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Dr Shiv Prakash Shrivastav

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Rama University, Kanpur

Major Cereals, Pulses, **Oilseed**, Fodder, cash , vegetable and horticulture crops (*Kharif Seson*)

OILSEEDS GROUND NUT (MONKEY NUT, PEANUT) Arachis hypogaea (2n = 40) Allo tetraploid Genomic constitution AABB Place of origin : Brazil Putative parents and origin of cultivated ground nut. The cultivated ground nut is a Allotetraploid having A and B genomes. The genus Arachis is sub divided into 7 sections. The cultivated ground nut comes under section Arachis. This section includes 12 species of which hypogaea is the only cultivated species having 2n = 40. The other one is A.monticola. The rest ten species are diploids. One view is that cultivated ground nut arose from cross A.cardinasi x A.batizoccoi. But this view is not accepted by Prasad (1996). According to studies involving RFLP, PCR, isozyme have led to the conclusion. a) A.hypogaea had an allopolyploid origin. b) A large amount of genomic differentiation between the diploid A and B genomes occurred. c) Definite identification of progenitors of A.hypogaea has not been completed. d) A.duranansis may be the female parent e) A.batizoccoi would have contributed the smallest chromosome. Groundnut an unpredictable Crop Ground nut is popularly known as unpredictable legume. Since the pods are borne below ground positively geotropic we cannot predict its performance before harvest as in the case of other crops. Further Ground nut is highly influenced by environment. If there is no favorable environment yield alone will not be affected but also the quality characters. Less boron means low shelling % and more of immature seeds moisture stress leads to lower yield as well as reduction in well developed kernels. Oil percentage is also influenced by environment. Excess moisture leads to more vegetative growth and reduction in yield. Compared to any other crop here. G x E interaction is more pronounced. Besides abiotic stress, biotic stress also play a major role Rust and leaf spot in diseases, red hairy caterpillar and leaf minor in pests cause major havoc. Seed multiplication ratio is 1:5. This is also one of the bottlenecks in the spread of improved varieties. 62 Classification : The genus Arachis is subdivided in to the following seven sections. (Gregory and Gregory, 1973) Arachis Erectoides Rhizomatasae Extranervosae Triseminate Ambinervosae Caulorhizae. 1. Arachis 2n Arachis villosa 20 A.batizoccoi 20 A. cardinassi 20 A.chacoense 20 A.monticola 40 A.hypogaea 40 2. Erectoides A.tuberosa 20 A.paragurensis 20 3. Rhizomatasae A.glabarata 40 A.hagen beckii 40 4. Extra nervosae A. Villosulicarpa 20 A.marginata 20 5. Triseminate A.pusilla 2n = 20 6. Ambinervosae none, named 7. Caulorhizae A. repens 2n = 20 In hybridization programme intersectional hybridization is not successful but intra sectional hybridization is successful keeping wild species as female is more successful. According to Smart 1961 A.hypogaea has been sub divided in to two sub species Viz. A.hypogaea subsp. hypogaea A.hypogaea subsp fastigiata According to this hypogaea the first two nodes bear vegetative branches then next two branches bear inflorescence 63 fastigiata : Inflorescence are borne on second and subsequent nodes of primary branches. Karpavickas (1968) recognised two other botanical varieties in each of the sub species. A.hypogaea subsp hypogaea var. hypogeae. Virginia type spreading var hirsuta hirsuta type semi spreading. A. hypogaea sub. sp. fastigata Var. fastigata (Valencia type) subsp var vulgaris Spanish bunch. In India the cultivated types are grouped into i) bunch type Valencia Spanish bunch ii) semi spreading - Virginia bunch iii) spreading - Virginia runner. Breeding objectives : Majority of area in Tamil Nadu is cultivated with bunch type and semi spreading is confined to certain pockets only. So the objectives are for bunch type. 1. Breeding high yielding bunch ground nut with dormancy suitable for dry land conditions The dry land bunch type sown during June - July often caught up in early N.E. monsoon rains which results in germination of varieties. So it is necessary to breed varieties having dormancy. Semi spreading varieties are dormant TMV 7 slightly dormant varieties, BSR.1, ALR 2 dormant for 15 days. 2. Breeding varieties for quality a) High shelling percentage > 75% Thin shelled varieties have high shelling percentage. b) High oil content > 50% TMV 10 the semi spreading variety is having 52% oil. Oil content is highly influenced by environment. ALR.2 52% oil c)

