Autosomal chromosomes carrying sex genes in *Momordica dioica* Roxb.

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Cucurbits display a variety of sex forms ranging from hermaphroditism to dioecism through monoecism and other intermediate type. Precocious separation of bivalents in the species during meiotic phase cannot be explained on the basis of heteromorphic nature of chromosome as all the chromosomes were smaller in size. The character indicates its incipient heteromorphy in which total chromosome length in not taking part in sex expression, rather the autosomes carrying sex-deciding genes. This species exhibits intermediate stage of sex mechanism where one pair of autosomes is responsible for sexual dimorphism.

CUCURBITS exhibit a variety of sex forms. In the dioecious species of the family, sex mechanism has been explained entirely on the genic basis of sexual dimorphism without any cytological manifestation, e.g. *Luffa echinata*[1]. In some dioecious species it has been studied on X/Y chromosome basis (*Coccinia indica*) where distinctly heteromorphic pair of chromosomes is present[2]. An intermediate type of sex mechanism has been reported in *Trichosanthes dioica*[3] on the basis of homologus chromosome complements expressed during microsporogenesis in the male which is an indicative of incipient type of sexual dimorphism.

Momordica dioica is a perennial, rhizomatous and distinctly dioecious species of the family Cucurbitaceae[4]. Somatic chromosome number[5,6] is $2n = 28$ and heteromorphic bivalents are reported earlier[7]. But this has not been confirmed in later studies. The present paper deals with the autosomal behaviour carrying sex genes in diploid and induced polyploid cytotypes of *M. dioica* and is being reported for the first time.

For meiotic analysis young staminate floral buds were fixed in 1 : 3 acetoalcohol in both the cytotypes. In diploid cytotype it has been found that one pair of chromosomes showed precocious separation at late metaphase I (Figure 1, *a*). All the chromosomes were found to be arranged on the equatorial plane except two that separated early and moved far from the equatorial plane. Polyploidization was induced in the species by colchicine treatment[8]. Autotetraploid cytotype showed bivalent and quadrivalent associations. Segregation behaviour in one pair of chromosomes (Figure 1, *b*) has also been met with during metaphase and anaphase. Separation pattern of chromosomes in both the cytotypes remained the same.

Precocious separation of bivalents during metaphase and anaphase I and II meiosis in the diploids and autotetraploids cannot be judged on the basis of heteromorphic nature of the chromosomes, because in both the cases chromosomes are smaller in size and do not differ in morphology. Hence,

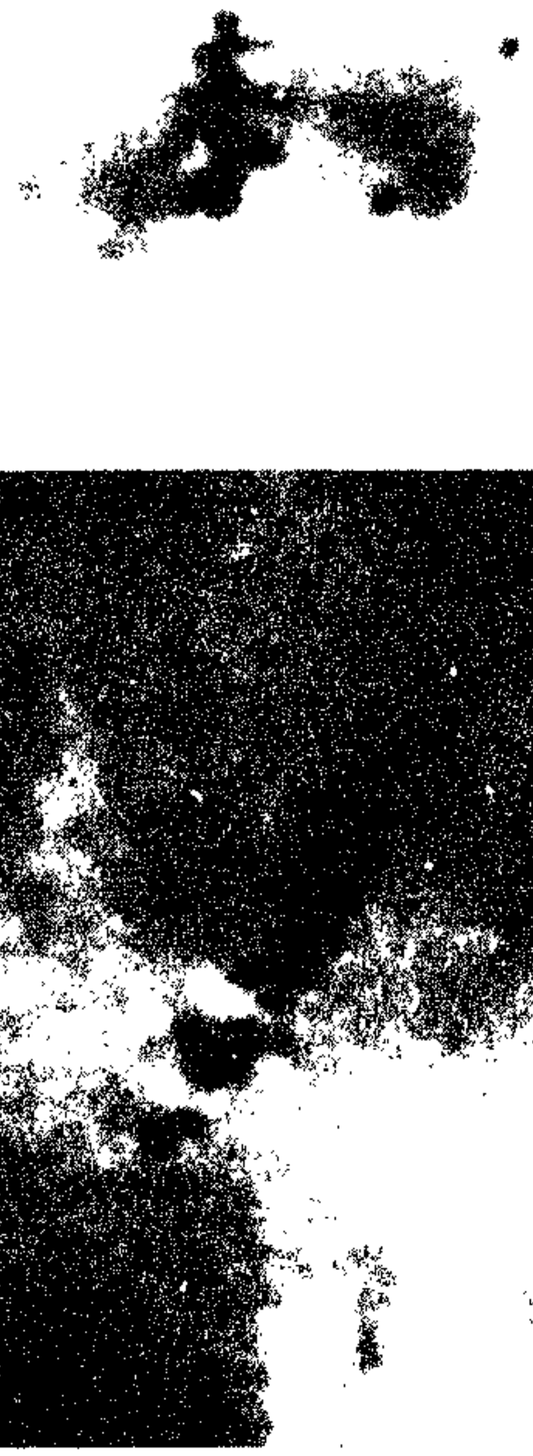

Figure 1. *a*, Metaphase of meiosis in diploid *M. dioica* with precocious separation. *b*, Metaphase in colchiploid shows early separation of chromosomes.

