

How US sorghum seed distributions undermine the FAO Plant Treaty's Multilateral System

Overlap and use of the CGIAR and US sorghum genebank collections

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Overlap and use of the CGIAR and US sorghum genebank collections

New data from ICRISAT and the US Department of Agriculture and a comparison of genebank records indicates that half or more of ICRISAT's sorghum genebank collection is also being distributed outside of the Multilateral System. This yawning gap creates an economic incentive for the Multilateral System and its benefit sharing requirements to be avoided.

USDA's sorghum germplasm customers, who are primarily corporate and commercially oriented academic breeders, are taking advantage of this perverse incentive. In the past six years, they have ordered four times more ICRISAT genebank seeds from USDA than from ICRISAT itself. Globally, it is likely that more distributions of Multilateral System sorghum take place without an SMTA than occur with one.

Recipients of large USDA distributions of sorghum are not obligated to share benefits and do not comply with the restrictions of the SMTA on patenting parts of the material. Under present circumstances, the promise of the Multilateral System cannot be fulfilled for sorghum, a crop of global food security importance, particularly in Africa. Further, even if the US ratifies the ITPGRFA, a vexing problem has been created by USDA's recent massive distributions of Multilateral System sorghum germplasm to institutions potentially not bound by the Treaty's provisions, such as Texas A&M University.

The collections

ICRISAT and USDA operate two of the world's most important sorghum genebanks. Procedures to access seeds from the two collections, however, are quite different. Almost 97% of ICRISAT's sorghum genebank collection is part of the Multilateral System under the ITPGRFA. Access to it is granted through an ITPGRFA-compliant Standard Material Transfer Agreement (SMTA). On the other hand, with few exceptions,¹ the United States collection is freely distributed to domestic and international requesters.

While both collections are approximately the same size – 37,000 – 38,000 accessions – determining the overlap between the collections is difficult due to incompatible recordkeeping systems. Basic information about the collections is summarized in the following chart:

¹ In some cases in which the US has acquired sorghum from ICRISAT since the establishment of the ITPGRFA Multilateral and its predecessor agreement between CGIAR and FAO, USDA distributes these seeds with a disclaimer stating that acceptance of the germplasm constitutes acceptance of the terms of the in-trust agreement. However, no material transfer agreement, ITPGRFA-compliant or otherwise, is executed.

Chart 1		
	World Sorghum Collection	US National Sorghum Collection
Institution	International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT)	Plant Genetic Resources Conservation Unit (PGRCU), Agricultural Research Service (ARS), US Department of Agriculture (USDA)
Location	Patancheru, Andra Pradesh, India	Griffin, Georgia, US
Number of Accessions	37,949	37,124
In-Trust Accessions	36,771 (97%)	<i>unknown</i> ²
Access	SMTA / Multilateral System	Free

The US and ICRISAT sorghum collections share common roots in international agricultural research projects dating to the 1950s. This research was funded by governments, the Rockefeller Foundation, and other public and non-profit entities. Thus, in addition to having acquired some seeds from each other over, for many years both ICRISAT and USDA have held copies of the same seed collections assembled as long as 60 years ago. While this is common knowledge among agricultural scientists in relevant fields, little research has sought to quantify the overlap between the collections, an issue of both scientific and policy import.

A preliminary calculation of overlap between the US and ICRISAT collections

Calculating the overlap of accessions between the US and ICRISAT sorghum collections is not straightforward because the two institutions have different naming systems for sorghum seed, and do not reliably cross-reference each other's seed accession identifiers in their databases.³ Thus, simply searching the US collection for sorghums with associated ICRISAT accession identifiers (or vice-versa) yields a dramatic undercount of the duplication between the collections.

