Notified-Hybrid Varieties (9).

The remaining prominent groups classified as oilseeds, pulses, vegetable and spices have respectively, 212, 138, 78 and 5 registrations of plant varieties (Table 2). It can be seen from the table that the Indian Mustard-Sarso (61) and Chickpea (42) are leading crops under oilseeds and pulses, respectively. Under vegetables category 78 plant varieties were registered.
varieties have been registered with the major contribution from Field Pea (26), Potato (15), Brinjal (10), Okra (10) and Tomato (8). Despite being one of the most important commercial crops, Tomato got very small number of varieties registered out of a large number of filed applications (1069). The first application for tomato variety registration was filed as late as 2010. Inability of applicants to comply with the procedural requirements (provision of mandatory information and material) was another crucial reason for poor success rate (0.73%) in terms of proportion of tomato varieties registered out of the filed applications.

Applications for registration of Turmeric varieties were filed very late (38 in 2016 and 42 in 2015 while the first one was filled in 2011) most of which were under preliminary process of scrutiny and only two (out of 122) (Table 2) got registered (both were the ICAR varieties). In case of Garlic the two successful applications (out of 61) were also from government institutions. The only successful application of Small Cardamom out of 15 filed for registration was also from ICAR. Sugarcane is another leading commercial crop (after Cotton) where 38 plant varieties out of 313 applications got registered. In case of

Table 3: Type of registered varieties under PPV&FRA.

| Type of varieties       | Category of applications                                                                 | Registered varieties (No.) |
|-------------------------|------------------------------------------------------------------------------------------|-----------------------------|
| Essentially             | Transgenic & Hybrid=1                                                                     | 1                           |
| Derived Varieties (EDV) | [Tetraploid Cotton(1)]                                                                    |                             |
|                         | Hybrid=159                                                                               |                             |
|                         | [Maize(43), Pearl Millet(33), Cotton (31; Tetraploid Cotton=21; Diploid Cotton=9), Rice(16), Sorghum (11), Sunflower(6), Okra/Lady’s Finger(5)] | 903                         |
|                         | Typical=697                                                                              |                             |
|                         | [Rice(139), Wheat(94), Cotton (49; Tetraploid Cotton=33; Diploid Cotton=16), Indian Mustard-Sarso (44), Chickpea(39), Sugarcane(38), Groundnut(30), Maize(30), Sorghum(25), Field Pea(20), Soybean(20), Pigeon Pea(19), Potato(13), Green Gram(11), Lentil(11), Pearl Millet(11), Brinjal(10), Jute(10)] |                             |
|                         | Others=9                                                                                 |                             |
|                         | [Onion(3)]                                                                               |                             |
|                         | Unclassified=3                                                                            |                             |
| Extant (VCK)            | Transgenic=1                                                                             | 223                         |
|                         | [Tetraploid Cotton(1)]                                                                    |                             |
|                         | Transgenic & Hybrid=14                                                                    |                             |
|                         | [Tetraploid Cotton(14)]                                                                  |                             |
|                         | Hybrid=97                                                                                |                             |
|                         | [Maize(23), Pearl Millet(16), Rice(16), Sunflower(14), Tetraploid Cotton(14)]           |                             |
|                         | Typical=74                                                                               |                             |
|                         | [Sorghum(25), Rice(18), Indian Mustard-Sarso (10), Maize(8)]                            |                             |
|                         | Others=21                                                                                |                             |
|                         | [Pearl Millet(11)]                                                                       |                             |
|                         | Unclassified=1                                                                            |                             |
| Farmer                  | Typical=831                                                                              | 832                         |
|                         | [Rice(805)]                                                                              |                             |
|                         | Others=1                                                                                 |                             |
|                         | [Wheat(1)]                                                                               |                             |
| New                     | Transgenic=6                                                                              | 311                         |
|                         | [Tetraploid Cotton(6)]                                                                   |                             |
|                         | Transgenic & Hybrid=28                                                                   |                             |
|                         | [Tetraploid Cotton(28)]                                                                 |                             |
|                         | Hybrid=102                                                                               |                             |
|                         | [Maize(39), Rice(27), Pearl Millet(19), Sorghum(11)]                                   |                             |
|                         | Typical=138                                                                              |                             |
|                         | [Sorghum(31), Rice(26), Sunflower(25), Maize(15), Wheat(10), Pearl Millet(8), Tetraploid Cotton(8)] |                             |
|                         | Others=34                                                                                |                             |
|                         | [Rice(11), Maize(8)]                                                                     |                             |
|                         | Unclassified=3                                                                            |                             |