High sound mature kernel (SMK) Which is also influenced by environment. Increased boron application results in high shelling percentage and high SMK % d) Table purpose varieties Hand picked kernel for export market. Valencia types are suitable for this. 3. Breeding disease resistance varieties. Rust and leaf spot are causing major damage. If the onset of rust is in initial stage it results in total failure. Late leaf spot hinders harvest of crop due to foliage loss. 64 Tomato spotted wilt virus or Bud nacrosis of late gaining importance. NCAC 17090 - resistant 4. Breeding for pest resistant varieties Red hairy caterpillar, leaf miner are major pests. 5. Breeding short duration (85 days) varieties suitable for irrigated conditions Chico VR1 3 - (R33-1 x Ah selection 1) 90 days. Breeding Methods: 1. Introduction: All the ground nut lines are introduced ones. Ground nut was introduced in to Tamil Nadu by East India Company 2. Selection: a) Pure line selection TMV 2 - Selection from local Gudiyatham bunch. b) Mass selection JL 24 from Taiwan variety. 3. Hybridization and Selection a) Inter varietal Bunch x Bunch - VRI 2 (Co2 x JL 24) SSP x Bunch - VRI 3 (R 33-1 x Ah selection) b) Inter specific For transfer of disease resistance. Arachis sp : A.hypogaea x A.batizoccoi 2n = 40 2n = 20 (Resistant) Triploid sterile doubled Hexaploid Reduced to tetraploid. A. chacoense 2n = 20 A.monticola - for thin shelled conditions Extranervosa sp. A.villoulicarpa for increased number of pods. 5. Mutation breeding Gregory in USA extensively adopted and released varieties. Co2 EMS from POL 1 TMV 10 Natural mutant from Argentina local. 65 TG 1 to TG 6 (Vikaram) from BARC Trombay. GNLM - Gujarat Narrow Leaf Mutant. 6. Embryo rescue technique : A.puscilla x A.hypogaea crosses. But not much successful. Cotyledon culture is a success. 7. Transgenic plants Transgenic plants for disease resistance. Transfer of a particular gene from wild species thro' use of medium of carrier (plasmid) micro projectile bombardment direct transfer. Transfer of disease resistance gene from wild species through plasmid is a success. Ground nut varieties for Tamil Nadu Varieties Parentage Duration Bunch Co 1 Ah 6279 x TMV 3 105 Co 2 Mutant from POL 1 105 ALR 2 Selection from ICGV 86011 105 TMV 2 Selection from Gudiyatham bunch 105 TMV 7 Selection from Tennesse white 105 TMV 12 Selection from Uganada variety 105 POL 2 Pollachi Red x Ah 2105 105 JL 24 Selection from Taiwan variety 105 VRI 1 TMV 7 x FSB 7-2 105 VRI 2 JL 24 x Co2 105 VRI 3 J 11 x Robout 33-1 95 VRI 4 VG 5 x NCAC 17090 110 BSR 1 Selection from ICGV 86143 110 Co3 VRI 2 (VG 55 x JL 24) 105 ALR 3 (R33-1 x KG 68) x (NCA 17090 x ALR 1) 105 Semi spreading TMV 10 Natural mutant from Argentina 130 TMV 8 Selection from Manapparai local 135 Spreading TMV 3 Selection from west African variety 'Bassi' 140.

