Gene-ecological Investigations in *Pisum* Mutants

Part 2: Comparative Performance in Germany and North India

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**Summary.** Six mutants and nine recombinants of *Pisum sativum* were grown along with the mother variety at Kurukshetra, North India. The findings obtained were compared with those obtained for the same material grown at Bonn, Germany. The following observations were made.

Stem length and degree of branching are influenced differentially in the various genotypes tested in India as a consequence of a specific reaction of the genes to the climatic conditions. A gene for weak stem fasciation and gene *efr* for earliness in a specific gene combination are unable to express their action in North India whereas they are fully active in Germany. Furthermore, in Kurukshetra early flowering of some recombinants does not result in early ripening because their seeds require about double the time for full ripening than those of the mother variety.

At Kurukshetra, recombinant R 674A proved to be highly heat susceptible. All the plants died in early stages of ontogenetic development. Four other genotypes died due to heat before completing seed ripening. One mutant and three recombinants were found to be more tolerant to powdery mildew attack than the mother variety and Indian local lines. The seed production of eight genotypes in relation to that of the initial line was essentially better in North India than in Germany. They are obviously better adapted to the semi-arid conditions. Some of them appear to be useful for pea breeding in India. In contrast, a fasciated mutant, high yielding in Germany, is not able to express this potentiality at Kurukshetra. At Udaipur (Rajasthan, Western India), this mutant is unable to flower. Another four genotypes, tested at both Indian locations, exhibited an essentially poorer seed production at Udaipur than at Kurukshetra due to some ecological factors.

The findings indicate a specific response of some of the genotypes tested to the specific ecological conditions of the three locations, their response differing from that of the mother variety demonstrating thereby a different adaptational optimum.

**Key words:** Gene-ecology – Fasciated mutants – Penetration – Flowering behaviour – Seed production

**Introduction**

Usually, the behaviour of mutants is compared to that of their mother varieties under those environmental conditions in which they have been developed. There is an increasing number of examples which demonstrate that mutants can have adaptational optima different from those of their initial lines and can be thus superior to them under distinct ecological conditions. The best way to study the ecological reaction of mutants is by cultivating them under the controlled conditions of a phytotron. This has been successfully done with barley mutants in Sweden (Dormling et al. 1966; Dormling and Gustafsson 1969; Gustafsson and Dormling 1972; Gustafsson et al. 1973a, c, 1974, 1975). In this way, the impact of distinct climatic factors such as temperature, photoperiod, light quality amongst others that influence the specific traits of the genotypes tested can be singled out.

Another possibility for testing the ecological reaction of mutant genes is to grow them in locations having diverse climatic conditions. This has been done for small groups of *Pisum* mutants and recombinants of our collection which were cultivated along with the mother variety in Germany, Egypt, Ghana, Uganda, Brazil and in five climatically different regions of India. Drastic differences in the behaviour of some of these genotypes in relation to that of the initial line were found with regard to stem architecture, flowering and ripening time, seed and pro-
tein production, tolerance to heat, drought and diseases (Gottschalk and Patil 1971; Gottschalk and Kumar 1972; Gottschalk and Imam 1973; Gottschalk and Kaul 1975; Müller 1975; Wolff 1975; Gottschalk 1976, 1978a; Müller and Gottschalk 1978; Gottschalk and Müller 1979). Inve-

Materials and Methods

The following X-ray induced mutants of the variety 'Dippes Gelbe Viktoria' of Pisum sativum utilized exhibit the below given traits when grown in Bonn:

- R 667: Longer internodes, stem linearly fasciated, not late.
- R 853: Longer internodes, stem feebly fasciated, normal leaves, earlier than the mother variety. From the cross of the mutants 489C (strong stem fasciation) X Blixt's cochleata 5137 (reduced stipules).
- R 878: Short internodes, broad round stipules, early flowering. From the cross of mutants 2641 (short internodes) X 46C (earliness).
- R 879: Stem dichotomously bifurcated with high penetrance of the gene, early flowering. From the cross of mutants 1201A (stem bifurcation, reduced penetrance) X 46C (earliness).

The material was grown along wire fences during winter 1977/78 at Kurukshetra, North India along with the mother variety. 30 to 50 plants per genotype were evaluated with regard to:

- shoot height and internode length,
- degree of branching,
- days to flower and days for seed ripening,
- susceptibility to heat and mildew attack,
- number of pods per plant, seeds per pod and seeds per plant,
- thousand grain weight,
- yield per plant in grams.

The same material has been cultivated at Bonn for many generations in the form of 4 to 6 replications per genotype per year with 50 plants per replication (Fig. 1). All the values obtained are related to the corresponding mean values of the mother variety 'Dippes Gelbe Viktoria' grown in the same year at the same location.

Results

The material grown in North India shows striking differences from that grown in Germany with regard to many of the traits studied. As the main aim of our investigations consists in testing the ecological reaction of the genotypes, the relative values related to those of the mother variety, not absolute values, are of interest. In the following section some traits which are specifically influenced by environmental factors are discussed.

Shoot Height

Shoot height is a quantitative trait controlled by many genes of the genome and influenced by the environment. This becomes clear from the comparison of the stem length values obtained at Bonn and Kurukshetra for each genotype.

The climatic differences between Germany and North India induce significant alterations in even the initial line. The mean values for the stem length vary between 75 and 82 cms at different locations in Bonn whereas the corresponding value at Kurukshetra was 122 cms. In comparison to the mother variety, only three genotypes showed the same behaviour in Germany and India (the short-stemmed genotypes 33B and R 878 and the long-stemmed recombinant R 848). With regard to the other types tested, two groups can be distinguished. In one group, a ten-