Grand total 2270
Sugarcane, 37 registered varieties out of 54 applications were the ICAR varieties (Table 7). However, the proportion of registered varieties out of the total applications filed for registration was quite high in Jute (33%) and Coconut (25%) as compare to Cotton (12.82%) and Sugarcane (12.14%) (Table 2). At all India level only 8 varieties of tomato got registered (out of 1099 applications); while 6 registered varieties of tomato were the ICAR varieties (out of 21 applications) (Table 7).

**Types of varieties registered under PPV&FRA:** Only one variety (Tetraploid Cotton) was registered under EDV category which belonged to Transgenic and Hybrid category out of the total 2270 registrations (Table 3) filed by Vikram Seeds Limited in 2010. The highest number of plant varieties registered (903) were Extant Notified Varieties because of less time taken for the registration under this type of varieties, followed by Farmer Varieties (832) and New Varieties (311). Among all type of varieties, rice has been mostly registered under ‘Typical’ category of applications, whereas maize and cotton were mostly registered under ‘Hybrid’ and ‘Transgenic and Hybrid’ categories, respectively.

Very high strategic significance has been associated with the pulses especially in terms of their role in nutritional security and sustainable production in India (Martolia and Rana, 2016; Pathak et al., 2017). Pulses had the highest number of registrations in ‘Typical’ category of Extant Notified type of varieties. The registered Farmers’ Varieties belonged to the traditional crops like rice and wheat only. None of the spices’ varieties have been registered under New Varieties. Among the 1062 registered varieties of rice, Farmers Varieties constituted the highest proportion (805) followed by Extant Varieties, including all categories of applications (181) and New Varieties (64). Majority of Tetraploid Cotton registered varieties belonged to the categories of Extant Notified-Typical Varieties (33), New Varieties-Transgenic and Hybrids (28), Extant Notified-Typical Varieties.

**Table 4:** Status of registration of plant varieties according to categories of applicants.

| Category of applicants | Registered | Filed | Registration (%) of filed applications |
|------------------------|------------|-------|---------------------------------------|
| Public institutes      | 933        | 1758  | 53.07                                 |
| Private sector         | 505        | 3404  | 14.84                                 |
| Farmer                 | 832        | 7527  | 11.05                                 |
| Individual breeder     | 1          | 2     | 50.00                                 |
| **Total**              | **2270**   | **12691** | **17.89**                           |

**Table 5:** Performance of SAUs versus ICAR institutes in terms of varietal registration process.

| Public Institutes                     | Registered | Filed | %Reg.* | Major crop registered                                    |
|---------------------------------------|------------|-------|--------|----------------------------------------------------------|
| ICAR institutes                        | 718        | 1188  | 60.44  | Rice(109), Wheat(93), Maize(83), Sorghum(49), Indian Mustard- Sarso(38) |
| All SAUs                              | 200        | 500   | 40.00  | Cotton(53); Diploid Cotton=19, Tetraploid Cotton=34, Rice(44), Sorghum(23), Wheat(16), Cotton(7); Diploid Cotton=4, Tetraploid Cotton=3, Rice(4), Chickpea(3), Sorghum(6), Cotton(4); Diploid Cotton=1, Tetraploid Cotton=3, Groundnut(3), Wheat(3) |
| Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola | 31         | 70    | 44.29  | Sorghum(6), Tetraploid Cotton(6), Rice(5) |
| Mahatma Phule Krishi Vidyapeeth, Rahuri | 24         | 67    | 35.82  | Sorghum(6), Tetraploid Cotton(6), Rice(5) |
| Tamil Nadu Agricultural University, Coimbatore | 20         | 22    | 90.91  | Rice(14), Black Gram(2), Rapeseed-Toria(2) |
| Orissa University of Agriculture & Technology, Bhubaneswar | 19         | 24    | 79.17  | Rice(14), Black Gram(2), Rapeseed-Toria(2) |
| University of Agricultural Sciences   | 19         | 46    | 41.30  | Groundnut(5), Wheat(5), Cotton(4); Diploid Cotton=2, Tetraploid Cotton=2 |
| CCS Haryana Agricultural University   | 17         | 18    | 94.44  | Cotton(12); Diploid Cotton=3, Tetraploid Cotton=9, Wheat(4) |
| Punjab Agricultural University, Ludhiana | 10         | 89    | 11.24  | Cotton(3); Diploid Cotton=1, Tetraploid Cotton=2, Indian Mustard-Sarso(2), Rapeseed- Mustard(2), Cotton(5); Diploid Cotton=2, Tetraploid Cotton=3, Sorghum(3) |
| Vasantrao Naik Marathwada Agricultural University, Parbhani | 8          | 10    | 80.00  | Cotton(6); Diploid Cotton=4, Tetraploid Cotton=2, Rice(2) |
| Navsari Agricultural University, Gujarat | 8          | 26    | 30.77  | Rice(17), Cotton(6); Diploid Cotton=2, Tetraploid Cotton=4, Indian Mustard-|
| Other SAUs                            | 44         | 128   | 34.38  | |