GINGELLY (TIL, ELLU) Sesamum indicum 2n = 26 Centre of origin : Africa Related species : So far 36 species were recorded in the genus sesamum 20 of them occur in Africa. Wild species utilised in breeding programme S.alatum 2n = 26 Resistant to phyllody S.alatum x S.indicum alatum is having dormancy. S.malabaricum (2n = 26) Occurs in Travancore of Kerala. It freely crosses with cultivated gingelly. Oil content is low 32% It is utilised to induce male sterility in cultivated sesame. S.laciniatum 2n = 32 Tolerant to phyllody, drought and jassid resistant. Fertile auto allopoly ploid produced by crossing S.indicum x S.laciniatum Sterile, Double. S.prostratum occurs in S.India (2n = 26) Tolerant to drought. Breeding objectives 1. Breeding high yielding varieties tolerant to drought. 2. Breeding white seeded varieties Finest quality of oil is obtained from white seeded lines. 3. Development of mono stemmed varieties. By this more population per unit area and yield can be increased. Monostemmed varieties are low yielders. 4. Development of multicapsule / axil and multicarpellary varieties. 5. Rice fallow varieties : Shorter in duration. 6. Non- shattering varieties African lines. 7. Resistant to disease Powdery mildew; Phyllody - transfer from wild species. Breeding Methods : 1. Introduction : African lines. 2. Pure line selection. TMV4 - Sattur local TMV5 - Srivaikundam local TMV6 - Andhra local. SVPR1 - Western Ghat white seed variety 67 3. Hybridization and selection. a) Inter varietial Co1 (TMV 3 x SI 1878) x SI 1878, TMV 3 (S.A local x Malabar local), Paiyur-1 b) Inter specific : Male sterile lines evolved by crossing with S.malabaricum. 4. Population improvement 5. Poly ploidy breeding 6. Heterosis breeding Epipetalous nature makes emasculation and crossing easier Use of CMS lines is also being attempted. 7. Embryo

rescue technique. SESAMUM VARIETIES FOR TAMIL NADU Variety Parentage Duration Co 1 (TMV 3 x SI 1878) x SI 1878 90 TMV 3 South Arcot local x Malabar local 80 TMV 4 Pure line selection 80 TMV 5 PLS from Srivaikundam local 80 TMV 6 Selection from Andhra local 85 SVPR 1 Selection from Western Ghat white 80 Paiyur 1 SI 2511 x SI 2314 90 VRI 1 Selection from Tripathur local 75 68 MUSTARD and RAPE SEED Brassica sp (2n = 16, 18, 20, 22, 36, 38 and 48) Brassicaceae or cruciferae The genus Brassica contains more than 3000 species of which 40 are of economic importance. Cultivated brassica can be broadly divided in to two distinct types viz. Vegetable type : Cabbage, Cauliflower, turnip Oil seed type - Rape seed and mustard. Taxonomy : Harberd (1972) examined 85 species of Brassica and grouped species of the genus into cytodemes. These cytodemes are composed of different species with the same chromosome number and which are cross fertile and other having species with different chromosome number and cross infertile. According to him most important agricultural species are four diploids, three allopolyploids, each belong to a separate cytodeme. Four diploids are : 1. B.nigra - Black mustard 2. B.oleracea - Cabbage 3. B.campestris - Rape seed. 4. B.tourne frotii - Wild turnip Three allopoly ploids 1. B.napus - Rape seed of Europe 2. B.juncea - Indian mustard 3. B.carinata - sthipplam mustard (veg / oil seed) The genetical relationship between the oilseed brassicas are diagramaticaly represented as follows. B.nigra BB n= 8 B.carinata BC B.juncea AB n= 17 n = 18 B.oleracea CCB.napus AC B.campestris AA n = 9 n = 19 n = 10 B.napus will cross readily with B.campestris but with extreme difficulty in case of B.oleracea. Rape seed Botanical name 2n Economic characters 1.Brassica compestris 20 Indian Rape Seed. Self sterile in nature. Important oil seed crop of North India. 3 Cultivated types. B.campestris var. Brown sarson B.campestris var. Yellow sarson 69 B.campestris var. toria 2. B.napus 38 European Rape Seed. Self fertile. Mustard 1. B.nigra 16 Black mustard : Native of Eurasia. 28% fixed oil. Used as medicine pungent due to glucoside sinigrin. 2. B.alba 24 White mustard : Young seedling used as Salad, yellowish seed 30 % oil. 3. B.juncea 36 Indian mustard. RAI 35% oil. Leaves used as herb contains sinigrin. MUSTARD Breeding objectives : 1. Seed yield : Yield is the end product of many biological processes which are under control of complex polygenic systems. An ideal plant type is having increased branch number, pods per plant, seeds per pod and seed size. Further yield increase could result from increase in biomass and harvest index. Increased biomass can result from reduced photo respiration and increased light saturated rate of photosynthesis. 2 Early maturity : For use in various multiple cropping sequence. 3. Resistance to abiotic factors Frost resistance is needed to prevent yield losses. Winter hardiness is very important. 4. Resistance to biotic stress Powdery mildew Black leg Sclerotinia rot, alternaria blight mustard aphid - so far no resistance source identified. 5. Herbicide resistance : (Atrazine simabine) A few sources of resistance is available. 6. Shattering resistance B.napus - highly shattering B. juncea - tolerant. Introgressive breeding done. 7. Increased oil content and quality High oil content 45% yellow seed varieties > oil. For industrial purpose > Erucic acid. Development of low erucic acid cultivars for edible purpose. Reduced linolenic acid content is also desirable. 8. Meal quality Meal having less Glucosinolate content. 70 Breeding methods : 1. Introduction - Regina from Sweeden 2. Simple selection E.G. Seeta, Krishna, Kranti. 3. Hybridization and selection Intervarietal a) Bulk method b) Pedigree method c) single seed descent Inter specific 4. Back cross method 5. Population improvement R S, mass selection 6. Heterosis breeding CMS lines 7. Mutation breeding E.G. Regina, RLM 198 8. Tissue culture technique for production of homozygous diploids Saline resistance screening. Induction of mutation in haploids. 9. Embryo rescue technique for inter specific crosses.