To more accurately compare the collections, an alternative approach is required. Frequently, both USDA and ICRISAT indicate a third party's name for a particular seed, called an alternative identifier. On the basis of these alternative identifiers, additional matches can be made between the gene banks. Alternative identifiers relevant for sorghum include those assigned by IBPGR, predecessor to Bioversity International, ORSTOM, the former French government research agency, and national research centers in China, Sudan and elsewhere. More rarely, matches can be established using local names, when other data points, such as date and location of collection, concur.

It is thus possible to more accurately determine the overlap between the collection using alternative identifiers, although even these methods are imperfect in that they are still likely to still result in undercounting. This is because duplication may exist that is not reflected in the alternative identifiers, or the relevant alternative identifiers themselves are not recorded. The method requires a tedious manual comparison of genebank records.

² Since, as of 31 January 2010, the US has not ratified the ITPGRFA, the US has not committed its collection to the International System, however, the US collection contains many of the same sorghum accessions that have been declared in-trust by ICRISAT.

³ For this study, the USDA Genetic Resources Information Network (GRIN) was consulted (<http://www.ars-grin.gov>) for US data. For CGIAR data, both SINGER (<http://singer.cgiar.org>) and the ICRISAT germplasm website (<http://www.icrisat.org/what-we-do/crops/sorghum/Project1/pfirst.asp>) were consulted.

Manual comparison of all of the approximately 37,000 records in each collection was beyond the scope of this research. Instead, a sample of 2,655 ICRISAT genebank sorghum accessions in the Multilateral System (7.2% of the total genebank) was manually cross-referenced with the USDA database. These collections were selected from five countries in different regions of Africa (Togo, Zambia, Tanzania, Burkina Faso, and Algeria) as well as China, a secondary center of diversity, and Turkey and Argentina to represent germplasm from outside sorghum diversity centers.

Three criteria were determined. First, the number of ICRISAT's genebank accessions from each country that are in the Multilateral System were counted. Second, the number of those accessions that are also held by USDA was determined by comparison. Finally, the proportion of the USDA collection for a given country that is also ICRISAT in-trust germplasm was calculated.

The results are summarized in the following chart:

Chart 2			
Region COUNTRY	ICRISAT Seed bank # in trust	Proportion of in-trust accessions also held by USDA	Proportion of USDA seeds in the multilateral system via ICRISAT
West Africa			
Togo	294/294	247/294 (84%)	247/558 (44%)
Southern Africa			
Zambia	362/365	310/362 (86%)	310/570 (54%)
East Africa			
Tanzania	718/721	267/718 (37%)	267/330 (81%)
Sahel			
Burkina Faso	548/551	348/548 (64%)	348/352 (99%)
North Africa			
Algeria	24/24	19/24 (75%)	18/38 (47%)
Other Regions			
Turkey	51/51	49/51 (96%)	49/103 (48%)
Argentina	21/42	21/21 (100%)	21/69 (30%)
China	637/641	324/637 (51%)	324/1103 (29%)

Out of 2,655 ICRISAT in-trust sorghum accessions sampled, 1,305 (49.2%), were found to be available from USDA with no Plant Treaty SMTA. Looking at Africa specifically, the proportion of in-trust germplasm being distributed outside the multilateral system by USDA rises. The sample included 1,946 African in-trust accessions, over three fifths (1191, or 61.2%) of which were found in the USDA collection.

In the case of some countries, almost all of the sorghum seed being distributed by USDA is ICRISAT in-trust material. Out of 352 Burkinabe sorghums distributed by USDA, 348 (99%) are declared in-trust by ICRISAT. Similarly, 267 (81%) of USDA's 330 Tanzanian sorghums are ICRISAT in-trust germplasm.

