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FACULTY OF AGRICULTURE SCIENCES AND ALLIED INDUSTRIES

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For

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Unit I

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

FIBRE CROPS COTTON (Gossypium sp.) Diploid cotton : (2n = 26) G.arboreum - Karunganni cotton G.herbaceum - Uppam cotton Tetraploid cotton : (2n = 52) G.hirsutum - American cotton G.barbadense = Egyptain cotton, sea island cotton. A. Floral biology Simple, solitary, terminal extra axillary, petals yellow to cream in colour, hermophrodite, bracteoles called as epicalyx, three in number, free and deeply serrated and persistent at the base of the flower. Nectary gland is present on each bracteole. Calyx five united, cup shaped, corolla five, polypetalous, a purple spot is present on the inner side of the claw of the petal (petal spot) in some species. Androecium forming a staminal column (monadelphous), bearing numerous anthers. Ovary superior penta carpellary, style slender, passes thro' staminal column with three to five lobed stigma, ovules many in axile placentation. B. Anthesis and pollination There is much variation in case of flower opening. Asiatic cottons open between 8 and 10 AM. American cottons open much earlier. Temperature affects the flower opening. After flower opening the cream yellow colour corolla turns pink within a day and later changes to red. The receptivity of the stigma is 8 to 10 AM. C. Selfing Cotton is an example for often cross pollinated crop. Selfing is done by sealing the flower bud by using thread, paper clips, wet clay or mud and other devices to prevent entry of insects responsible for cross pollination. D. Emasculation and crossing Emasculation is done by removing the staminal column by giving a cut with thumb nail. Emasculation is done in the evening usually a day before flower opening. Immediately after emasculation the flower is covered with colour butter paper bag for easy identification next day morning. Pollen from the male flower is dusted on the emasculated flower by rubbing the staminal column of the male parent. Immediately after pollination the flower is covered with white butter paper bag and proper labelling is also done. This method is known as Doak's method. E. Agencies dealing with Cotton Research 1. National Agency : CICR - Central Institute of Cotton Research, Nagpur 2. State level : CICR - Regional Station, Coimbatore. All India, Coordinated cotton improvement project 3. TNAU : Cotton Breeding Station, Coimbatore, RRS, Kovilpatti CRS, Srivilliputhur. 79 F. Varieties released 1. Introduction : Cambodia cotton in South India, MCU- 1 2. Selection : K1 cotton reselection from SRT -1 3. Hybridization and selection a) Inter varietal : MCU 5 - Multiple cross derivative MCU 6 - Multiple cross derivative MCU 8 - Single cross hybrid derivative. MCU 9 - (MCU 5 x MCU 8) MCU 11 - (MCU 5 x Egyptian hirsutum) b) Interspecific hybridization : Acala 1517 lines of G.hirsutum resistant to wilt and best fibre quality are due to natural crossing with G.barbadense. Evaluation of tetraploid cotton is due to interspecific crossing and natural doubling. Old world diploid linted cotton x G.raimondii (A genome) (Dgenome) F1 sterile Doubling G.barbadense (AD genome) Old world diploid linted cotton x G. thurberi (A genome) (D genome) F1 sterile (Doubling) G.hirsutum (AD genome) 4. Heterosis breeding Both intraspecific and interspecific hybrids are evolved in cotton. a) Intraspecific : G.hirsutum x G.hirsutum Shankar (H4) cotton of Surat (Gujarat 67 x American nectariless) b) Interspecific hybrids : Varalakshmi (Laxmi x SB 289E) (hirsutum) x (barbadense) CBS 156 (Acala glandless x SB 10856) DCH 32 (DS 26 x SB 425) (Jayalakshmi) TCHB 213 (TCH 1218 x TCB 209) G. Hybrid Seed production 1. DOAK's method of hybrid seed production In this method, manual emasculation of flowers is done one day before anthesis, and pollination next day morning. For convenience, the parental varieties are grown in same fields in the ratio of 4:1 (Emasculation and pollination is done as described earlier). 80 2. Use of male sterile line Cytoplamic. genic male sterility was developed by Vesta G. Meyer an American scientist. She obtained CMS lines by transferring hirsutum genome to the cytoplasm of wild species G.harknessi. Restorer lines were also developed in hirsutum and barbadense back ground. Genic male sterility was also observed in cotton but utilisation is difficult due to segregation of sterile line in 50:50 ratio of sterile and fertile and maintenance of sterile line is laborious. Another type of male sterility is transformation

