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Review Article

Back crossing technique in interspecific hybridization in *Gossypium*[1]

by

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The theory of back-crossing: Back-crossing is crossing of F.1 hybrid with either of its parents. That parent of the hybrid with which it is again crossed, or with which it is repeatedly crossed is the back-cross parent or recurrent parent the other parent being the donor parent or non-recurrent parent (Knight, 1948) The principle involved in the use of the back-cross technique is the simple one of reducing the amount of genetic variance in the material in which selection is to be practised (Hutchinson *et al*, 1938). Thus, relatively small population need only be raised to select out the desirable genotype, if back-crossing is resorted to.

Value of back-crossing in breeding: When it is desired to breed a strain deriving a great preponderence of its genotype from one parent (the recurrent parent) and only a small proportion from the other (the non-recurrent parent) (Hutchinson *et al*, 1938) back-crossing is of value. The genotype of the recurrent parent on the average, will be recovered in 1/2, 3/4, 7/8, 15/16 progression as back-crossing proceeds. In a programme of repeated back-crossing designed to transfer a character from one species to another the character under transfer must be preserved in successive generations by selection (Thomas, 1952; Elliot, 1958).

The simplest case is the transference of a character dependent on a single dominant gene from one species to another. When the character to be transferred is recessive the heterozygotes can be recognised only through the segregation exhibited by their selfed progeny with respect to the required character. Back-crossing can be made in alternate seasons only as the constitution of the hybrids has to be determined. When several genes are to be transferred from one species to another it is usually advisable to transfer them separately and then bring them together by inter-crossing the hybrids (Thomas, 1952).

Undesirable genes may be linked with the gene intended to be transferred and it may be difficult to eliminate them without losing also the required gene. But, in a back-cross programme as the gene under transfer is brought in from the recurrent parent in each back-cross, the chance of a crossing-over and realization of the desired combination seems better than that by the pedigree plan. After

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a crossing-over takes place the new linkage formed will tend to make these combinations more frequent than under a system of independent inheritance of factors (Hayes, Immer and Smith, 1955).

Thus, it becomes evident that it is possible to introduce the desirable genes from related species into the commercial varieties of crop plants by adopting back-cross technique. This is especially valuable when economically important characters are not present within the limits of cultivated varieties but can be found in related wild species.

Haldane (1934) observed that 'in the case of repeated back-crossing, one set of chromosomes was retained as a going concern with the genes balanced and working together in the plant which was consequently unlikely to fall below a certain level of vigour whereas a good level of vigour could not be maintained if once the original chromosome complexes present in the hybrid were broken up plants'. The essential value of back-crossing is that it provides a means of limiting heterogeneity which would result from straight crosses between two types making it possible to produce a hybrid similar to whichever of the two parents that has the more valuable genetic constitution yet containing the desirable characters transferred from the other parent (Knight, 1945).

Thomas Andrew Knight (1759 - 1835) is referred to in text books as having made the first attempt of a back-cross. Ware (1936) stated that John Giffin had employed the technique in cotton breeding leading to the production of the variety 'Griffin' as early as 1867. The review presented here is a follow up of the exhaustive treat given by Thomas (1952) on the Back-crossing technique applied to *Gossypium*.

Back-cross technique as applied to *Gossypium*: Beasley (1942) doubled the cross *G. thurberi* x *G. arboreum*. When crossed to *G. hirsutum* the cross was found to be partially fertile.

In the Anglo-Egyptian Sudan, genes confering resistance to black arm *viz*, B, from *G. herbaceum*, B1, B2, B3 and B7 from *G. hirsutum*, B5 from *G. barbadense* and B4 and B6 from *G. arboreum* were transferred to the cultivated cotton 'Sakel', *(G. barbadense)* through initial crosses with the species possessing the resistant genes, followed by repeated backcrossing to 'Sakel'. (Knight, 1953 a, and b; 1954 a, b and c and Knight and Sadd, 1951). *G. arboreum* and *G. herbaceum* (2n : 26) had to be doubled before crossing with 'Sakel'. A single recessive gene b8 from *G. anomalum*, confering resistance to blackram, was transferred to *G. arboreum* (Knight, 1954-c). From the progeny of the third backcross of the hybrid *G. thurberi* x *G. barbadense* to *G. barbadense* selections with high strength were isolated. Transference of resistance to boll worms from *G. thurberi* and *G. armourianum* into *G. hirsutum* and *G. barbadense* respectively was attempted through backcrossing technique (Knight, 1954-a). A major hairiness gene (resistance to jassids) was transferred from doubled *G. arboreum* to *G. barbadense*

