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Intellectual property protection: An emphasis on plant varieties

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ABSTRACT

The enactment of Intellectual Property protection laws globally and involvement of private seed industry in India had become indispensable for protection of IP in agriculture as whole and plant varieties in particular. For protection of plant varieties, the Distinctiveness Uniformity and Stability (DUS) descriptors of various crops (vegetables, field crops, floriculture, horticulture crops, etc.) were developed and notified by the Protection of Plant Varieties and Farmers Rights (PPV and FR) Registry for testing. With increasing awareness of IPR in agriculture, the submission of applications of plant varieties from the notified crops for registration has started for protection under the Registry. Subsequently, public sector (Indian Council of Agricultural Research (ICAR) and Agricultural Universities (AUs)); private sector; and farmers started submission of Extant, New and Essentially Derived Varieties (EDVs) applications in the notified crops. The study period pertaining to years 2007-2015 reveals that public sector has contributed immensely in protecting plant varieties of self-pollinated crops (food, fibre and pulses crops), whereas the private sector's focus is largely confined towards open-pollinated varieties. Private sector has submitted highest number of 'EDVs' of tetraploid cotton. Progress in farmers' varieties for protection under PPV and FRA reinforces the importance and uniqueness of this *sui generis* system adopted by India. It is, expected that the prospects of variety and seed development sectors will improve overtime. This trend also opens the scope for the plant breeders to design varietal development programmes for desirable traits in various crop species.

Key words: DUS, EDVs, Extant, Farmers', New, Plant varieties and PPV&FR Act

To inculcate the intellectual property culture in agriculture, ICAR had formulated the guidelines for Intellectual Property Management and Technology Transfer/ Commercialization in 2006 and established the three-tier mechanism of Intellectual Property (IP) management. It is designed as IP/Innovation Management system in which each institute of Indian Council of Agricultural Research [supported/guided by middle-tier of Zonal units and top-tier at Intellectual Property and Technology Management (IP and TM) Unit, ICAR Hqrs] implements a coordinated system for best IP management practices. IP culture had been institutionalized in the ICAR system and in State Agricultural Universities (SAUs). Studies (ICAR/DARE Annual Reports 2008 to 2015) revealed increasing Intellectual Property Rights (IPR)-filing (patents, plant variety rights, copyrights, trademarks, design etc.) in ICAR.

Intellectual property rights in case of plant varieties refers to the legal protection of plant varieties developed by the plant breeder or group of persons or a farmer or group of farmers or any institution. This has happened with the involvement of seed industry in agriculture. After recognising the sovereign rights to the nations for Plant Genetic Resources in the Convention on Biological Diversity (CBD), 1993, and India being a member of World Trade Organization was obliged to comply with the provisions of Trade Related Intellectual Property Rights (TRIPs), 1995, in all fields of technology, including agriculture. WTO under TRIPs Article 27.3 (b) offered the options of patents or an effective *sui generis* system or combination of both to its member countries for the protection of plant varieties (Brahmi *et al*. 2004, Bala Ravi 2004). Subsequently, India had opted the *sui-generis* system for the protection of plant varieties in compliance of Article 27.3 of TRIPS Agreement and enacted PPV and FR Act, 2001. The Rules for this Act were notified in 2003 (The Gazette of India 2001, 2003). This act became effective with the establishment of PPV and FR Authority in 2005, and aims to promote the development of new plant varieties.The legal protection of plant varieties including safeguarding breeders', farmers' and community rights in India had started after inception of this unique national law. This legislation delineates the breeders' rights and farmers' rights with a separate chapter in the Act. This Act provides nine specific rights (Bala Ravi 2004, Ramanna 2006), viz. rights to seed; rights to registered varieties; rights

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to reward and recognition; rights to benefit sharing; rights to information and compensation for crop failure; rights to compensation for disclosed use of traditional varieties; rights to adequate availability of registered material; rights to free services; and protection from legal infringement in case of lack of awareness.