of staminal column into a petaloid condition. This was obtained when G.arboreum genome is transformed to cytoplasm of G.anamalum 3. Practical difficulties in use of CMS lines for hybrid seed production a) Lack of simply inherited restorer gene that maintains fertility over a wide range of environment. b) lack of development of good combiners possessing male sterile cytoplasm and restorer factor. c) Lack of dependable and economic method of controlling pollination by insect pollen vectors. 4. Mutation breeding MCU 7- Xray irradiated mutant of L 1143 MCU 10 - Gamma irradiated mutant of MCU 4 5. Population improvement followed in USA a) Recurrent selection : Pima S1 Pima S4 of G.barbadense b) Synthetic variety : Deltapine 15 developed at konyvllwer USA. c) Composite : Pima 17 of G.barbadense. H. Special breeding techniques in cotton a) Bulked progeny method (Texas method) In commercial cotton varieties with a broad genetic base is desirable so that they have the adaptability to the requirement of varied and widely different environmental conditions. Texas method provides such plasticity. (i) Open pollinated seeds of selected F2 single plants are grown in replicated randomized block design along with standard check variety. Best progeny are marked and harvested on single plant basis. Yield and fibre quality will be assessed and best ones will be selected and seeds will be bulked for testing in F4. (ii) Again the F4 bulks are also tested in replicated randomised block design the process done in F3 is repeated. (iii) The F5 and F6 progenies are tested in MLT and later released as variety. b) Mass pedigree selection technique of Harland This system was used by Harland for the improvement of Peruvian cotton variety with spectacular success. First season : Examine a large number of selected single plant from a heterogenous commercial crop and fix up specification or norms for making selection. Second season : (i) Grow progeny rows of single plants in replication 81 (ii) Examine bulk samples from these progeny rows and eliminate rows failing to confirm to the norms fixed during first season. This is known as bulk norm test (iii)Examine the single plants in the selected progeny rows and eliminate the plants failing to confirm to the norms. This is called 'single plant norm test'. Third season Repeat the bulk norms test as done in second season and select the best lines. Fourth season Mix the seeds of selected lines and raise the multiplication plot and distribute them. 82 COTTON TCHB 213 SEED PRODUCTION GUIDELINES Parentage : TCH 1218 x TCB 209 (G.hirsutum) (G.barbadense) For the seed production in an area of one acre, the female parent TCH 1218 is to be raised in 80 cents and the male parent TCB 209 in 20 cents. Spacing For female parent 4' x 2' Male parent 3' x 2' Synchronisation Sowing of male parent should be advanced by 15 days. The male parent should be sown 5 meters away from the female. Seed rate Female parent : 800 g Male parent : 200 g Season August. Dibble the seeds of male parent at 2 seeds/hill on 1st August and female parent on 15th August. Emasculation and pollination Emasculate and pollinate as far as possible in the buds appearing during the first six to eight weeks of reproductive phase to ensure good setting and development of bolls. Restrict emasculation to each day evening from 3 to 6pm and pollination next morning between 9 AM to 1 PM. Cover the male buds in the previous day evening with butter paper bag for their use in the next day. Emasculated buds may be protected with butter paper bag. Tie a thread to the pedicel of the bud immediately after pollination. Close the crossing programme after 9th week from commencement of crossing and flowers appearing subsequently are removed to facilitate proper development of crossed bolls. Nip the top and side shoots to arrest further vertical and horizontal growth respectively. Normally one flower from the male parent will cover 5 to 10 flowers of the female parent for crossing.