*Reg.= % registration out of the field application
Hybrid Varieties (21), Extant Varieties of Common Knowledge (VCK)-Hybrids (14) and Extant VCK-Transgenic and Hybrids (14).

**Registration of plant varieties according to categories of applicants:** Applicant-wise status of registration of plant varieties has been given in Table 4. Public sector institutes covered institutions such as research institutes, State Agricultural Universities (SAUs) and national boards. These bodies filed 1758 applications for registration of plant varieties out of which they successfully registered 933 varieties. Public Sector Institutes got the highest success rate in registration of varieties (53.07% of filed applications). However, the Private Sector including domestic and international companies had a lower rate of registration (14.84%) out the total applications filed. Under the category ‘Farmer’ (individual farmers and farmers’ organizations) about 11% filed applications got registrations certificates for their varieties. The lower proportion of successful applications under ‘Farmer’ category is mainly due to large number of filed applications (7527) and lack of sufficient compliance and follow-up in the process. The ‘Individual Breeder’ category had just two filed applications and one registered variety.

**Comparison of performance between ICAR institutes and SAUs:** The comparative performance of public sectors institutes i.e. ICAR institutes and SAUs, in terms of varietal registration, has been presented in Table 5. ICAR institutes has performed much better on every front of varietal registration process i.e. number of filed and registered varieties as well as the proportion of registrations out of the filed applications. Among SAUs, PDKV Akola registered highest number of 31 varieties followed by MPKV Rahuri (24) and TNAU Coimbatore (20) while CCS-HAU Hisar got highest registrations out of the filed applications (94.44%), followed by TNAU Coimbatore (90.91%), VNMIK Parbhani (80%) and OUAT Bhubaneswar (79.17%). Rice, wheat and maize varieties were the major constituents of registered varieties by ICAR while cotton, rice and sorghum crops got highest number of registered varieties in SAUs.

**Comparison of performance between domestic companies and international MNCs:** Comparative situation of varietal registration by Indian domestic companies and international MNCs has been presented in Table 6. Domestic companies showed better performance in terms of registered varieties, filed applications and proportionate success in obtaining registrations as compared to the international MNCs. The Kaveri Seed Company Ltd. (with 87 registrations) was at the top of the list followed by Nuziveedu Seeds Ltd. (55), Nirmal Seeds Pvt. Ltd. (30) and JK Agri Genetics Ltd. (27) were the major domestic companies. On the other hand, Pioneer Overseas Corporation (27 registrations) followed by Syngenta India Ltd. (24) and Monsanto India Ltd. (20) were major international MNCs in the list. The domestic companies had higher success rate in terms of getting varieties registered (near 20% of filed applications) while

