

# Trait specific germplasm of oilseed crops

## Status of registration

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*International Undertaking on Plant Genetic Resources (EAO, 1983) defines PGR as the reproductive or vegetative propagating material of modern cultivars, obsolete cultivars, landraces, wild and weed species, near relatives of cultivated varieties and special genetic stocks (including elite and current breeder's lines and mutants). PGR, according to the Convention for Biological Diversity, are any living material of present and potential value for humans. In present time genomic resources including genes, DNA fragments and RNA are also being conserved in gene banks.*

**Keywords:** Cultivars, Germplasm, Oilseed, Plant genetic resources, Registration, Trait

PLANT genetic resources (PGR) evolved through natural and manmade selection over the years. Modern cultivars developed through efforts of breeders through artificial selection and hybridization. Most of the modern cultivars developed in different crops share more or less same parentage hence have narrow genetic base. Narrow genetic base may pose the risk of genetic erosion due to epidemics. Replacement of local landraces with modern cultivars with narrow genetic base is the main cause of genetic erosion. Further, climatic changes leads to emergence of new pest, diseases and weeds, ecosystem degradation due to urbanization cause further intensification of genetic erosion of crop species. Hence, there is a need to diversify the genetic base of high yielding cultivars through incorporation of diverse parents/germplasm in the hybridization programme. Diverse parent may include landraces, wild relatives with novel traits which can withstand vagaries of weather, biotic and abiotic stresses and may possess the desirable traits to improve the nutritional quality and yield of the crop. Systematic conservation, evaluation

and characterization of the genetic resources will be helpful for their effective utilization in crop improvement programme. Hence, there is a need to first evaluate and characterize the available germplasm for different traits of interest.

To inventorize document and facilitating safe use of germplasm, mechanism of registration of plant germplasm was instituted at National Bureau of plant Genetic Resources (NBPGR), New Delhi by the Indian Council of Agricultural Research (ICAR) for registration of valuable sovereign genetic resources with unique/novel characteristics of academic, scientific and commercial applications. For registration of plant germplasm guidelines have been developed by Plant Germplasm Registration Committee (PGRC), New Delhi.

### Importance of oilseeds in Indian Economy

India is the fourth largest vegetable oil economy in the World after USA, China and Brazil. Oilseed crops are cultivated across the country in about 26.20 mha area (2016-17), (Annual Report 2017-18, Ministry of agriculture and farmer

welfare), mainly on marginal lands, with low input and rainfed conditions. After soybean and ground nut, rapeseed-mustard is the third largest oilseed crop cultivated in Indian with a production of 8.32 mt (2017-18). Average production statistics and compounded annual growth rate (CAGR) of five year plans since 1951-55 is presented in Fig. 1. Production and yield of oilseeds showed an increasing trend whereas the area has been increased till 1991-95 after that it showed somewhat static trend in proceeding years. Since in last 25 years (1990-2015) production of oilseeds increased with CAGR of 6.29% while since last 65 years (1951-2015) CAGR of 2.51% was noticed in oilseed production (Fig. 1). As far as crop-wise scenario is concern area under soybean crop is continuously increasing since 1970 but area under groundnut and rapeseed-mustard is decreasing after 1991-92. Likewise production of soybean was increased till 2012-13 and reached up to 14.67 mt after that it is showing decreasing trend till 2015-16 (8.57 mt). Production of rapeseed-mustard was found staggering between 6-8 mt since 2003-04 (Fig. 2). Since 1971-

