was 70·8% while corresponding loss in healthy fruits was 53·3% only. Many investigatiors[2,4,7] working with common Indian fruits and vegetables have made similar observations in fruits under pathogenesis. Ascorbic acid functions as one of the biologeical oxidation-reduction substances. It is easily oxidized to dehydro-L-ascorbic acid by the enzyme ascorbic acid oxidase or by certain other oxidative enzymes.

It seems, therefore, probable that the decline in the ascorbic acid is due to the production of ascorbic acid-degenerating enzymes either by the fungus itself or by the host-parasite interaction as postulated by Ghosh *et al.*[1].

The author is grateful to Professor K. S. Bilgrami, Head of the Botany Department, for providing laboratory facilities.

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RADIATION-GENETIC STUDIES IN GARDEN PEA: TWO EARLY FLOWERING AND RIPENING INDUCED MUTANTS

ISOLATION of early flowering and ripening mutants is one of the most important goals in pea breeding. A few early mutants in *Pisum sativum*, the garden pea, have been reported. The earliness in these mutants is due to the formation of the first inflorescence at the nodes which are formed early in the development of these plants. The flowers in these mutants are produced in the axil of 4th–6th instead of 11th–13th leaf. In comparison to their respective initial lines, most of these mutants flower 10–14 days earlier, but their seed production gets significantly reduced[1].

In a radiation-genetic experiment, in which the seed of Bonneville variety of pea were utilized[5], early plants segregated in two M2 lines and they bred true in M3 and M4 generations. Crossing with the initial line indicated a monogenic recessive control of the earliness in these. Intercrossing between these two early mutants indicated that the two genes inducing earliness were non-allelic, as the F1 was not early unlike the parents. In 1975, 40 plants of each of these two mutants, the initial line, the control, the local line and Prof. Gottschalk's early mutant 46C were grown in a randomised block in 5 replications (each replicate comprised of 40 plants) at two locations, Kurukshetra (N. India) and Shillong (N.E. India); the plant to plant and row to row distance in each case was 10 and 30 cm, respectively. Critical difference for each trait was computed following the usual analysis of variance technique.

Yield and other agronomic characters of these mutants are given in Table I, a perusal of which reveals that EM1 and EM2 differ significantly in morphological traits from 46C. Unlike 46C, they also exhibit a perfectly normal floral structure and physiological earliness. At Kurukshetra, EM1 was significantly shorter and more productive than its initial line and 46C (Table I). However, at both the locations, 46C and EM1 were earlier in flowering and ripening than the initial and the local line. All the genotypes (except EM1) became dwarf, flowered and ripened later, and, yielded fewer seeds at Shillong than at Kurukshetra (Table I). This differential behaviour of the genotypes at these two locations could be an expression of "place or location effect". At Shullong, both the early mutants exhibited a significantly higher seed production than the initial and local line; highest seed production being in EM1. In fact, EM1 is the best productive early genotype at both the locations and represents one of the potential genotypes to be used for pea breeding in these two regions. Unfortunately, due to late sowing, the pea genotypes were attacked by *Erysiphae polygoni* DC. and *Perenosporapisi* Syd., at the fruiting stage at Shillong. This also reduced their total grain production.

While Snoad and Arthur[7] found that early flowering from the accumulation of dominant alleles, Rowlands[6] and Snoad and Arthur[7] reported the result to be due to an accumulation of recessive alleles. Watts *et al.*[9] regarded that the early flowering in garden pea was due to an accumulation of recessive alleles, and the genetic system was mainly additive in effect. However, their regression of Wr on Vr after Hayman[4] indicated the existence of full dominance. The dominance was lower in F2 than in F1. Therefore, the chances of recognising dominance were higher in F1 rather than in F2. Analysing the basic pea material used, it appears that while in the diallel crosses of Rowlands[6], Watts *et al.*[9], and Snoad and Arthur[8], only European and North American cultivars were utilised, out of 6 parents used by Snoad and Arthur[7], 4 were quite unrelated to European cultivars and these, therefore, exhibited differences in the system of genetic control of some traints. This is obvious

TABLE I

*Performance of early mutants, initial line and the local lines of garden pea at two locations**

Location	Genotype	Shoot height (cm)	Total nodes per plant	Mean inter-node length (cm)	Days to first flowering	Days to ripen	Pods per plant	Seeds per pod	Seeds per plant	1,000 grain weight (g)	Grain yield per plant
Kurukshetra	Initial line	94·1	21·2	6·2	68	138	12·8	4·5	58·2	97·5	5·6
	Early mutant I (EM1)	68·3	19·4	3·5	52	121	11·4	3·8	44·3	160·0	7·1
	46 C	125·4	25·1	4·9	55	127	14·0	1·8	25·3	165	4·1
	Local line	133·4	21·2	3·9	66	137	15·2	2·8	44·0	162	7·1
	Critical difference value at 5% P level	8·3	2·7	2·7	5·3	8	2·1	0·3	4	5·7	0·7
Shillong	Initial line	69·8	14·9	4·5	117	170	5·01	2·8	14·0	113·4	1·6
	46 C	70·4	11·1	6·3	83	134	3·60	2·9	10	175·8	1·8
	Early mutant I (EM1)	65·3	14·3	4·5	77	128	6·70	5·2	35	172·3	6·10
	Early mutant II (EM2)	64·4	14·1	4·5	86	133	4·92	4·2	21	230·2	4·8
	Local line	120·9	17·7	6·8	112	173	5·90	3·4	20·0	215	4·3
	Critical difference value at 5% P level	9·7	2·6	1·3	3·7	11·4	2·7	0·4	3·4	5	0·65

* (Mean value of 200 plants; 40 plants each in five replications.)

from the fact that even with European and North American cultivars there have been suggestions of different genetic systems governing flowering time. For instance Cousin[2], from the analysis of all-cultivar diallel crosses, has indicated the presence of second polygenic system in which earliness of flowering is due to an accumulation of dominant alleles. Watts *et al.*[9] demonstrated that the late flowering in the variety "*Jade*" was the cause of gene interactions tending to increase earliness of flowering in combination with late flowering cultivars and delayed the flowering in combination with earlier flowering types. In the present material, mutation of specific dominant genes to their recessive forms resulted in earliness, the two early genes isolated are non-allelic indicating thereby a multiple allelic control of earliness in the garden pea.