Even in the case of China, the country with the lowest observed correlation between the genebanks, more than half of ICRISAT's in-trust collection is being distributed outside Multilateral System by USDA (324/637, or 51%).⁴

Thus, in summary, using a conservative methodology to sample eight representative countries, this study concludes that, at a minimum, half (49.2%) of ICRISAT's in-trust sorghum germplasm is being distributed with no ITPGRFA MTA by USDA. In addition, because the methodology used here is more prone to undercounting than false positives, the actual overlap is likely to be

⁴ It also bears noting that, sometimes, the "street runs both ways", such as that of Argentinean sorghum. All of ICRISAT's Argentinean sorghum collection is distributed by USDA; but this is because all of ICRISAT's Argentinean sorghum was acquired from USDA.

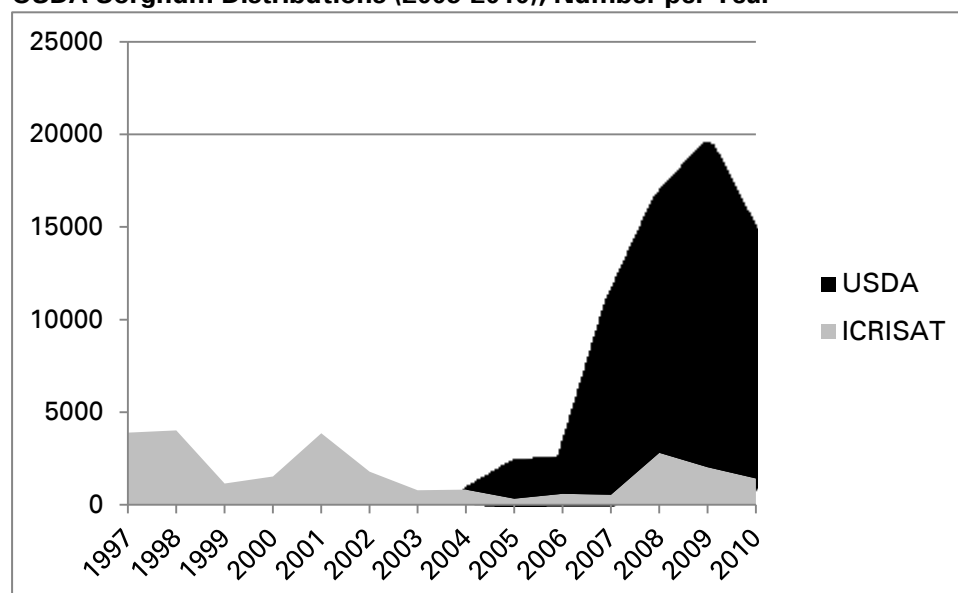
significantly higher, greater than two thirds for African sorghums and one half for the collection as a whole.

Utilization of the collections

If USDA's sorghum collection significantly replicates ICRISAT's in-trust collection, and USDA distributes seeds outside the ITPGRFA Multilateral System, then does it follow that germplasm users would prefer to use USDA's 'no strings attached' seeds over ICRISAT's? If so, what implications does this have for the Multilateral System?

Data collected from ICRISAT and USDA on utilization of the two sorghum collections suggests that at least some major sorghum breeders avoid in-trust germplasm from ICRISAT in favor of acquiring the same accessions, with no SMTA, from USDA.

**ICRISAT Sorghum Genebank Distributions (1997-2010)
USDA Sorghum Distributions (2005-2010), Number per Year⁵**



While both ICRISAT and USDA have experienced fluctuations in the number of sorghum genebank distributions made in recent years, much heavier use of the USDA collection is apparent. Each year between 2005 and 2010, inclusive, USDA has distributed at least 3 times more sorghum than ICRISAT (2006), and as much as 8.5 times the CGIAR center's total (2009).

Unlike as some might fear, the ITPGRFA SMTA *per se* does not appear to have discouraged utilization of ICRISAT's sorghum collection. Distributions by ICRISAT have increased since it began using the SMTA in 2007.

Use of USDA's collection, however, has been much more active and experienced greater growth. Between 2005 and 2010, ICRISAT distributed 7,719 sorghum samples from its sorghum genebank. As previously noted, 97% of the genebank is held in-trust, meaning that about 7,500 accessions were distributed in the multilateral system.