CASTOR Ricinus communis (2n = 20) Place of origin : Ethiopia Classification : Monotypic, all varieties of castor from giant perennials to short internode dwarf have the same chromosome number. Zugovosky (1962) has described three species in the genus Ricinus 1. R. communis 2. R. macro carpus 3. R. micro carpus But this is not accepted by Botanists. There are sub species which are considered to be ecological extreme varieties i.e. poly morphic of cultivated type. They are R. communis subsp persicus (Persian) ssp.chinensis (chinese species) ssp. zanzi barensis (Zanzibar) ssp. sanguinens (Crimson species) ssp.

africanus (African) ssp. mexicanus (Mexican) Red castor varieties (Popova 1930) Subsp gibsoni subsp cambogenisis Breeding objectives : 1. Long duration varieties for dry lands S.A.1, Co1 perennial - Tall - Normal internodal, high node number. Intermediate - Normal internode, low node no (13 or 10) 2. Short duration high yielding varieties suitable for irrigated mixed cropping conditions TMV 5 3. Breeding non shattering spineless varieties Baker variety of USA Non - Shattering. 4. Breeding for insect resistance Semi looper, jassid. Hopper burn - serious in dry land varieties. Triple bloom - TMV 5. - Triple bloom condition gives resistance. 5. Breeding varieties with low ricinin content. Breeding Methods: 1. Introduction. Hospet varieties. Russian lines. 72 2. Selection a) Pureline selection - Co 1 from Anaimalai local b) Mass selection TMV 3 - from South Arcot local. 3. Hybridization and selection TMV 5 (SA2 x S 248/2) TMV 6. (VP 1 x RC 962) 4. Population improvement By using recurrent selection technique. 5. Mutation breeding Aruna castor SA2 Natural Mutant from TMV 1. 6. Heterosis breeding GAUCH - 1 100 % pistillate lines. Geneic male sterility Temperature plays a major role. GCH 4 TMVCH 1 (LRES 17 x TMV 5) 73 SUN FLOWER Helianthus annuus Place of origin : North America. Classification : The genus comprises nearly 67 species - all native to America. Of these two are cultivated. a) H.annuus - diploid 2n = 34 Oil seed crop. b) H.tuberosus - Hexaploid 2n = 102. Jerusalem artichoke - cultivated for tuber. Wild species : H.hirsutus, H.rigidus moderately resistant to Alternaria. Putative parent : Weed sunflower gave rise to cultivated one. The weed sunflower was modified by introgression with H.petiolaris. Cultivars of sunflower : a) Giant types : 6 - 14 feet tall. Late maturing, Large heads 12 - 30” in diameter, seeds large, white or grey or with black stripes. Oil content is very low. E.g. Mamoth Russian. b) Semi dwarf varieties : Medium tall - 4 ½ to 6 feet, Early maturing. Heads 7 - 9” in diameter. Seeds smaller, black, grey or striped. High oil content 35%. E.g. Jupiter, Pole star. c) Dwarf types 2 to 4½ feet tall. Early maturing. Head size 5½ - 6½ “ diameter. Small seeds, high oil content 37%. E.g. Sunrise, Morden, Co1, Co2 Breeding objectives 1. To develop short duration varieties suitable for dry land and irrigated conditions. Dryland successful in black soils only. In red soil under rainfed it is not successful. 2. Breeding varieties with high oil content : Ranges 38 to 48%. Complex character yield and oil content are negatively correlated. To increase oil content the shell must be thin. 3. Breeding for self fertile lines. Protoandry and self incompatability mechanism operates in sunflower. Hence hand pollination is necessary. To avoid this self fertile lines can be evolved. 4. Breeding for disease resistance. Maharastra hybrid susceptible to powdery mildew. Hence ban is there. Powdery mildew, rust, charcoal rot, Alternaria. Wild species like H.hirsuta are moderately. resistance to Alternaria. 74 5. Resistant to pests Heliothis , Grass hopper Jassids. Breeding Methods: 1. Introduction : Morden from Canada. 2. Mass selection: Ec 68414 from Russia. Co1 mass selection from Morden. Useful for characters which are highly heritable. E.g. Plant height, disease resistance. 3. Hybridization and selection a) Intervarietal : E.g. Co2 Derivative of multiple cross Co4 - (Dwarf x Surya) b) Interspecific : Wild species of North American origin and best Soviet varieties were crossed and number of varieties were evolved. E.g. Progress. Novelty Jubilee 60- They are resistant to Verticillium wilt also 4. Mutation Co3 (Mutant from Co2 thro’ gamma rays) 5. Head to row and remnant seed method Developed by Pustovoit in Russia. By this method oil content is increased. In this method the following are the steps: a) From open pollinated type a large no (10,000 to 12,000) plants are selected based on Head size. b) The selected lines are analysed for oil content and high oil content lines are isolated (1000 plants). c) Part of the seed reserved and the part is sown in progeny rows along with check to estimate yield. d) Second season testing is also done. The best lines are identified. e) The remnant seed of elite plants which give high yield were raised in isolation and multiplied for crossing interse next season. f) The multiplied lines also tested for oil content and high yielding high oil content lines were raised in isolation and crossed interse. 6. Population improvement By mass selection, recurrent selection and use of male sterile lines population can be improved and utilised for breeding. 75 7. Heterosis breeding : Development of inbred lines and crossing them to harness heterosis was first done as early as 1920 in Russia. During 1970 cytoplasmic geneic male sterility was identified in wild types and obsolete cultivars. Now this system is being extensively used for production