JUTE Corchorus sp (2n=14) Tiliaceae The genus Corchorus includes about 40 species. In India only 8 species occur. Two cultivated species are C.capsularis : White jute 50 races occur in this C.olitorius : Tossa jute 8 races occur in this. Both the species are not crossable. Among the two olitorius yields more fibre/unit area. The fibre is finer, softer, more, lustrous and less rooty than capsularis. Olitorius occupies about 25% of jute area in India. One of the draw backs of Tossa jute is pre mature flowering if the varieties are sown earlier in March-April in early monsoon rains. The pre mature flowering leads to profuse branching and deterioration in fibre quality. Capsularis strains are characterised by a single flush

of flowering at the end of single vegetative period. Based on maturity, the varieties in Capsularis are divided in to Early - Flowering in July Medium - August Late - September. Breeding objectives 1. Breeding for high yielding short duration jute varieties. Early varieties are generally low yielders whereas late varieties are high yielders. So to combine high yield with earliness is one of the main objectives. Yield is positively correlated with plant height, basal diameter of stem, fibre-stick ratio. Higher photo synthetic capacity with increased lamina length, breadth, petiole length and leaf angle at 400 also contribute to yield. 2. Breeding for quality fibre In jute quality is negatively, correlated with yield. The quality characters are a) Fibre length. b) Fibre strength c) Fibre colour d) Lustre e) Percentage and quality of retting d) Proportion of faults such as roots, spects, knots. Environment plays a major rote in quality. Alternate and fluctuating bright sunshine, humidity and temperature and rainfall at minimal level are favourable for improved quality. Further retting in clear and slow running water gives good quality fibre. The tall and thick plants in general gives inferior fibre than that in short and thick plant. 84 3. Breeding for pest and disease resistant varieties In pests, stem borer and aphids cause greater damage and in diseases Macrophomena is major. Though resistance sources are available in other related species, the crossability barrier prevents transfer. 4. Breeding varieties for high seed yield : Since jute is cut for fibre at 50% flowering stage, it is essential to reserve some plants for production of seeds. The fibre obtained from seed crop will be poor in quality. Hence it is necessary to breed varieties specially for high seed production with out loosing quality characters. 5. Breeding for olitorius varieties having non-shattering habit coupled with non-pre flowering habit. JRO 524 JRO 7885 Sudan green x JRO 632 Breeding Methods: 1. Germplasm building and Utilisation Central Jute Technological Research Institute, Calcutta is maintaining the Jute collections. This shows wide range of variability thus offering a great scope for improvement by selection and hybridsation. 2. Introduction : Introduced short duration varieties are Jap green, Jap red, Jaichung sudan green. 3. Hybridization and selection a) Inter vareital: Multiple crossing and selection are followed both in olitorius and capsularis improvement. In olitorius improved varieties are JRO 524, JRO 7885. In capsulanis JRL 412, JRL 919 Since yield and quality are negatively correlated a balance must be struck in breeding for improved varieties. b) Inter specific cross: So far not successful. Attempts were made by straight cross mixed pollen method, Stigmatic paste method, self anther paste method, stigma cut method polyploidy breeding. But none of them proved successful. Difference in embryo endosperm growth is the reason 4. Mutation breeding : Using x rays useful jute mutants were obtained at Calcutta JRC 7447 and Rupali two varieties. 85 MESTA, KENAF BIMLI JUTE Hibiscus cannabinus H.sabariffa Var.altissima Malvaceae In Thailand Siami jute or Roselle in India. Both the species are important jute supplements and show wide adaptability unlike jute. At present both the species are known as Mesta. Place of origin : H.cannabinus have its possible origin in Africa H.sabadariffia - Asia. Kenaf is used for making ropes, twines, fishing nets and also in the paper pulp making from kenaf stalks especially fine paper, structural boards. H.cannabinus : mesta Compared to jute mesta is of inferior in quality in respect of fineness, lusture, and colour. Mesta varieties show poor performance in spinning because the fibre is coarse, stiff, brittle and irregular in cross section mesta alone cannot be spun in jute machines unless it is mixed with jute in some proportion. H.sabadarifra var.altissima (Roselle) Roselle is an useful substitute to jute. It is also called as Siamijute two types are available. i. Tall non branching types cultivated for fibre. ii. Dwarf, bushy wild type used as green and edible calyx as pickle. Breeding objectives : 1. Breeding of high yielding short duration mesta varieties (Similar to Jute) 2. Breeding for quality fibre (Similar to Jute) 3. Breeding for pest and disease resistant varieties.