The development of new and improved varieties of plants and availability of such varieties to Indian farmers is of crucial importance for a sustained increase in agriculture productivity. Looking into these facts, the appropriate policy frame work and programme interventions were adopted to stimulate the varietal development in tune with market trends, scientific-technological advances, suitability for harsh climate, locational adaptability and farmers' needs. PPV and FR Authority undertakes the registration of Extant, New, Essentially Derived Varieties (EDV) and farmers' varieties through plant variety protection Registry on the basis of varietal characteristics. The variety which is eligible for the registration under the Act should fulfil the requirements of the Distinctiveness, Uniformity and Stability (DUS). In other words, the candidate variety which is distinguishable by at least one essential characteristic from the varieties of common knowledge in any country at the time of filing applications. The variety must be uniform to express the essential characteristics generation after generation. Once the application in the Authority is accepted, two years rigorous testing under DUS criteria is mandatorily required for newly bred varieties and one-year testing needs for extant varieties. Afterwards, the passport data is published in the journal of the Authority, i. e. Plant Variety Journal of India to invite the claim or opposition from the opponent if any within 90 days after publication. The validity of the certificate varies for the trees, vines and other crops. The varieties having unique characteristics received from the various states like traditionally rice growing states and varieties of concerned crops undergo for one year testing for confirming DUS characteristics as per the laid guidelines. Other criteria for testing of these varieties are similar to the 'new' and 'extant' varieties (Srivastava and Chaudhary 2013).

There have been consistent and continuous development efforts of the Indian agriculture research and development. After inception of the PPV and FR Act, IP portfolio of intellectual assets in agriculture as whole and plant varieties in particular has led to positive changes in the overall scenario of protection for IP of NARS (National Agricultural Research System includes ICAR and AUs).

Keeping in view the institutionalization and developed scenario of IP protection culture in agriculture, the study specially focussed on both type of plant variety; and sector wise analysis of plant variety protection from NARS and other public sector organizations, private sector, and farmers' after the notification of agricultural field crops, horticultural and plantation crops for registration.

MATERIALS AND METHODS

The information has been collected, compiled and analysed from secondary source of data from ICAR institutes, PPV and FR Authority's website and Annual Reports of ICAR/DARE. The study was narrated on type of plant varieties in different sectors like Public sector (ICAR and AUs), other public sector organization, private and farmers' sector. The data on plant varieties of different crops were analysed sector wise for the period of 2007-2015 using temporal tabular analysis particularly focusing on the plant varieties submitted as well as registered with the PPV and FR Authority.

RESULTS AND DISCUSSION

The XIth and XIIth Plan scheme of IPR in ICAR and its stable institutionalization has opened the new way to move forward to strategically strengthen IP environment in agriculture. A robust IPR-led innovation system in the public sector research organizations had provided ample opportunities to encourage partnerships with public and private seed industries/agencies and it would definitely lead to development of new plant varieties and increase the vast scope of agricultural research areas particularly on breeding of high-yielding plant varieties with new traits for resistance to various stresses/climate resilient agriculture.

Protection status of plant varieties

Analysis of submitted plant varieties (type of varieties) to the PPV&FR Authority: Out of the total plant varieties (10939 till 12 January 2016) submitted to the PPV and FR Authority for registration, the highest number of farmers' varieties (6310) were attempted for submission to the Registry followed by Extant (2372), New (2118) and EDV (139) (Fig. 1).