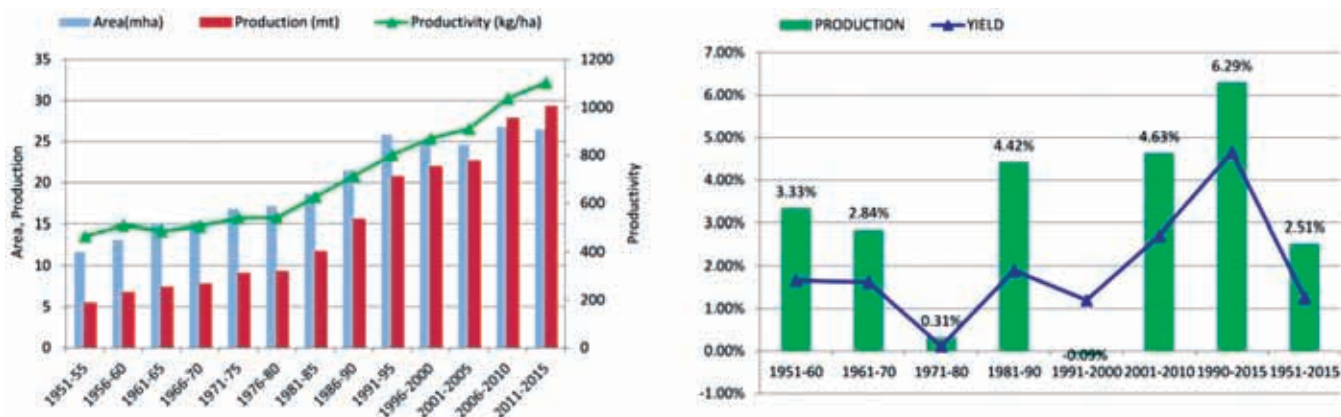


Fig. 1. Production statistics (average of five year data is presented) and compounded annual growth rate (CAGR) of oil seeds in different 10 years period

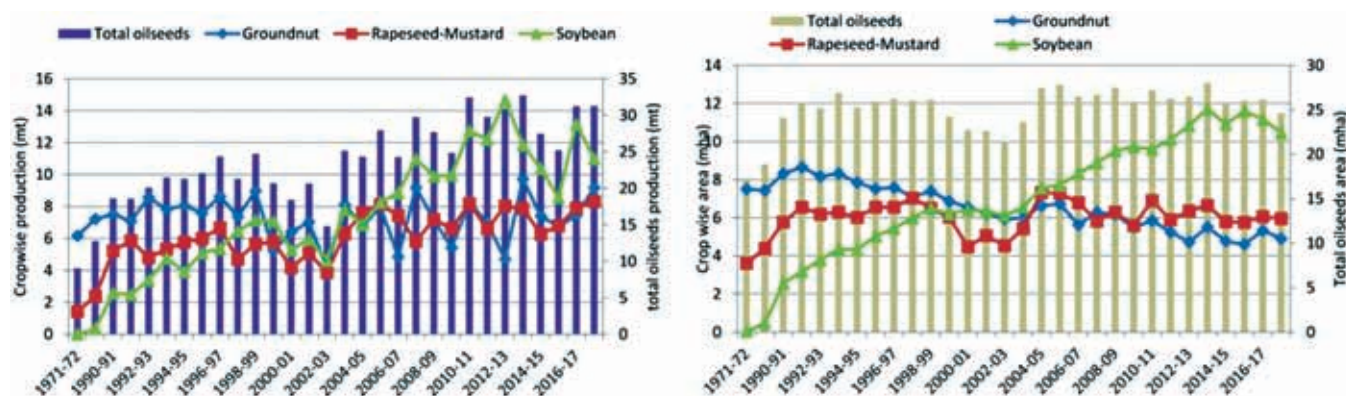


Fig. 2. Area and production statistic of major oilseed crops

72 yield of rapeseed-mustard increased from 396 to 1397 kg/ha (2017-18) (Fig. 3). Madhya Pradesh is having maximum area (6.64 mha) and production (6.95mt) under oilseeds crops (2017-18). In 2017-18 Rajasthan was largest producer of rapeseed-mustard (3.4 mt) followed by Haryana (1.11 mt) and Madhya Pradesh (0.98 mt). Rajasthan alone accounted for 40.87% of total rapeseed-mustard production during 2017-18. In 2017-18 oilseeds production was 31.31 mt with productivity of 1270 kg/ha (Agricultural Statistics 2017). Out of this 8.31 mt was of rapeseed-mustard with productivity of 1397. The oilseeds accounts for 13.68% (2016-17) of gross cropped area (Agricultural Statistics 2017). Due to ever increasing population, demand for edible oil is increasing (Fig. 4). In 2016-17 net edible oil availability was 103.8 lakh tonnes while the imported edible oil was more than it (119.4 lakh tonnes). Hence there is a need to further increase in production of edible oils to meet ever increasing demand in future.