⁵ Sources: Laxmipathi Gowda CL and HD Upadhyaya (2006). International Crop Germplasm Exchange at ICRISAT. Indian J of Plant Gen Res 19:3. For 2007-2010. Upadhyaya HD (2011). Personal Communication. USDA data is available for 2005-2010. Source: Pederson GA (2011). Personal Communication. (Pederson is Acting Sorghum Curator for the USDA Plant Genetic Resources Conservation Unit.)

The data in Chart 2 provides a factor by which the number of USDA distributions that are in-trust germplasm may be estimated. In the sample of eight countries, 50.7% (1584/3123) of USDA seeds were found to be declared in-trust by ICRISAT.

Between 2005 and 2010, USDA distributed a total of 59,055 sorghum genebank accessions. Thus, based on the sample, it is estimated that USDA made 30,000 distributions of in-trust seeds in the 2005-2010 time period (59,055 x .507).

Put differently, over the past six years and outside the Multilateral System, USDA has distributed four times more in-trust genebank sorghum than ICRISAT itself. This information is summarized in Chart 3. It should also be recalled that this estimate for the proportion of USDA's distributions that are in-trust is likely an undercount, meaning that the actual number of USDA distributions of in-trust germplasm may be higher.

Chart 3		
Institution	USDA (ARS PGRCU)	ICRISAT (sorghum genebank)
Sorghum Distributions, 2005-2010 (inclusive)	59,055	7,719
Percent Estimated to be In-Trust Varieties	50.7% (See Table 2)	97% (See Table 1)
Estimated Number of Distributions of In-Trust Varieties, 2005-2010	30,000	7,500
Number Distributed with Signed ITPGRFA SMTA ⁶	None	6,500 (88%)

The implications of this data for ITPGRFA are clear. The majority of the in-trust ICRISAT collection is available without an SMTA through the US Department of Agriculture. As the SMTA requires benefit sharing payments in the event of commercialization/restricted access for further breeding, the lack of an MTA creates an economic incentive for sorghum breeding companies and institutions to request germplasm from USDA, thereby allowing the Multilateral System and its benefit sharing requirements to be avoided.

While a variety of factors are likely at play, it is proposed that one of the reasons why USDA's sorghum collection is much more active than ICRISAT's is the lack of an MTA.

To wit, USDA, in the last six years, has distributed four times as much in-trust sorghum as ICRISAT. While other seed banks of governments that are party to the ITPGRFA distribute sorghum seeds within the Multilateral System, under present conditions, USDA's transfers of in-trust sorghum outside of the Multilateral System constitute a large percentage, and perhaps the global majority, of distributions of in-trust sorghum.

Under these circumstances, the promise of the Multilateral System cannot be fulfilled.

Who is receiving in-trust sorghum varieties from USDA?

If USDA is the world's largest distributor of in-trust sorghum genebank seeds, even though the US has not ratified the ITPRGFA, who are USDA's customers?

⁶ 7,500 less 97% of those accessions distributed in 2005 and 2006 under the superceded FAO-ICIRSAT agreement. It is assumed that ICRISAT has used an ITPGRFA SMTA for all transfers for the years 2007-2010. USDA does not execute an MTA when distributing in-trust germplasm. Instead, in some but not all cases, it uses the disclaimer described in note 1.

The question assumes a particular importance as the United States has recently moved toward ratification of the ITPGRFA.⁷ If US ratification occurs, then USDA will presumably begin to participate in the Multilateral System. This participation, however, will not be retroactively applied to germplasm transfers that occurred in the years leading up to ratification. It will therefore be important for the Plant Treaty to identify where large collections of in-trust sorghum may be held that were acquired from USDA prior to US ratification.

Data from USDA indicates that the largest users of its sorghum collection are US universities, followed by companies (domestic and foreign), and then the US government's own researchers. Chart 4 summarizes the number of distributions made to each type of recipient each year.