Sector wise analysis of plant varieties submitted to the PPV and FR Authority: Since inception of PPV and FR Act, the filing of applications of plant varieties for protection started under PPVFR authority by public sectors and other sectors. There were 1433 varieties which include 1059 from ICAR (872 Extant; 185 New; and 2 EDVs) and 374 from AUs (320 Extant; and 54 New) were submitted with the authority during the period (Fig 2). The private sector has also exhibited significant incremental interest in number of filing of 3179 plant varieties (1168 Extant; 1874 New; and 137 EDV) for protection during the study period. Data of crop varieties submitted from public and private sector shows that there has been higher number of plant varieties application submission for protection from private sector in comparison to public sector. The 'Extant' varieties submission position has been observed at higher side from the NARS than the private sector. The other public sector organizations (other than NARS) have also contributed by submitting 17 (12 Extant and 5 New) varieties in different species. The private sector has continuously shown interest in submitting the 'New' varieties and 'EDVs' for protection. The farmers' have also shown interest in protecting their intellectual assets. A total of 6310 farmers' varieties were filed with the registry for safeguarding the accruing benefits from their IP assets in future. Out of the total farmer's

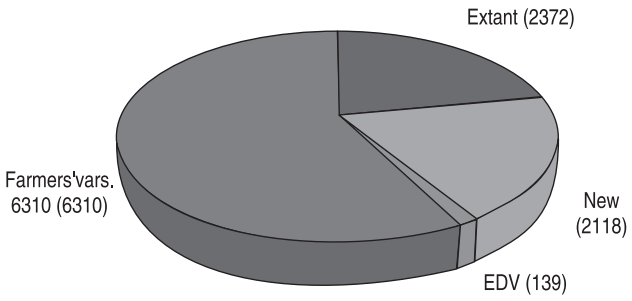

Fig 1 Analysis of type of varieties submitted to PPV and FR Registry

varieties submitted for protection, rice crop occupies big chunk of 4309 (68.2%) varieties. This shows great interest of farmers' in rice which seems to be larger contributor in agro-biodiversity among food crops in India.

A total of 76 crop species have been contributed in submission of plant varieties during the period by the public, private and farmers' sectors for the registration in the PPV and FR Registry. The group of crops species which have been contributed in submission of varieties for protection were cereals, pulses, oilseed, food and fibre crops including millets, cash crops, horticultural crops (include fruits, plantation crops, spices, seed spices, vegetables, medicinal and aromatic crops, and floriculture crops) and forest trees etc. (Table 1).

The percent increase of submission of plant varieties was observed to be highest in case of farmers' varieties (58%) followed by 29% from private sector and 13% contribution from public sector (ICAR and AUs) (Fig 2). The continual improvement in filing of plant varieties to the Registry by the ICAR has exhibited an increasing trend. In 2007, only 277 (272 extant and 5 new) varieties were filed and up to 12 January 2016, the figure has increased to 1059 (872 Extant; 185 new; and 2 EDV. Out of the total 102 notified crop species for registration, the ICAR has contributed in submission in 45 crop species; 37 from AUs; 38 from private sector; 67 crops from farmers' and; 8 crop species from other public sector organization. The analysis of submission of plant varieties for protection in India for the period 2007-2015 revealed that ICAR had submitted highest number of varieties in case of rice (185) followed by maize (127) and wheat (121). The Agricultural Universities have also shown interest in submission of plant varieties contributing maximum in case of rice (71) followed by tetraploid cotton (66) and sorghum (40). Private sector has expressed keen interest in submitting plant varieties for protection in the crops like tetraploid cotton (963) which include (130) EDVs followed by maize (365) and rice (341) during the period. The highest number of farmers' varieties were submitted to the PPV and FR Registry in case of rice (4309) followed by mango (180) and maize (170). The overall highest percentage of submission of varieties was analysed in case of rice (44.05%) followed by tetraploid cotton (9.51%) and maize (6.10%) (Table 1). The higher submission of varieties in these crop species is in consonance with the available rich diversity in these crops. This analysis also reveals that the public sector's research focus is on the development of varieties that can be recurrently grown for years together by the farmers' unlike the hybrids. These varieties have been mainly developed by the breeding methods like simple selection or with controlled pollination. Therefore, it is clear from the trend of submission of varieties during this period that the NARS has focused on those varieties where farmers' can get farm-saved-seed for raising crops in subsequent years. Most of the hybrids or its parental lines have been filed under the extant category due to commercialization scope of these varieties. The private sector has focused on submission of varieties including 963 varieties of tetraploid cotton, out of which 130 are EDVs and this clearly indicates the interest of this sector in producing hybrids and to get good commercial benefit. This study is in conformity with Srivastava *et al*. (2015) who found that the public sector has preferably filed applications of 'extant' varieties notified in the Seed Act, 1966. Private sector mainly focused on submission of cross pollinated crops where hybrids are being developed through exploitation of heterosis.