| Private sector                        | Registered | Filed | % Reg.* | Major crop registered                                      |
|--------------------------------------|------------|-------|---------|-----------------------------------------------------------|
| Domestic companies                   | 350        | 1761  | 19.88   | Cotton(76); Diploid Cotton(11), Tetraploid Cotton(64), Rice(52), Maize(51), Pearl Millet(40), Sorghum(39), Sunflower(35) |
| Kaveri Seed Company Ltd              | 87         | 215   | 40.47   | Sunflower(29), Maize(23), Sorghum(16), Pearl Millet(10)   |
| Nuziveedu Seeds Ltd                  | 55         | 668   | 8.23    | Rice(22), Pearl Millet(16), Maize(7)                      |
| Maharashtra Hybrid Seeds Company Ltd | 31         | 188   | 16.49   | Cotton(11); Diploid Cotton=2, Tetraploid Cotton=9, Sorghum(5), Pearl Millet(4), Rice(4) |
| Nirmal Seeds Pvt Ltd                 | 30         | 121   | 24.79   | Rice(9), Cotton(5); Diploid Cotton=2, Tetraploid Cotton=3, Indian Mustard-Sarso(3), Sorghum(3), Wheat(3) |
| JK Agri Genetics Ltd                 | 27         | 154   | 17.53   | Tetraploid Cotton(9), Maize(5), Pearl Millet(5), Sorghum(5) |
| Rasi Seeds Pvt Ltd                   | 19         | 55    | 34.55   | Tetraploid Cotton(16), Maize(3)                           |
| Devgen NV                            | 17         | 61    | 27.87   | Sorghum(10), Rice(5), Pearl Millet(2)                     |
| Vibha Agrotech Limited               | 17         | 40    | 42.50   | Tetraploid Cotton(7), Sunflower(4), Pearl Millet(3)       |
| M/S Shakti Vardhak Hybrid Seeds Pvt Ltd | 16     | 29    | 55.17   | Cotton(11); Diploid Cotton=6, Tetraploid Cotton=5, Indian Mustard-Sarso(5) |
| Ankur Seeds Pvt Ltd                  | 12         | 24    | 50.00   | Cotton(7); Diploid Cotton=1, Tetraploid Cotton=6, Rice(4) |
| Bisco Biosciences Pvt Ltd            | 10         | 61    | 16.39   | Maize(10)                                                 |
| DCM Shriram Limited                  | 10         | 89    | 11.24   | Tetraploid Cotton(4), Maize(3)                            |
| Krishidhan Seeds Pvt Ltd             | 10         | 43    | 23.26   | Rice(8)                                                   |
| Nusun Genetic Research Ltd           | 9          | 13    | 69.23   | Tetraploid Cotton(6), Sunflower(2)                        |
| International MNCs                   | 88         | 624   | 14.10   | Maize(36), Rice(22), Pearl Millet(17)                     |
| Pioneer Overseas Corporation         | 27         | 156   | 17.31   | Maize(9), Pearl Millet(9), Rice(7)                        |
| Syngenta India Ltd                   | 24         | 370   | 6.49    | Rice(10), Maize(9), Sunflower(4)                          |
| Monsanto India Limited               | 20         | 34    | 58.82   | Maize(18), Tetraploid Cotton(2)                           |
| Bayer Bioscience Pvt Ltd             | 12         | 24    | 50.00   | Pearl Millet(8), Sorghum(2)                               |
| Bayer Crop Science                   | 5          | 40    | 12.50   | Rice(5)                                                   |

*Reg.* = % registration out of the field application

Electronic copy available at: https://ssrn.com/abstract=3388499
this percentage was about 14% in case of international MNCs. Cotton, rice, maize and pearl millet varieties topped the list of registrations among domestic companies while maize, rice and pearl millet varieties were the main registrations by the international MNCs.

Crop wise varietal registration by ICAR: ICAR being the premier organisation engaged in agricultural R&D and registration of plant varieties in India, crop wise varieties registered by them has been presented in Table 7. Rice was the most important crop in India with 109 registered varieties followed by wheat (93), maize (83) and sorghum (49) establishing the importance of cereal crops in overall agricultural R&D in ICAR. However, the proportion of registrations out of filed applications was relatively lower in cereal crops viz. Rice (about 51.9%), wheat (68%), maize (64%) sorghum (68%) compared to oilseed crops like linseed, rapeseed-toria, sunflower, Safflower and Indian Mustard-Karan Rai having 100% registrations. The proportion of registrations was relatively higher in case of other oilseed and pulse crops indicating that the PPV&FRA was conducive to the needs of the country and ICAR aptly acted to the contemporary needs of the country. The coverage of ICAR in terms of varietal registration has been quite diverse and desirable.