Chart 4				
Utilization of the USDA Sorghum Collection by Year and Requester Type⁸				
Year	Academic	Companies	US Government	Other
2005	863	286	643	247
2006	568	235	884	301
2007	4302	3191	2872	174
2008	7825	2321	3255	488
2009	9648	4948	1862	1003
2010	5452	5328	1546	756
TOTAL	28658	16309	11062	2969

To identify those making greatest use of in-trust sorghum acquired from USDA, a list of all institutions requesting more than 50 sorghum accessions in a given year, from 2005 through 2010, was also obtained from USDA.⁹ This data did not include any subsequent transfers from USDA's clients to third parties (which are not tracked by USDA).

Chart 5		
Ten Largest Recipients of Sorghum from the USDA Collection, 2005-2010¹⁰		
Recipient Location	Number of Distributions	Comment
Texas A&M University <i>College Station, TX US</i>	18,733	Breeds sorghum for agrofuel, food, and feed uses, agreements with Ceres, Chevron, and others.
USDA ARS <i>Various Locations, US</i>	11,422	Distributions to USDA research scientists for non-conservation research and development.
NuFarm Ltd <i>Laverton, Victoria, Australia</i>	3,100	NuFarm's sorghum breeding is based at Vega, TX US, via 2009 acquisition of MMR Genetics. ¹¹ Also via MMR, NuFarm has sorghum relationships with Monsanto and BP partner Mendel Biotechnology

⁷ Congressional Record (2010). Executive Report of the Committee – Treaty. 15 December. p. S10303.

⁸ Here, academic requesters include US state agricultural research agencies, frequently attached to a public university. Division of domestic and foreign companies was not useful, as many sorghum companies operating in the US have foreign ownership or are conducting sorghum R&D under contract with foreign companies.

⁹ Pederson GA (2011). Personal Communication.

¹⁰ In this data, only orders in a single year summing greater than 50 accessions are included. Thus these figures may somewhat under count the number of accessions provided to each recipient.

¹¹ NuFarm (2009). NuFarm acquires leading US sorghum seed Companies (news release). 5 August.

Ceres <i>Thousand Oaks, CA US</i>	3,024	Agrofuel sorghum breeder, partner with Texas A&M. Owners include Belgian and UK investors.
University of Nebraska <i>Lincoln, NE US</i>	2,452	Grain and agrofuel breeder.
Chromatin <i>Chicago, IL US</i>	1,816	Alliance with Syngenta, has bought smaller US sorghum companies.
Iowa State University <i>Ames, IA US</i>	1,719	Recent emphasis on agrofuels.
G and S Crop Services <i>Unknown (Iowa) US</i>	1,246	This little known company is interested in phytoconverted varieties primarily from Africa. ¹²
Cornell University <i>Ithaca, NY US</i>	1,197	Breeds for food and agrofuel, has support from Syngenta, US government, and others.
Kansas State University <i>Manhattan, KS US</i>	944	Develops grain, herbicide resistant, and agrofuel varieties. Sorghum R&D relationship with DuPont (Pioneer Hi-Bred).

Several of the largest recipients of USDA sorghum are known to be pursuing intellectual property rights. These patent and plant breeder's rights applications are discussed in recent publications of the African Centre for Biosafety.¹³ They are summarized below:

Chart 6	
Recent Intellectual Property Claims on Sorghum Varieties and/or Genes by Top Recipients of USDA Sorghum Germplasm	
Institution	Claims
Texas A&M University	US Plant Variety Protection application 201000093. US Patent Applications 20100064382, 20100050501, 20100024065, US Patent 7,582,809.
Ceres	US Plant Variety Protection applications 201000045 and 201000046.
Chromatin	US Patent Application 20100205686
Kansas State University	US Patent Applications 20100293628 and 20100115663.
USDA Agricultural Research Service	US Patent 7,582,809.