Analysis of registered plant varieties (both variety and sector wise): A total of 1935 plant varieties (1076 Extant; 256 New; 1 EDV; and 602 Farmers' varieties) have been

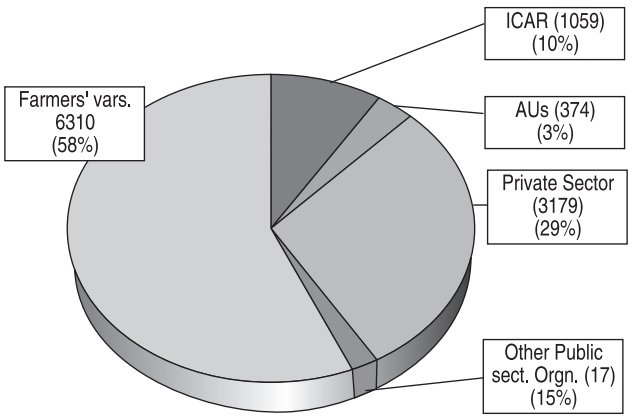

Fig 3 Sector wise analysis of plant varieties submitted to the PPV and FR Registry

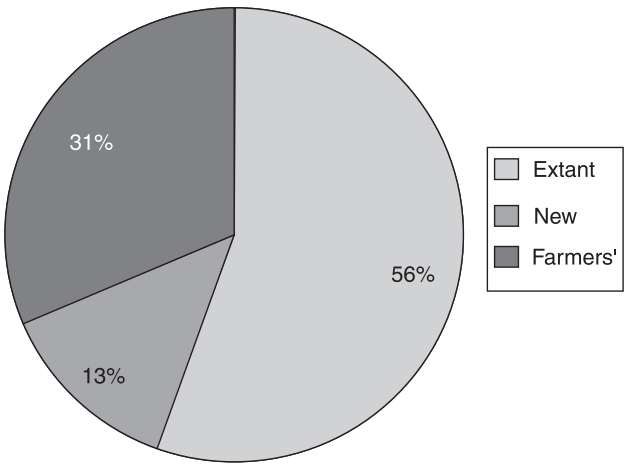

Fig 3 Analysis of registered plant varieties to the PPV and FR Registry

Table 1 Status of submitted crop varieties from ICAR and AUs (NARS); private sector; other public sector organizations; and farmers to PPV and FR Authority during (2007-2015*)

Crop	ICAR				Agricultural universities (AUs)			Private sector				Public sector organization other than NARES			Farmers total	Grand total	Percentage
	Extant	New	EDV	Total	Extant	New	Total	Extant	New	EDV	Total	Extant	New	Total			
All cardamom	1			1												1	0.01
Apple									1		1				1	2	0.02
Acid lime															5	5	0.05
Apricot															1	1	0.01
Barley								6	3		9				32	41	0.37
Banana															15	15	0.14
Bell pepper															4	4	0.04
Blackgram	14	2		16	8	1	9	1	1		2				80	107	0.98
Bitter gourd					3		3	22			22				28	53	0.48
Bottle gourd					1		1	9			9				28	38	0.35
Black pepper	4			4											7	11	0.10
Brinjal	13	2		15	4	1	5	120	131		251				66	337	3.08
Brahmi															1	1	0.01
Cabbage	2			2					17		17				2	21	0.19
Chilli								74	60		134				29	163	1.49
Castor	5	1		6				3	6		9				11	26	0.24
Cauliflower	3			3	1		1	9	44		53				6	63	0.58
Chickpea	48	3		51	11	2	13								66	130	1.19
Coconut	11			11	3	1	4								8	23	0.21
Casurina													1	1		1	0.01
Cucumber					2		2	22	8		30				16	48	0.44
Coriander						1	1								30	31	0.28
Chrysanthemum	2			2									2	2	2	6	0.05
Canna		1		1												1	0.01
Dicoccum wheat	1			1	2		2									3	0.03
Diploid cotton	1	2		3	35	3	38	9	13		22				4	67	0.61
Durum wheat	5			5	4		4		2		2				2	13	0.12