### Procedure for registration of plant germplasm

The germplasm registration application should be submitted online to germplasm registration system (GRIS) of NBPGR (<http://www.nbpgrernet.in:8080/registration/>), New Delhi. After successful online submission, the hard copy of the application should

be sent to the Director, NBPGR, New Delhi, along with the seed sample and a certificate of submission of propagules with respective crop/plant-based National Active Germplasm Site (NAGS) for establishment/conservation. Detailed guidelines for registration of germplasm is available on NBPGR website (<http://www.nbpgrernet.in>)

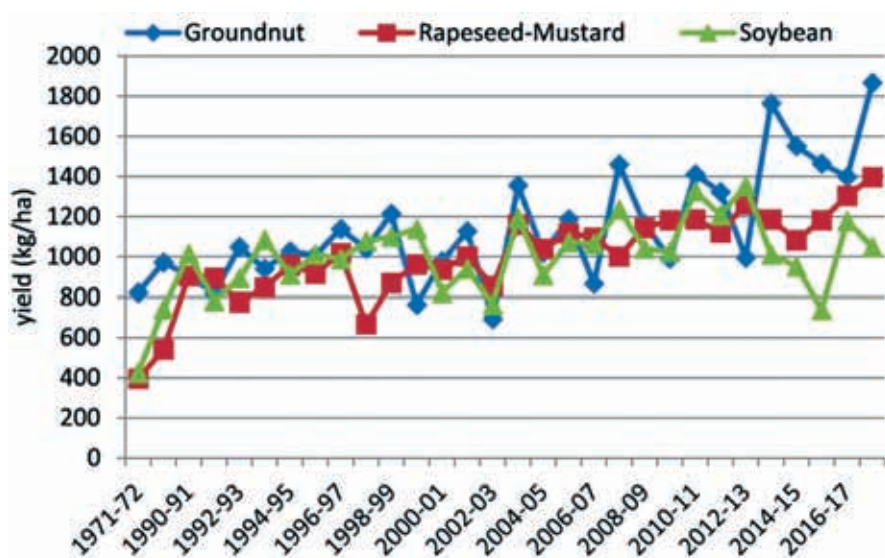


Fig. 3. Yield statistic of major oilseed crops

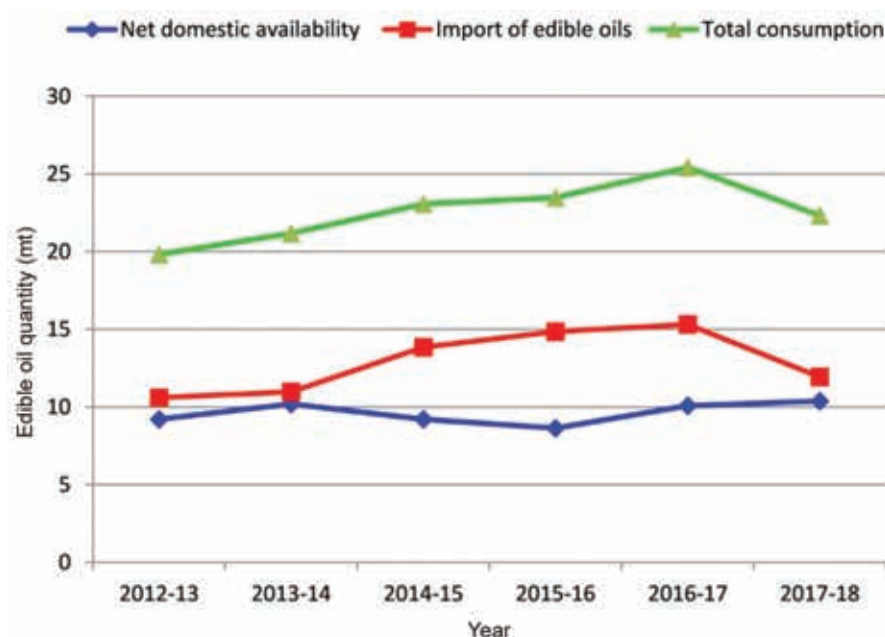


Fig. 4. Domestic availability and consumption of oilseeds in India

[www.nbpgrernet.in:8080/registration/Guidelines.aspx](http://www.nbpgrernet.in:8080/registration/Guidelines.aspx)). The plant germplasm identification committee generally meets two times in a year to identify germplasm suitable for registration based on registration criterion.

#### Status and significance of oilseed crops germplasm registered

Among the 09 oilseed crops grown in the Country, 07 are edible (soybean, groundnut, rapeseed-mustard, sunflower, sesame, safflower, and niger), and 02 non-edible (castor and linseed). Apart from these 09 oilseed crops minor crops of 03 species like coconut and oil-palms are also grown in the country.

The novel germplasm has been developed and registered for scientific, academic and commercial application in oilseed crops. In crop improvement programme resistance to biotic stress (disease and insect

pest) and abiotic stresses (drought, heat, salinity) are important traits. Furthermore, improvement in nutritional quality is also necessary for nutritional security. As most of the present day high yielding varieties are prone to these stresses, the developed genetic stocks with resistance / tolerance to these stresses can use as donor parent to improve high yielding cultivars.