of hybrids. First hybrid BSH 1 CMS 234 A x RHA 274 BSH 2 BSH 8. A number of CGMS lines were bred by Government as well as private seed growers and are utilised now. Male sterility can also be inducted by GA 100 ppm. Steps 1. Development of inbreds. 2. Evaluation of inbreds for combining ability. 3. Conversion of inbreds into CGMS lines and R lines. 4. Production of hybrids. Varietial renovation In sun flower the varieties released are renovated annually to produce super elite (Breeder seed) and Elite Seed (Foundation seed). 76 SAFFLOWER Carthamus tinctorius (2n = 24) Place of origin : Africa Related species : The wild species Carthamus oxycanthus is found in many parts of Punjab. It is a dwarf bushy plant, very spiny, forming small achenes. The oil content is 15 to 16 percent Classification of safflower : Safflower can be grouped in to two broad categories. 1. The outer involucral bracts spinose, lanceolate mainly cultivated for oil. Flowers yellow in colour. 2. Involucral bracts moderately spined or spineless which are cultivated mostly for the dye than the spiny types. Flowers orange in colour. Breeding objectives : 1. Breeding for high oil content : Normal oil content is 32% of which 72% is linoleic acid, the factor which reduces blood cholesterol. Oil content is negatively correlated with yield. Wild species of C.oxycanthus having 28% oil were utilised in hybridization programme to increase yield and oil content but success was not achieved. 2. Breeding for non-spiny varieties with high oil content. A very limited success was achieved Co1 safflower is an example for this. 3. Breeding varieties having thin shell Thin shelled varieties have high oil content. 4. Breeding varieties for dry land conditions. Under dry land conditions the spiny nature will be more pronounced. How ever dry land varieties with less pronounced spines were evolved. E.g. K.l. 5. Breeding varieties resistant to pest and diseases : Pests like Prodenia and Heliothis are important pests. The wild species C.oxycanthus is moderately resistant to pests. This is being utilised in breeding programme. 77 NIGER Guizotia abyssinica (2n = 30) It is a cross pollinated crop oil content is 35 to 45 %. The inflorescence is a head or capitullum and heterogamons and florets are similar to that of sun flower. The breeding objectives and methods are similar to that of sunflower.