(*Contd.*)

Table 1 (*Continued*)

Crop	ICAR				Agricultural universities (AUs)			Private sector				Public sector organization other than NARES			Farmers total	Grand total	Percentage
	Extant	New	EDV	Total	Extant	New	Total	Extant	New	EDV	Total	Extant	New	Total			
Eucalyptus													1	1		1	0.01
Fenugreek															17	17	0.16
Field pea	33	3		36	1	1	2		2		2				44	84	0.77
Finger millet															8	8	0.07
Foxtail millet															8	8	0.07
Ginger	3			3											48	51	0.47
Greengram	35	2		37	8		8	1	2		3				43	91	0.83
Garlic					2	1	3					6		6	39	48	0.44
Groundnut	21			21	15	2	17		1		1				21	60	0.55
Grapes		1		1					4		4				5	10	0.09
Gladiolus		1		1												1	0.01
Indian mustard (Sarso)	37	3		40	7		7	18	10		28	2	1	3	79	157	1.44
Indian jujube (Ber)					2		2								162	164	1.50
Isabgol															1	1	0.01
Indian mustard (Karan Rai)	2			2											5	7	0.06
Jute	21	7		28	1	1	2		4		4				6	40	0.37
Kidney bean	10			10				1			1				59	70	0.64
Lentil	14			14											60	74	0.68
Linseed	5			5	1		1								48	54	0.49
Maize	72	55		127	2	3	5	105	260		365				170	667	6.10
Mango															180	180	1.65
Muskmelon		1		1												1	0.01
Menthol mint												1		1	3	4	0.04
Onion	7	2		9	1		1	9			9	2		2	13	34	0.31
Okra/Lady's minger	8			8	4		4	53	71		124				13	149	1.36
Orchid															4	4	0.04
Pearl millet	55	4		59	1	1	2	71	155		226				11	298	2.72

(*Contd.*)

Table 1 (*Concluded*)

Crop	ICAR				Agricultural universities (AUs)			Private sector				Public sector organization other than NARES			Farmers total	Grand total	Percentage
	Extant	New	EDV	Total	Extant	New	Total	Extant	New	EDV	Total	Extant	New	Total			
Pigeonpea	23	2		25	3	4	7	2	23		25				115	172	1.57
Pomegranate															2	2	0.02
Potato	16	2		18				7	14		21				24	63	0.58
Pumpkin															28	28	0.26
Rapeseed (Toria)	4			4	3		3								26	33	0.30
Rapeseed (Gobhi Sarson)					6		6	1			1					7	0.06
Rice	154	29	2	185	54	17	71	77	262	2	341				4309	4906	44.85
Rose								7			7				4	11	0.10
Safflower	3			3	5		5								5	13	0.12
Small cardamom	2			2				1			1				11	14	0.13
Sorghum	41	30		71	37	3	40	25	79		104				40	255	2.33
Sesame					9		9								50	59	0.54
Soybean	21			21	2		2	3	11		14				11	48	0.44
Sugarcane	46	8		54		2	2	1		1	2	1		1	21	80	0.73
Sunflower	4			4	5		5	24	86	1	111				1	121	1.11
Sweat Orange															1	1	0.01
Tetraploid Cotton	7	3		10	60	6	66	368	465	130	963				1	1040	9.51
Tomato	11	2		13	9		9	102	122	3	227				26	275	2.51
Turmeric	6			6											77	83	0.76
Wheat	101	20		121	8	4	12	6	17		23				65	231	2.11
Watermelon								11			11					11	0.10
Walnut															2	2	0.02
Total	872	185	2	*1059*	320	54	*374*	1168	1874	137	*3179*	12	5	17	*6310*	10939	100.00

Source:Information compiled from PPVR and FR Authority's website (12th January' 2016); and ITMUs/ZTMCs of ICAR Institutes.