Earliness and lateness, and dominance and recessiveness, being relative terms, can be compared when the results from two different sets of diallel crosses with only one common parent are available. In the control of flowering time of pea, major and subtle differences seem to exist. The system appears to be under more than one genetic control. Therefore, for breeding purposes, it is vital to screen extensively, both, the primitive and the cultivated group of peas, with a hope of determining different genetic systems controlling other traits of breeding value. The differences already revealed even in one trait, the control of flowering time, indicate the fragmentary nature of the evidence which is obtainable from such small sets of diallel crosses. These also show how unwise it would be to extrapolate beyond the parents used, in any one experiment since only a portion of the whole range of genetic variability is sampled on each occasion. Finally, the results which are obtained at different times and in different places are inevitably influenced by genotype-environment interactions that are operative all through. Therefore, the differential behaviour of mutant genes in garden pea at N. India and N.E. India is a pointer towards mutant gene-environment interaction and needs to be further analysed. However, preliminary studies on the genecological investigations in *Pisum* mutants by Gottschalk and Kaul[3] have revealed facts of interest and importance for pea breeders.

The author is grateful to Prof. W. Gottschalk, Director, Institute of Genetics, University of Bonn, W. Germany, for his guidance and for sending the seeds of his early mutant. His thanks are also due to Mr. N. K. Matta of BNC University, Kurukshetra, who collected the data at Kurukshetra and helped him in this investigation all through.

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INHIBITION OF RUSTS OF IRIS AND WHEAT BY TWO PHYTOPATHOGENIC PSEUDOMONADS

Pseudomonas marginata (McCulloch) Stapp has been reported to initiate infection on iris leaves through rust pustules[1]. As the rust pustules were acting as principal avenues for the entry of the bacterium in host leaves, it was considered intresting to krow the influence of the association on the rust fungus [*Puccinia iridis* (DC) Wallr.]. Germination tests were, therefore, conducted with uredospores collected from apparently normal and bacteria infested rust pustules. A remarkable reduction of germination of uredospores was detected in the latter case. A similar phenomenon was also observed to occur when non-contaminated uredospores of iris rust were allowed to germinats in a drop of aqueous suspension of 48 hr old culture of *P. marginata*. It was, thus, indicated that the contamination of rust uredospores with *P. marginatae* inhibited the germination of iris rust uredospores, in nature.

To confirm the inhibition of germination by *P. marginata*, uredospores of rusts of iris and wheat, (*P. graminis* f. sp. *tritici* and *P. recondita*) were kept for termination on glass slides in drops of bacterial suspension in a dilution series. The test in drops of water and an aqueous suspension of *P. sesami* served as checks. Inhibition of germiration occurred with *P. marginata* only. In the drops with higher bacterial concentrations, the inhibition was complete whereas in the cases of lower concentrations, the uredospores did germinate but the growth of germ-tubes was remarkably retarded. For further microscopic examination, the drops on slides were air dried and stained with crystal violet bacteria staining solution. In drops with *P. marginata*, a congregation of bacterial cells was observed on the surface of uredospores and germ tubes. Heavy congregation of bacterial cells seemed to effect a total inhibition of uredospore germination. In the cases where germination of spores had occurred, the bacterial cells collected in large numbers around the tips of germ tubes resulting either in a growth retarding effect on germ-tubes or bursting of their tips. In the case of *P. sesami*, congregation of bacterial cells occurred in the vicinity of tips of germ-tubes but without any obvious influence on these structures.

The inoculation of healthy leaves of iris and wheat with *P. marginata* contaminated uredospores of respective rusts, failed to produce any rust infection. A normal rust infection, however, developed on the host leaves inoculated with *P. sesami* contaminated rust uredospores. It was further observed that when a dilution series of *P. marginata* was employed to contaminate the rust uredospores, the development of rust infection on both the hosts showed a negative correlation with the concentration of bacterial cells in the dilutions. *P. marginata* was, thus, observed to inhibit the iris and wheat rusts identically.

With a view to detecting the rust-inhibiting phenomenon with other bacterial phytopathogens, germination tests were carried out with uredospores of stem rust of wheat in drops of aqueous bacterial suspension of 8 cultures of *Pseudomonas*, 6 cultures of *Xanthomonas* and one culture each of *Agrobacterium tumefaciens* and *Erwinia carotovora*. Germination of uredospores in aqueous suspensions of *Eschrichia coli* and *P. marginata*, and water alone served as checks. The culture of *P. cichorii* (Swingle) Stapp. inciting a zonate spot on cabbage, was identified to act as strong inhibitor of germination of uredospores of stem rust of wheat.

The present investigation records *P. marginata* and *P. cichorii* as antagonistic to rusts of iris and wheat. Adequate information is needed on the mechanism of inhibition and the scope of utilizing these organisms for the control of plant rusts.

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