In oilseed crops, 187 accessions have been registered till 2019 (Fig. 5). Out of these, maximum of 68 accessions have been registered in oilseed Brassica, followed by groundnut (51), castor (32), soybean (14) (Table 2). Among oilseed brassica maximum 48 accessions were registered in Indian mustard followed by gobhi sarson (10 accessions), Karan rai (03), toria (03), yellow sarson (02), brown sarson (01) and *B. caudatus* (01). In Indian, mustard 10 genetic stocks have protected for male sterility and fertility restoration

system. *Mori* and *Ogura* based CMS lines have been developed and being used for development of hybrid varieties in Indian mustard. For biotic stresses resistant/tolerance (*Alternaria* blight, white rust) 11 genetic stocks have been developed and protected. Among these, white rust disease cause serious damage to mustard crop, therefore, 09 germplasm (BIO-YSR, NDUH-YJ-6, DRMR-2019, DRMR-2035, NDUH-YJ-6, DRMR 1-5, IC265495, IC313380, DRMRIJ 12 - 48) for resistance against white rust pathogen, from these lines Bio-YSR is extensively used as donor in white rust resistance breeding programme. For abiotic stresses (heat, drought, salinity) resistant/tolerance 15 genetic stocks were registered. Early sown (3<sup>rd</sup> and 4<sup>th</sup> week of September) mustard crop faces high temperature at seedling stage which leads poor germination and poor plant population. Furthermore, late sown crop faces terminal heat at maturity stage. Hence 08 germplasm (BPR-541-4, BPR-543-2, BPR-349-9, BPR-540-6, DRMR 2059, IC0626000, IC0628060) tolerant to high temperature at seedling stage and terminal heat stress have been developed and registered. From these lines BPR series is extensively used as a donor in mustard breeding programme. For soil salinity tolerance, 07 germplasm (RH-8814, RH 0116, BPR-540-6, BPR-541-4, CS 1100-1-2-2-3, CS 15000-1-2-2-2-1, CS 52-SPS-1-2012) were registered. For oil content and quality traits, 09 germplasm has been protected in Indian mustard. In oil quality, emphasis is mainly on development of double low quality (low erucic acid <2%, low glucosinote <30g of defatted seed meal) or canola quality mustard oil. Therefore, 05 double low quality germplasm (TERI- GZ-05, Heera, NUDH-YJ-5, BIO-YSR, DRMR 1-5) were developed and registered. Out of these lines Heera and BIO-YSR are more frequently used in breeding programme. In Gobhi sarson, 07 accessions have been registered for oil quality (low erucic acid, low glucosinolate, high oleic acid).