Table 2 Crop wise registered varieties of ICAR; AUs; Private sector; Farmers; and other public sector organizations during (2009-2015)*

Crop	ICAR			AUs			Private				Public Sector other than NHRDF			Farmers total	Grand total	Percentage
	Extant	New	Total	Extant	New	Total	Extant	New	EDV	Total	Extant	New	Total			
Blackgram	10	0	10	4		4	1			1					15	0.78
Brinjal	7	0	7	2		2									9	0.47
Bread wheat	84	1	85	5		5	2	3		5				2	97	5.01
Castor	3	1	4				2	1		3					7	0.36
Cauliflower	2	0	2												2	0.10
Chickpea	35	0	35	2		2								1	38	1.96
Cotton				5		5	3	6		9					14	0.72
Cabbage	1		1												1	0.05
Coconut	6		6												6	0.31
Diploid cotton	1	1	2	21		21	2			2					25	1.29
Durum wheat	1		1	2		2									3	0.16
Field pea	18		18												18	0.93
French bean	2		2												2	0.10
Garden pea	8		8												8	0.41
Groundnut	19		19	14		14									33	1.71
Greengram	26		26	2		2									28	1.45
Garlic				2		2					1		1		3	0.16
Indian mustard	40		40	8		8	12	1		13				1	62	3.20
Jute	10	4	14												14	0.72
Kidney bean	6		6												6	0.31
Linseed	4		4												4	0.21
Lentil	11		11												11	0.57
Maize	64	16	80	2	1	3	45	27		72				5	160	8.27
Mungbean							1			1					1	0.05
Okra	6		6	1		1									7	0.36

(*Contd.*)

Table 2 (*Concluded*)

Crop	ICAR			AUs			Private				Public Sector other than NHRDF			Farmers total	Grand total	Percentage
	Extant	New	Total	Extant	New	Total	Extant	New	EDV	Total	Extant	New	Total			
Onion	1		1	2		2					2		2		5	0.26
Pearl millet	33		33	1		1	44	26		70					104	5.37
Pigeonpea	20		20											3	23	1.19
Potato	13		13				1	2		3					16	0.83
Rice	102	5	107	47	1	48	39	55		94				588	837	43.26
Rapeseed (Toria)	4		4	3		3									7	0.36
Rapeseed (Gobhi sarson)				4		4	1			1					5	0.26
Small cardamom	1		1												1	0.05
Sugarcane	37		37												37	1.91
Sunflower	3		3	6		6	13	24		37					46	2.38
Soybean	19		19	2		2	1			1					22	1.14
Safflower	3		3	3		3									6	0.31
Sorghum	35	11	46	25	1	26	12	25		37				1	110	5.68
Sesame				5		5									5	0.26
Tetraploid cotton	6	2	8	33		33	29	35	1	65					106	5.48
Tomato	5		5												5	0.26
Turmeric	2		2												2	0.10
Wheat	8	5	13	7	1	8	1	1		2				1	24	1.24
Total	656	46	702	208	4	212	209	206	1	416	3		3	602	1935	100.00

*Source:Information compiled from PPV and FR Authority's website (upto 1st December 2015); and ITMUs/ZTMCs of ICAR Institutes.

