Attention has recently been directed[9] to the metabolic interrelations of root and shoot, but little is known concerning any specific requirement of the shoot for nitrogenous compounds. It may be that all the shoot requires is a bulk supply of inorganic or organic nitrogen, or it may be that all or some of the specific compounds present in xylem sap are essential for shoot development.

E. G. Bollard

Fruit Research Station,
Department of Scientific and Industrial Research,
Auckland, New Zealand.

Aug. 28.

[1] Bollard, E. G., *Nature*, **171**, 571 (1953).
[2] Bollard, E. G., *J. Exp. Bot.*, **4**, 363 (1953).
[3] Bollard, E. G. (in the press).
[4] Miettinen, J. K., and Virtanen, A. I., *Physiol. Plantarum*, **5**, 540 (1952).
[5] Reuter, G., and Wolffgang, H., *Flora*, **142**, 146 (1954).
[6] Tracey, M. V., "Modern Methods of Plant Analysis", **4**, 119 (1955).
[7] Mothes, K., and Engelbrecht, L., *Flora*, **139**, 586 (1952).
[8] Tolbert, N. E., and Wiebe, H., *Plant Physiol.*, **30**, 499 (1955).
[9] Mothes, K., "Die Kulturpflanze", **1**, 157 (1953).

Alloploid Nature of Okra, *Abelmoschus esculentus* (L.) Monech.

Abelmoschus esculentus (L.) Moench. (= *Hibiscus esculentus* L.[1]), commonly known as lady's fingers, okra or bhindi, is an important vegetable crop cultivated in the different countries of the world. The chromosome number of this species has been variously reported as $2n = 130$ [2] and $2n = 72$ [3]; in a number of varieties examined by us[4], the chromosome number was invariably found to be $2n = 130$.

Pal, Singh and Vishnu Swarup[5] described from India a new species, *Abelmoschus tuberculatus* Pal et Singh, related to okra. The chromosome number of this wild species was determined by us[4] to be $2n = 58$.

Meiosis and seed setting in *A. esculentus* ($2n = 130$) and *A. tuberculatus* ($2n = 58$) were normal. The F_1 hybrids ($2n = 94$) obtained from reciprocal crosses between these two species were totally sterile. Chromosome pairing in these hybrids appeared to be interesting from the phylogenetic point of view. Out of 122 pollen mother cells which could be very clearly analysed, 105 showed the chromosomal association, $29^{II} + 36^{I}$, 13 showed $28^{II} + 38^{I}$ and 4 cells showed $27^{II} + 40^{I}$. The most frequent association, $29^{II} + 36^{I}$, strongly suggests that the 65-chromosome cultivated okra is an alloploid comprising two genoms, one with 29 and the other with 36 chromosomes. The former genom is homologous with that of *A. tuberculatus*; the latter genom may be related to any among the species of *Abelmoschus* having $n = 36$ chromosomes.

Among the *Abelmoschus* species of which chromosome numbers have so far been reported in the literature, three have $n = 36$ chromosomes: *A. ficulneus* (L.) Wt. and Arn.[6] (= *Hibiscus ficulneus* L.), *A. moschatus* Medik. (= *Hibiscus abelmoschus* L.[2]), and *Hibiscus esculentus* var. Blue Long *A* [3]. *A. tuberculatus* seems to be the only species so far for which the chromosome number, $2n = 58$, is certain.

A chromosome number approaching that of *A. tuberculatus* was reported for *Hibiscus manihot* ($2n = 60$)[3,7]; however, Skovsted[2] reported $2n = 66$ and Kuwada[8] $2n = 68$ chromosomes for this species. Teshima[3] observed all the chromosomes as univalents, during meiosis, in the F_1 hybrid (*H. esculentus* var. Blue Long *A*, $n = 36 \times$ *H. manihot*, $n = 30$), and in the F_1 hybrid (*H. esculentus* var. Dwarf Prolific, $2n = 126$–134, $\times$ *H. manihot*, $2n = 60$) Chizaki[7] reported the formation of 0–7 pairs during meiosis. Recently, Prof. Kuwada of the Kagawa University, Japan, observed at meiosis in the F_1 hybrid of *A. esculentus*, $2n = 124$, with *A. manihot*, $2n = 68$, the formation of 0–7 bivalents (personal communication). The cytological features of these hybrids are thus distinct from those of the present one, namely, *A. esculentus* $\times$ *A. tuberculatus*.

We have so far not met with a form of *A. esculentus* with $2n = 72$ chromosomes, the number reported for the variety Blue Long *A* of this species by Teshima[3]. Should Teshima's observations be confirmed, *A. esculentus* would appear to comprise two chromosomal races, $2n = 72$ and $2n = 130$. While it would then be interesting to study the evolutionary origin of the form with $2n = 72$ chromosomes, it would appear from the present results that cultivated okra (*A. esculentus*, $2n = 130$) may have originated through hybridization between a 29-chromosome and a 36-chromosome species of *Abelmoschus* followed by chromosome doubling in the resulting hybrid.

In this context, it is interesting to note that the F_1 hybrid, *A. ficulneus* ($n = 36$) $\times$ *A. tuberculatus* ($n = 29$), studied by us was totally sterile and formed, on an average, 1·63 chromosome pairs per pollen mother cell, the frequency being as follows:

No. of pairs per pollen mother cells	0	1	2	3	4	5	6	7	
No. of pollen mother cells	27	14	18	7	8	1	2	1	(= 78)

Experiments are under way to synthesize an $n = 65$-chromosome form through chromosome doubling in this hybrid.

Vavilov[9] has suggested, on the basis of phytogeographical studies, an Abyssinian origin for *A. esculentus*. Further studies on the world distribution of *Abelmoschus* species, especially in the Abyssinian region, and on their cytogenetic affinities would be helpful in elucidating the problem.

We are grateful to Dr. B. P. Pal and Dr. S. M. Sikka for encouragement and helpful criticism during the course of these investigations.

A. B. Joshi
M. W. Hardas

Division of Botany,
Indian Agricultural Research Institute,
New Delhi.

July 26.

[1] Hochreutiner, B. P. G., *Candollea*, **2**, 79 (1924).
[2] Skovsted, A., *J. Genet.*, **31**, 263 (1935).
[3] Teshima, T., *J. Fac. Agric. Hokaido Univ.*, **34**. 1 (1933).
[4] Joshi, A. B., and Hardas, M. W., *Curr. Sci.*, **22**, 384 (1953).
[5] Pal, B. P., Singh, H. B., and Swarup, V., *Bot. Gaz.*, **113**. 455 (1952).
[6] Hardas, M. W., and Joshi, A. B., *Indian J. Genet. Plant Breed.*, **14**, 47 (1954).
[7] Chizaki, Y., *Proc. Crop Sci. Soc., Japan*, **6**, 164 (1934).
[8] Kuwada, H., *Tech. Bull. Kagawa Agric. Coll.*, **1**, 12 (1949).
[9] Vavilov, N. I., *Chron. Bot.*, **13**, 1 (1949–50).

Protective Coloration and Animal Behaviour

Procryptically coloured insects may resemble objects occurring in their environment very closely[1]; thus leaf-mimicking butterflies may bear markings resembling veins, holes eaten by phytophagous insects, mildew, etc. This has been held by some authors to invalidate the theory of natural selection