SUGAR CANE Saccharum sp Six species of perennial grasses all of which originated in old world. Of these six two are occurring in a wild state. They are S.spontaneum with a wide distribution from North East Africa thro' Asia to pacific. S.robustum confined to New Guinea and neighbouring islands. The other four

species are cultigens 1. S.officinarum - Noble cane of New guinea. 2. S.barberi - North Indian canes 3. S.sinensis - Chinese cane. 4. S.edule - Melenesian cane. Systematics, origin and distribution 1. Saccharum spontaneum (2n = 40 - 128) A perennial grass, free tillering, often with Rhizomes. S.spontancum represents a polyploid series. Forms with the smallest chromosome numbers are found in North India which is probably the centre of origin. Natural hybridization with S.officinarum would have produced S.barberi and S.sinense S.spontaneum is widely used in breeding of modern commercial hybrids by a process of nobilisation with S.officinarum. Spontaneum provides vigour, hardiness and resistance against diseases. 2. Saccharum robustum : (2n = 60 - 194) Origin New guinea vigorous perennial. robustum would have given rise to S.officinarum with which it is interfertile. S.robustum is highly susceptible to mosaic virus and leaf scale and because of this its use in breeding programme is very much limited. 3. Saccharum officinarum (2n = 80) Origin : South pacific. Chewing cane. Noble cane This cane is suited to tropical conditions and requires favourable soil and climate for its performance. The stems are stout thick high in sucrose, low in fibre and with soft rind. The noble canes are susceptible to most of the diseases. Some of the earlier cultivars are Bourbon, Cheribon, noble canes. 4. S. barberi 2n = 82 - 124 S.barberi is short medium to slender in thickness, with high fibre content, medium sucrose content and poor yielder. 5. S.sinense : (2n = 18) Chinese cane. Tall vigorous, slender, high fibre content. Poor juice quality. 6. S.edule : Polynesian cane (2n = 118) Slender, weed like form. Seeds are edible. Not much used. 93 Nobilisation in Sugar cane. Nobilisation is crossing the noble cane S. officinatum with S.barberi, S.spontaneum and infusing disease and pest resistance in the noble cane. The first successful use of nobilisation was made and variety cheribon was crossed with S.barberi variety and progenies having resistance to sereh disease were evolved. But they were susceptible to mosaic and inferior in sucrose content. By subsequent crossing with S.officinatrum i.e. second and third nobilisation good varieties like POJ 2878 were evolved. In India, nobilisation of local spontaneum was begun by Barber and Venkata raman in 1912 at SBI Coimbatore. At coimbatore crosses were initially made between local strains of S.barberi (Which is unproductive but adapted to climates of North India) and tropical noble cane (thick soft stem, high sucrose content but unsuited to climates of North India). Later on by crossing these resultant hybrid with wild cane S.spontaneum canes with high sucrose content suitable for North India were evolved. In this way a large number of tri hybrid canes were developed. Breeding objectives. 1. Breeding varieties suitable for Jaggery making. Co 853, Co 62175, CoC67 2. Breeding varieties for factory purposes - high Brix value and recovery %. Co 658, Co 772, Coc 8001 3. Breeding varieties suitable for all the three seasons Early - Dec - Jan Mid - Feb - March Late - April - May. 4. Breeding varieties resistant to shoot borer. 5. Breeding varieties resistance to disease shoot disease, Rust, Brown spot. 6. Breeding varieties with high ratooning ability. 7. Breeding varieties with drought resistance. 8. Breeding varieties with more number of productive tillers. 9. Varieties with shorter duration without yield less. COC 671 Sugar cane varieties for Coimbatore : Early Mid Late Special Factory Jaggery Factory Jaggery Factory Jaggery COC 90063 COC 91061 COC 91061 COC 776 COC 774 Co 740 Co 8201 Co 8021 Latest variety COC 99061 (Co 6806 x Co 740) Suitable for mid and late season.