protected during the period (till 1st December 2015) in the registry. Fifty-six per cent of the total plant varieties protected in the PPV and FR registry are extant varieties followed by 31% farmers' and 13% new plant varieties (Fig 3). The sector wise protection analysis of these varieties shows that the highest number of plant varieties have been protected by the ICAR (out of 702 varieties: Extant 656 and New 46) followed by farmers' (602); private sector (416: Extant 209; New 206; and EDV 1); AUs (212: Extant 208; and New 4) and other public sector organization (3 Extant) (Fig 4). The public sector (ICAR) has registered highest number of plant varieties so far in rice (107) followed by wheat (85) and maize (80) which are staple food crops (Table 2). AUs have registered highest number of rice varieties (48) followed by tetraploid cotton (33) and sorghum (26). Private sector has registered the highest number of varieties in case of rice (94), followed by maize (72) and tetraploid cotton (66) for protections. The contribution from public sector (NARS) for protection of varieties has also shown encouraging results in case of pulse crop varieties. As a result, chickpea (37), greengram (28) and field pea (18) varieties have been registered. This shows the strength and contribution of public sector organizations towards nutritional security in the country. The current overall scenario of registered varieties reveals that the public sector (NARS and other public sector organizations) varieties (917) are at the forefront followed by registering of farmers' varieties in the Registry (Fig 4). The overall crop wise scenario of registered varieties appears highest in case of rice (43.26%) followed by maize (8.27%) and sorghum (5.68%) (Table 2). This reveals clear cut picture of distinctness, uniformity as well as genetic purity of material available in these crop varieties. It also supports the availability of rich diversity and systematic breeding programmes successfully conducted in these crops in the country.

Conclusion

IP protection in agriculture has steadily progressed after institutionalization of three-tier IP management in ICAR particularly in the field of plant variety protection. In this regard, the overall higher trend of percentage submission of plant varieties was shown in rice followed by tetraploid cotton and maize which indicates the rich biodiversity in these crop species. The highest number of varieties in rice was submitted for protection as it has the Indian centre of origin which clearly exhibits the maximum diversity available in this crop. The introduced crops from South-Mexican and Central American centre of origin of crops like maize and tetraploid cotton, respectively, showed the heterotic source for hybrid breeding programme wherein the private sector seems more interested to protect varieties in these crops. Inferences from the submission scenario of varieties for protection in India showed that the private seed industry has expressed great interest in commercially viable crops. However, farmers are focussing on the traditionally available/cultivable crop varieties in their agro-climatic zones. The overall submission of plant varieties were largely observed in case of rice (44.85%) followed by tetraploid cotton (9.51%) and maize (6.10%). The highest number of applications of plant varieties registered to the authority were exhibited in case of rice (43.26%) followed by maize (8.27%) and sorghum (5.68%) which shows that apart from the various reasons of qualifying the varieties in DUS criteria, there could have been systematic pre-breeding and breeding programmes had been attempted during development of varieties in these crops.

After enactment of PPV and FR act, it can be commented that the significant progress has been made in the field of IPR in agriculture.The progress has clearly brought out the intent domain of the stakeholders. Hence, the uniqueness of this protection law has gained cognizance globally as per TRIPS agreement of WTO. Thus, the PPV and FR Act can be considered as an effective plant variety protection system which can be a model for developing countries having similar agro-climatic and socio-economic condition.

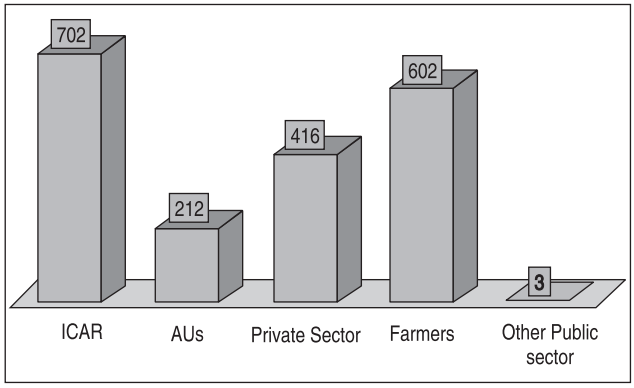

Fig 4 Sector wise plant varieties registered withthe PPV&FR Registry

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