Majority of the rice (97; 89%) and wheat (87; 93.5%) registered varieties by ICAR belonged to Extant Notified-Typical Varieties (Table 8). However, maize varieties were registered by ICAR under well diversified categories viz. Extant Notified-Hybrid Varieties (34; 41%), Extant Notified-Typical Varieties (28; 34%), New-Hybrid Varieties (14; 17%) and New-Typical Varieties (5; 6%). Sorghum is another important crop where ICAR registered varieties under Extant VCK-Typical Varieties (20; 41%) followed by New-VCK Typical Varieties (12; 24.5%) and Extant Notified-Hybrid Varieties (9; 18%). Other important crops like sugarcane (37; 100%), chickpea (35; 97%), Indian Mustard-Sarson (37; 97%); field pea (20; 77%), pigeon pea (19; 95%); groundnut (19; 100%);

| Crop            | Registered | Filed | Registered (%) of filed |
|-----------------|------------|-------|-------------------------|
| Rice            | 109        | 213   | 51.17%                  |
| Wheat           | 93         | 136   | 68.38%                  |
| Maize           | 83         | 129   | 64.34%                  |
| Sorghum         | 49         | 72    | 68.06%                  |
| Sugarcane       | 37         | 54    | 68.52%                  |
| Chickpea        | 36         | 50    | 72.00%                  |
| Indian Mustard-Sarso | 38   | 41    | 92.68%                  |
| Pearl Millet    | 33         | 59    | 55.93%                  |
| FieldPea        | 26         | 37    | 70.27%                  |
| Green Gram      | 26         | 37    | 70.27%                  |
| Pigeon Pea      | 20         | 25    | 80.00%                  |
| Groundnut       | 19         | 29    | 65.52%                  |
| Soybean         | 19         | 29    | 65.52%                  |
| Jute            | 14         | 28    | 50.00%                  |
| Potato          | 13         | 19    | 64.24%                  |
| Lentil          | 11         | 14    | 78.57%                  |
| Black Gram      | 10         | 16    | 62.50%                  |
| Kidney Bean     | 9          | 11    | 81.82%                  |
| Okra/Lady’s Finger | 8     | 11    | 72.73%                  |
| Tetraploid Cotton | 8   | 11    | 72.73%                  |
| Brinjal         | 8          | 18    | 44.44%                  |
| Coconut         | 6          | 11    | 54.55%                  |
| Tomato          | 6          | 21    | 28.57%                  |
| Linseed         | 5          | 5     | 100.00%                 |
| Castor          | 4          | 6     | 66.67%                  |
| Durum Wheat     | 4          | 7     | 57.14%                  |
| Rapseseed-Toria | 4          | 4     | 100.00%                 |
| Sunflower       | 3          | 3     | 100.00%                 |
| Safflower       | 2          | 4     | 50.00%                  |
| Cauliflower     | 2          | 4     | 50.00%                  |
| Dicoccum Wheat  | 2          | 4     | 50.00%                  |
| Diploid Cotton  | 2          | 3     | 66.67%                  |
| Indian Mustard-Karan Rai | 2 | 2 | 100.00% |
| Turmeric        | 2          | 6     | 33.33%                  |
| Cabbage         | 1          | 2     | 50.00%                  |
| Onion           | 1          | 1     | 9.09%                   |
| Small Cardamom  | 1          | 3     | 33.33%                  |
| Others          | 0          | 61    | 0.00%                   |
| Total           | 718        | 1188  | 60.44%                  |

| Type of varieties | Category of applications | Registered varieties (No.) |
|-------------------|--------------------------|----------------------------|
| Extant (notified) | Hybrid=81                | 643                        |
|                   | [Maize(34), Pearl Millet(17), Sorghum(9), Rice(5)] |
|                   | Typical=520[Rice(97), Wheat(87), Indian Mustard-Sarso(37), Sugarcane(37), Chickpea(35), Maize(28), Field Pea(20), Groundnut(19), Pigeon Pea(19), Soybean(19), Potato(13), Lentil(11), Pearl Millet(11), Jute(10), Green Gram(8), Brinjal(8), Kidney Bean(7)] |
|                   | Others=4                 |                            |
|                   | [Chickpea(1), Maize(1), Rice(1), Onion(1)] |
|                   | Unclassified=38          |                            |
| Extant (VCK)      | Typical=22               | 23                         |
|                   | [Sorghum(20)]            |                            |
|                   | Others=1                 |                            |
|                   | [Rice(1)]                |                            |
| New               | Hybrid=17                | 52                         |
|                   | [Maize(14), Sorghum(2), Tetraploid Cotton(1)] |
|                   | Typical=35               |                            |
|                   | [Sorghum(12), Wheat(6), Rice(5), Maize(5), Jute(4)] |
| Grand total       |                          | 718                        |
soybean (19; 100%); jute (10; 71.5%); potato (13; 100%); lentil (11; 100%) and kidney bean (7; 78%) were largely registered under Extant Notified-Typical Varieties).