sex mechanism in *M. dioica* does not follow the X/Y chromosomal basis. Precocious separation during metaphase or non-disjunction behaviour of chromosomes during anaphase can be explained on the basis of incipient heteromorphic pair of chromosomes which revealed similar morphology but differs in segregating pattern during the meiotic phase[9]. It may be assumed that total chromosome length of such a homologous pair is not responsible for sex expression in this species as it is in *Melandrium album*[10] and *Coccinia indica*[11], rather the autosomes carrying sex-deciding genes in *M. dioica* favour the production of male and female dioecious plants; and the block of genes in staminate plants cause early separation of chromosome during metaphase and anaphase due to the heterogametic nature in male sex. In other way, the aberrant nature of one pair of chromosomes suggests that this pair carries sex-deciding genes without any heteromorphy. It indicates that *M. dioica* exhibits intermediate stage towards chromosomal basis of dioecism in which a pair of autosomes

associated with sexual dimorphism are structurally homomorphic but the linkage group provides a very short homologous segment and a large differential one causing precocious separation during metaphase.

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Genotype-dependent response to *Azospirillum* treatment in yield and nitrogenase activity in *Brassica juncea* L.

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Twelve advanced lines of mustard (*Brassica juncea* L.) were evaluated for response to treatment with *Azospirillum brasilense* in yield and a few components. Two lines gave yield increases with concomitant increases in nitrogenase activity and *Azospirillum* population. In general, there were desirable and significant correlations between plot yield, nitrogenase activity and $\log_e$ (*Azospirillum* population). The results point to the possibility of utilizing genotype-dependent response to *Azospirillum* in breeding programmes and also for exploring new avenues of *Azospirillum*-based cultural practices in sustaining improved productivity.

In the context of imperative need for increasing and sustaining productivity in oleiferous Brassicae, the utility of bio-fertilizing agents assumes crucical importance. *Azospirillum* has been reported to be a good microaerophilic nitrogen fixer in several plants[1,2]. Its potential to increase grain yields has been recorded in crops like sorghum, pearl millet, ragi and barley, though the magnitude of improvement varied with the crop and genotypes. The utility of such biofertilization in Brassica did not appear to have been examined or reported so far. This paper summarizes the results of a pilot study on the response of *Brassica juncea* to seed treatment with *Azospirillum brasilense*.

Ten advanced lines of *B. juncea* developed in the Oilseeds Unit of the Indian Agricultural Research Institute, and the two checks, Pusa Bold and Pusa Barani formed the material. Seeds of the lines were coated with *A. brasilense* following the procedure outlined by Subba Rao *et al.*[3] Thus in each line there were two treatments—control, and treated with *Azospirillum*. The material was grown in a split-plot design with three replications, with the lines allotted to main plots and the two treatments to sub-plots. The plot size was five rows of 5 m length, with inter-row space of 60 cm and inter-plant distance of 10 to 15 cm. The crop was raised under normal agronomic and cultural practices. The crop was free of diseases; but aphids were controlled by timely application of the insectiside, Rogor.

Observations were recorded on plot yield (g) and on the following characters on samples of five plants, with mean values being used for statistical analysis: plant height (cm), number of primary branches, number of secondary branches and biomass (g). The presence of *Azospirillum* in the rhizosphere soil was detected by the most probable number (MPN) method[4]. The bacterial population in the endorhizosphere was estimated by macerating one gram of fresh roots after surface-sterilizing the roots with 0.1% chloramine-T for 30 min and making to 10-fold serial dilutions in sterile distilled water. The MPN counts were taken according to Alexander[5] and the population expressed as per g dry soil or per g fresh weight of roots. The cell count values were transformed to log scale to remove non-normality for further analysis. The acetylene reduction assay suggested by Hardy *et al.*[6] was used to assess the nitrogenase activity in excised roots.

The variation among the lines was significant for plot yield and the three characters—$\log_e$ (*Azospirillum* population in rhizosphere, RHS), $\log_e$ (*Azospirillum* population in endorhizosphere, ERS) and nitrogenase activity (NGA). Treatment variation and the line × treatment interaction were significant for biomass, ERS and NGA; they were not significant for plot yield.

The range of variation among the lines was high in the control lines for all characters except primary and secondary branches (Table 1). *Azospirillum* treatment enhanced the mean and the range of variation still further. Overall, plot yield showed a little but non-significant depression under treatment. In general, the coefficient of variation (CV) for the treated lines was much higher than the corresponding values for control, though for *Azospirillum* cell count and nitrogenase activity there were either no differences or a nominal decrease in the CV of treated lines.

However, a few cultures responded to the *Azospirillum* treatment and could show significant improvement over control for primary branches, biomass and plot yield (Table 2). The improvement was relatively higher for other