Table 1. NAGS centre for oilseed crops germplasm

| Crop                                                 | NAGS centre                                                                                |
|------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Rapeseed-mustard                                     | ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur, Rajasthan                 |
| Groundnut                                            | ICAR-Directorate of Groundnut Research, Junagarh, Gujarat                                  |
| Soybean                                              | ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore, Madhya Pradesh            |
| Sesame, Niger                                        | AICRP on Sesame & Niger, Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur, Madhya Pradesh |
| Sunflower, Safflower, Castor, Sesame, Niger, Linseed | Directorate of Oilseeds Research, Rajendranagar, Hyderabad, Andhra Pradesh                 |

**Table 2.** Genetic stocks/germplasm registered in oilseed crops for important traits

| Trait                                                         | Genetic stock                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Indian mustard (<i>B. juncea</i>)</b>                      |                                                                                                                                                                                                                                                                                                                          |
| Male sterility system (CMS and restorer lines)                | IC296683, IC296682, IC296701, IC296702, IC296703, IC296705, IC296706, IC296746, IC296749                                                                                                                                                                                                                                 |
| Oil content and quality (low erucic acid, low glucosinolate)  | Low erucic acid (SWARNA {TERI(OE)M21}, PRQ-2005-1); Low glucosinolate (NDUH-YJ-6), (NDUH-YJ-6), Double zero (TERI- GZ-05, Heera, NUDH-YJ-5, BIO-YSR, DRMR 1-5); High oil content (NDYR 8, NDYR10)                                                                                                                        |
| Resistance/tolerance to biotic stress                         | White rust (BIO-YSR, NDUH-YJ-6, DRMR-2019, DRMR-2035, NDUH-YJ-6, DRMR 1-5, IC265495, IC313380, DRMRIJ 12-48); Alternaria blight (PAB 9511, IC0628060, IC0626000, DRMRIJ 12-48)                                                                                                                                           |
| Resistance/tolerance to abiotic stress                        | High temperature (BPR-541-4, BPR-543-2, BPR-349-9, BPR-540-6, DRMR 2059, IC0626000, IC0628060); Drought (DRMR-541-44, DRMR10-40, DRMR4001); Salinity (RH-8814, RH 0116, BPR-540-6, BPR-541-4, CS 1100-1-2-2-3, CS 15000-1-2-2-2-1, CS 52-SPS-1-2012)                                                                     |
| Yellow seed coat                                              | NDYR 8, NDYR10, TM-1(YSM2), TERI- GZ-05, BIO-YSR, PRQ-2005-1, NDUH-YJ-6, DRMR 1-5                                                                                                                                                                                                                                        |
| <b>Gobhi sarson (<i>B. napus</i>)</b>                         |                                                                                                                                                                                                                                                                                                                          |
| Male sterility system                                         | IC296747, IC296704                                                                                                                                                                                                                                                                                                       |
| Oil quality (low erucic acid, low glucosinolate)              | Low erucic acid [TERI –Gaurav (TERI-00-R986); TERI- Garima (TERI-00-R985)]; Phaguni (TERI(OE) RO3); Shyamali (TERI(OE) RO9J)]; Double low (NUDB-38; NUDB-42; TERI (00) R9903)                                                                                                                                            |
| <b>Karan rai (<i>B. carinata</i>)</b>                         | Male sterility system (IC0589777, IC0590093)                                                                                                                                                                                                                                                                             |
| <b>Brown sarson (<i>B. rapa</i> var. <i>brown sarson</i>)</b> | Male sterility system (IC296707)                                                                                                                                                                                                                                                                                         |
| <b>Toria (<i>B. rapa</i> var. <i>toria</i>)</b>               | High oleic/ linolenic acid (PHOT-2-2, PHOT-8-2-11)                                                                                                                                                                                                                                                                       |
| <b>Groundnut (<i>Arachis hypogea</i>)</b>                     |                                                                                                                                                                                                                                                                                                                          |
| High fodder biomass                                           | NRCG-11846, NRCG-11847, NRCG-12035, NRCG-12990, NRCG-17205, NRCG-17206                                                                                                                                                                                                                                                   |
| Oil quality                                                   | Oil content e"50% (PBS 29031, MH 34, NRCG-14326, NRCG-14336, NRCG-14350, NRCG-14409); High oleic acid (IC0630593, IC0630594)                                                                                                                                                                                             |
| Resistant to biotic stress                                    | PBND, Stem rot, tolerant to late leaf spot, early leaf spot (CS 19, NRCGCS-77, NRCGCS-85, NRCGS-86, NRCGCS-21, NRCGCS-83, NRCGCS-124, NRCGCS-180, NRCGCS-222, NRCGCS-15, NRCGCS-74, NRCGCS-186, NRCGCS-196, PBS 30138, Mutant 28-2); Army worm and thrips (Mutant 28-2); <i>Aspergillus flavus</i> (NRCG 12431)          |
| Fresh seed dormancy                                           | Upto 40 days (NRCG-14326, NRCG-14336, NRCG 14380, NRCG 14368); Upto 60 days (NRCG-14350, NRCG-14409)                                                                                                                                                                                                                     |
| Abiotic stress                                                | Iron chlorosis (PBS 24004, PKVG 8)                                                                                                                                                                                                                                                                                       |
| Large kernel size                                             | PBS 29031, TG-18A, NRCG CS 281                                                                                                                                                                                                                                                                                           |