Some of the intellectual property claims identified in Chart 6 can be directly linked to in-trust germplasm. These include US Patent 7,582,809, owned by Texas A&M and USDA (as well as Brazil's Embrapa), which claims an aluminum tolerance gene from a Tanzanian in-trust farmers' variety of sorghum.¹⁴¹⁵ In other cases, including both of Ceres plant variety protection applications, the company has refused to identify the origin of the germplasm that is claimed, arguing that it is a trade secret.¹⁶ This is also the case with much of the activity in Texas A&M University's large sorghum breeding program.

¹² Slings R (2009). E-mail to William Rooney, Texas A&M University. Obtained under the Texas Public Information Act. Slings is general manager of G and S.

¹³ Please consult the African Centre for Biosafety website to access its recent sorghum-related publications, which discuss each of the IPR claims in Chart 6 in greater detail. See URL: <http://www.biosafetyafrica.net>

¹⁴ ICRISAT designation IS 7173, alternative designations PI 533869 (USDA) and SC 283 (Texas A&M).

¹⁵ Hammond (2009). Africa's Granary Plundered - Privatisation of Tanzanian Sorghum Protected by the Seed Treaty. African Centre for Biosafety. December.

¹⁶ In 2009 and 2010, Texas Public Information Act requests were lodged with Texas A&M University for information including the parentage of the two Ceres varieties (Ceres and Texas A&M have a research collaboration). Ceres opposed these requests on trade secret grounds and the University ultimately refused to release the information on

It thus may be concluded that institutions that are top recipients of USDA sorghum are actively pursuing intellectual property claims over sorghum plants and genes, and that in at least some cases, these claims extend to in-trust materials. In other cases, sorghum germplasm recipients refuse to release information on the parentage of commercial sorghum varieties, making it impossible to determine if they include in-trust materials. Finally, other companies that release commercial sorghum hybrids (including subsidiaries of Chromatin and NuFarm), which offer a degree of biological “copy protection” are large users of USDA germplasm.

Conclusion

Based on a sample of 2,655 (7.2%) of ICRISAT World Sorghum Collection accessions from eight geographically representative countries, it is conservatively estimated that half of the sorghum varieties declared in-trust by ICRISAT are being distributed without an SMTA by the US Department of Agriculture. When the sample is restricted to in-trust sorghum from Africa, that proportion exceeds three fifths.

The free availability of in-trust sorghum from USDA, rather than ICRISAT, creates an economic incentive for corporate and commercially oriented academic breeding programs to access in-trust varieties from USDA rather than ICRISAT. From 2005 to 2010, it is estimated that USDA distributed 30,000 samples of in trust sorghum varieties against a mere 6,500 by ICIRSAT with an ITPGRFA SMTA.

The ITPGRFA Multilateral System, including the requirements of the SMTA to share benefits and to not patent material in the form received, is not effective for sorghum under the present circumstances. Distributions of in-trust sorghum seeds outside the Multilateral System appear to exceed those within it. Recipients of large distributions of sorghum varieties from USDA are active applicants for plant breeder’s rights and utility patents over sorghum varieties and genes, and claims of trade secrets by companies and universities further impedes investigation of possible commercialization of in-trust materials.

Ratification of the ITPGRFA by the United States would presumably result in use of an ITPGRFA compliant MTA by the US national sorghum collection, requiring that future distributions support the Multilateral System. Left open, however, is the question of the status of sorghum at institutions, such as Texas A&M University, that have benefitted from the massive free distributions by USDA in recent years. If those distributions are not addressed, then the effectiveness of the Multilateral System for sorghum will remain in question even if the United States ratifies the ITPGRFA.

that basis. Ceres’ demand for confidentiality is contained in its legal briefs to the Texas Attorney General, Public Information Act Case ID’s #369850 and 363082 (public records available on request from the Attorney General of Texas).