(Knight, 1954–b). The gene complexes governing jassid resistance (hairiness) from two *G. hirsutum* varieties Fergusan (Phillippines) and M. U. S. (Indian) were reported to have been transferred to *G. barbadense* background (Knight, 1954-a and 1954-b).

Increase in the number of locules per boll and the number of seeds per locule in *G. barbadense* was reported to have been achieved through back-crossing technique using *G. hirsutum* and *G. aridum* respectively as donor parents. From the second back-cross of *G. barbadense* x *G. raimondii* hybrid hexaploid to *G. barbadense*, types with larger bolls and high lint index were selected. (Hutchinson, Silow and [Stephens, 1947). The fourth back-cross of the tri-hybrid (*G. arboreum* x *G. thurberi* amphidiploid) x *G. hirsutum* to *G. hirsutum* showed high strength of fibre (pressley index over 11·0) Cuany, 1952). The caducous bracts of *G. armourianum* were transferred to *G. hirsutum* to help reducing trash in mechanical harvest (Cuany, 1952).

Economic strains 170-Co. 2 (Deviraj) and 134-Co. 2 M. (Devitej) were the outcome of crosses between *G. hirsutum* on the one hand and *G. herbaceum* and *G. arboreum* on the other followed by the utilisation of the hybrids in a back-cross programme. The fourth backcross of *G. hirsutum* (Co. 2) x *G. tomentosum* hybrid to Co. 2 resulted in cultures named 'Co-tom' which proved not only resistant to jassids besides to drought but possessed good ginning out-turn and staple length (Pandya & Patel, 1959).

Back-crossing the *G. hirsutum* (Co. 2) x *G. anomalum* hexaploid to Co. 2 resulted in promising types called 'Co-ano' giving high fibre strength and fineness (Pandya and Patel, 1959, Deodicar, 1950).

An enormous amount of variability was observed in the progenies of the doubled hybrid of *G. arboreum* x *G. thurberi* crossed with *G. hirsutum* and *G. barbadense* (*G. thurborsutum* and *G. thurbandense*) and backcrossed to the respective tetraploid parents (Ganesan, 1952.)

The 'C' 2 doubled hybrid of *G. hirsutum* x *G. raimondii* was backcrossed to *G. hirsutum* and hybrids showing fine lint have been obtained (Ganesan, 1947).

The Jubilee cotton, *G. arboreum*, was crossed with *G. anomalum* and the hybrid was twice backcrossed to Jubilee. Through selection in subsequent generations strains with better yield, ginning out-turn and lint fineness than Jubilee were obtained (Afzal, Sikka and Rahman, 1945).

G. hirsutum x *G. raimondii* hybrid was doubled and back-crossed to *G. hirsutum*. Blackarm resistant types combining good yield and ginning percentage were observed. (Kesava Iyengar, Santhanam and Rajagopalan, 1955).

The hybrid *G. barbadense* var. *darwinii* x *G. hirsutum* var *punctatum* was backcrossed twice to *G. hirsutum*. Selection in the progeny resulted in culture 9-8 found to be consistently jassid tolerant (Kalyanaraman and Santhanam, 1954).

The potentialities of utilizing of *G. anomalum* for transferring the lint fineness to the cultivated *G. arboreum* were indicated by Kalyanaraman and Santhanam (1957). In *arboreum—anomalum* crosses Kesava Iyengar, Santhanam and Leela (1958) observed fibre length values transgressing the *arboreum* parent with an appreciably lowered fibre weight.

The transference of specific characteristics *viz.*, lint fineness, strength, resistance to blackarm, to jassids etc., from the donor parent (any wild species) into the cultivated background is an attainable proposition if such a programme is pursued on an organised scale using backcrossing technique.

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