| <b>Soybean (<i>Glycine max</i>)</b>                           |                                                                                                                                                                                                                                                                                                                          |
| Oil quality                                                   | Low linolenic acid (VLS 59); High oleic acid (NRC 106, IC 210)                                                                                                                                                                                                                                                           |
| Free from kunitz tripsin inhibitors                           | NRC 101, NRC 102, NRC 142                                                                                                                                                                                                                                                                                                |
| Free from Lipoxigenase-2                                      | NRC-109, NRC 142                                                                                                                                                                                                                                                                                                         |
| Early maturity                                                | NRC 106, IC 210, NRC 101, NRC 102, NRC-109, EC390977, MACS 330, AGS 25                                                                                                                                                                                                                                                   |
| Photoperiod insensitivity                                     | EC390977, MACS 330, EC34101                                                                                                                                                                                                                                                                                              |
| <b>Sunflower (<i>Helianthus annuus</i>)</b>                   |                                                                                                                                                                                                                                                                                                                          |
| Male sterility system                                         | ARG-CMS and ARG CMS ( Maintainer)                                                                                                                                                                                                                                                                                        |
| <b>Safflower (<i>Carthamus tinctorius</i>)</b>                |                                                                                                                                                                                                                                                                                                                          |
| Male sterility system                                         | IC296708, IC0618568                                                                                                                                                                                                                                                                                                      |
| Resistant to biotic and abiotic stress                        | Fusarium wilt (IC0588696, IC13884), Drought (IC0588696)                                                                                                                                                                                                                                                                  |
| Oil content and quality                                       | High oil content (SFS-9943, Ole-9-P2-P1-P22), High oleic acid (Ole-9-P2-P1-P22)                                                                                                                                                                                                                                          |
| <b>Sesamum (<i>Sesamum indicum</i>)</b>                       |                                                                                                                                                                                                                                                                                                                          |
| Male sterility system                                         | IC296761                                                                                                                                                                                                                                                                                                                 |
| Oil quality                                                   | High lignin and sesamol (IC0582890)                                                                                                                                                                                                                                                                                      |
| <b>Linseed (<i>Linum usitatissimum</i>)</b>                   |                                                                                                                                                                                                                                                                                                                          |
| Oil quality                                                   | High oleic acid (NS/08/047, NS/08/102), high oil content (IC0268345)                                                                                                                                                                                                                                                     |
| Resistant to biotic stress                                    | Powdery mildew, rust and Alternaria blight (PCL 8)                                                                                                                                                                                                                                                                       |
| <b>Castor (<i>Ricinus communis</i>)</b>                       |                                                                                                                                                                                                                                                                                                                          |
| Pistillate line                                               | LRES-17, DPC-9, M-619, MCP 1-1, DPC-16, JP-96, IPC-15 (DPC-15)                                                                                                                                                                                                                                                           |
| Resistant to biotic stress                                    | Fusarium wilt (RG392, RG 47, JI 220, RG 297, RG 1608, RG2819, SKP 84, SKP215, DCS-106, RG 2818, JI-258 ); leaf miner (RG 1930, RG1771) Macrophomina root rot (RG 2722, RG2819, RG-2822 ); reniform nematode-wilt complex (SKP 84, SKP215); Multiple resistance (RG 2787, RG 43); leaf hopper (DCS-106, IC-374272, G-631) |
| Abiotic stress                                                | Drought (DCH-7, IC274758,                                                                                                                                                                                                                                                                                                |
| Oil quality                                                   | High ricinolic acid (RG-57)                                                                                                                                                                                                                                                                                              |