Year wise varietal registration pattern at All India level: Year wise national status of varietal registration for one decade of PPV&FRA’s service has been depicted in Fig 1. During initial years the Extant Notified Varieties existing in the NARS were presented for registration. As the registration process of such varieties is less time consuming and fairly easy the success rate of varieties getting registered (out of the filed applications) was quite high (72.45%) in 2007 which fell gradually to 23.89% (2010). After the system getting adequately trained and sensitised, large number of varieties were filed in 2011 (1361 varieties) with 62.23% rate of registration. Year 2012 onward, private companies and farmers’ organisations started filing very large number of applications with inadequate compliance hence the success rate in terms of varietal registration gradually decreased.

Year wise varietal registration pattern at ICAR level: The pattern of year wise varietal registration by ICAR institutes has been presented in Fig 2. The number of varieties presented for registration was exceptionally high during 2007 and 2008 due to the Existing Notified Extant Varieties. Although the number of varieties presented for registration considerably decreased after the year 2008, yet the success rate in getting varieties registered (out of filed applications) was throughout impressive. During last three years i.e. 2014 to 2016 the success rate appears subdued but it is largely due to pending decisions on registration. Higher success rate of ICAR varieties in terms of registration proportion, compared to non-ICAR entities, has also been described in Tables 4 and 5.

SUMMARY AND CONCLUSION

Plant varieties being very important constituent of agricultural intellectual properties in Indian NARS, PPV&FR Act was passed in 2001 in order to protect rights of not only the breeders but farmers also. PPV&FR Authority came into being in 2005 and started its functioning on 21 May 2007. So far (31 December 2016) the Authority has received 12691 applications under 92 crop species (114 permitted) out of which 2270 plant varieties have been registered. About 47% registered varieties belong to rice followed by maize, tetraploid cotton, sorghum and wheat. About 71% registered plant varieties are from cereals. Among type of registered varieties about 40% are Extant Notified followed by Typical Farmers Varieties (36.7%) and New Varieties (less than 14%). About 41% plant varieties were registered by public sector institutions while farmers registered nearly 37% and private sector registered only 22% plant varieties. Out of the public-sector institutions ICAR registered 77% varieties while SAUs
registered 21.5%. Out of 718 plant varieties registered by the ICAR about 15% were rice varieties followed by wheat (13%), maize (11.6%) and sorghum (7%). The overall focus of ICAR was much diversified towards oilseeds, pulses, vegetables and spices crops as compared to the overall varietal registration process at the national level. Majority of the varieties registered at ICAR was Extant Notified (89.5%) followed by about 7% new varieties and slightly more than 3% Extant Varieties of Common Knowledge. Ratio of registered varieties of total filed applications was much higher in ICAR (60.44%) compared to SAUs (40%), private sector (14.84%), farmers (11%) and overall country level (17.9%).

In conclusion, PPV&FRA is playing very important role of protecting rights of plant breeders as well as farmers. As other groups or organizations might have limited interest or compliance capabilities the better inferences can be drawn out of the ICAR’s numbers. Taking numbers of ICAR into consideration it can be concluded that the organization is paying higher emphasis on issues related to national interest as the proportion of registered varieties out of the filed ones is quite high in case of pulses and oilseeds. ICAR has adequately diversified focus on registering varieties of all major crops while the other groups have very high focus on cereal crops. Future of agriculture in general and India in specific will be guided by IPRs to a very large extent hence PPV&FRA may include more crops under their ambit and modify rules and procedures in line with the needs of the time.

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