Source: <http://www.nbpg.ernet.in:8080/ircg/index.htm>

In groundnut, 51 accessions were registered from them 45 are of *Arachis hypogea* and 06 are of other wild species of same genera. From 45, maximum 16 genetic stocks have been registered for biotic stresses (stem rot, late leaf spot, early leaf spot, rust, Alternaria leaf blight, army worn, thrip, peanut bud necrosis disease). Germination in freshly harvested groundnut is a matter of concern as it affect the quality and total yield of the crop. Scientist have developed and registered ground nut genotypes (NRCG-14326, NRCG-14336, NRCG 14380, NRCG 14368, NRCG-14350, NRCG-14409) which has fresh seed dormancy from 40-60 days. 06 germplasm has been registered for oil content  $\geq 50\%$  (PBS 29031, MH 34, NRCG-14326, NRCG-14336, NRCG-14350, NRCG-14409) in groundnut. Six genetic stocks of wild *Arachis* species registered for fodder purpose traits.

In soybean, only 12 genetic stocks have been registered till 2018 from them 03 possessed oil quality parameters (VLS 59, NRC 106, IC 210) and 04 found novel in terms of free from anti-nutritional factors [trypsin inhibitor (NRC 101, NRC 102, NRC 142), *Lipoxygenase-2* (NRC-109, NRC 142)]. Tripsin inhibitors inhibit the activity of trypsin enzyme, which facilitates the digestion of food in our digestive tract. Therefore, trypsin inhibitors free line have been developed. *Lipoxygenase-2* enzyme causes the development of foul smell in soya products (snacks, soya chunk, namkeen) leading to poor quality. Hence,

*Lipoxygenase-2* free lines are required to for development soya products with enhanced shelf life. Apart from these, 03 photoperiod insensitive line have also been developed. In rest, 04 edible oilseed crops only 16 genetic stocks (07 safflower, 05 sesame, and 02 sunflower) have been registered

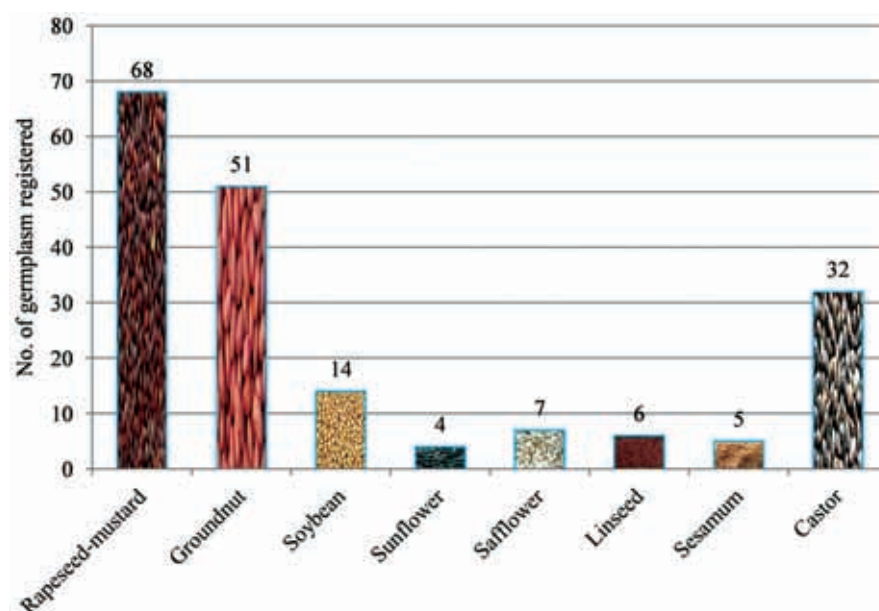


Fig. 5. Germplasm registered in oilseed crops (till 2019)

for unique traits. No germplasm has been registered in niger crop.

Among non-edible oilseeds 38 (32 castor, 06 linseed) unique genetic stocks have been protected. In castor,

from this, 07 pistillate lines have also been registered. In linseed, 06 genetic stocks have been registered from them 03 protected for oil quality. Germplasm and mutants with different morphological/ biochemical and physiological traits can be used in basic studies (genetics, transcriptomics, proteomics, molecular biology, genomics) to decipher different pathways associated with trait of interest and for development of linkage maps which can be used in marker assisted breeding programmes. Therefore, it is imperative that the breeders should register their potentially valuable trait specific germplasm. This will serve the basic intent of developing and protecting the potential germplasm through registration, further, its conservation, distribution and documentation for further utilization by the breeder to develop the climate-resilient varieties in oilseed crops in

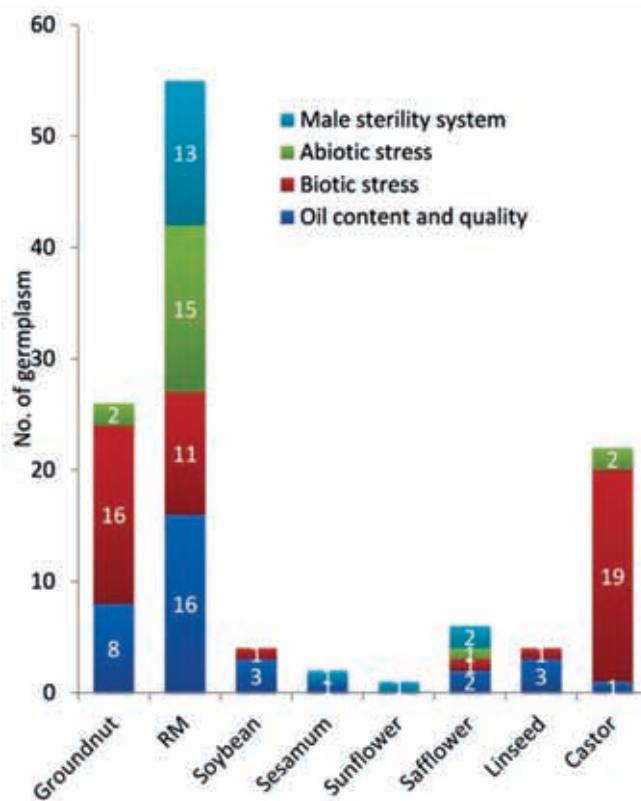


Fig. 6. Germplasm registered in oilseed crops for important traits

19 accessions with resistance/tolerant to biotic stresses (tolerant to Fusarium wilt, Macrophomina root rot, Botrytis grey rot, serpentine leaf miner, leafhopper, reniform nematode) were registered. Apart

future.

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