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RESPONSE TO SELECTION AND EARLY GENERATION EVALUATION IN PEA

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ABSTRACT

The response to selection was estimated in F_3, F_4 and F_5 generations from the plants selected in F_2 and F_3 generations of the cross HPPC 63 x Lincoln. The response to selection and realised heritability increased in the successive generations. The plants selected in F_2 generation did not show any correlation with their progenies in F_3 and F_4 generations for all the traits except resistance to powdery mildew disease which showed consistancy in subsequent generations also. However, the plants selected in F_3 generation showed positive correlation with their progenies in F_4 and F_5 generations for seed yield, pods/plant, 100-seed weight, harvest index, and reaction to powdery mildew. Maximum response was observed in F_5 generation when selection was practised in F_3 generation. The study, therefore, revealed that selection for polygenic traits like seed yield should preferably be done after F_2 generation. However, selection for monogenic or oligogenic traits like resistance to powdery mildew can be practised in F_2 generation itself.

Key words: Selection response, selection differential, heritability.

For rapid and effective genetic improvement for any economic trait, it would be advantageous if selection can be carried out in the earliest possible generation so that only best recombinant lines are retained for further testing. However, field testing of lines in early generations is of little value due to residual heterozygosity. The term early generation testing, generally associated with progeny testing from F_2 onwards. The correlations in performance between early and advanced generations, as observed in the present study, are indicative of positive response to selection.

MATERIALS AND METHODS

The material for the experiment was derived from the cross HPPC 63 x Lincoln. To estimate the response to selection, 33 and 39 high yielding and powdery mildew resistant

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lines were selected in F_2 and F_3 generations, respectively. The selection intensity was 15% in F_2 and 10% in F_3 generations. The plants selected in F_2 were evaluated in F_3 and F_4 and the F_3 selection were evaluated in F_4 and F_5 generations. Generations were advanced in the off-season at the Research Station, Sangla (H.P.). Selection differential, response to selection, and realised heritability were estimated as per Falconer [1]. Early generation evaluation was done by estimating the correlation coefficients of F_2 selections with their progenies in F_3 and F_4 and of F_3 selections with their progenies in F_4 and F_5 and F_4 selection with F_5 generation for seed yield, pods/plant, 100-seed weight, harvest index, and reaction to powdery mildew. The experiment was conducted in augmented block design [2] along with five checks, namely, HPPC 63, Lincoln, Kinnouri, HPPC 110 and HPPC 73.

RESULTS AND DISCUSSION

Whenever selection is carried out in early generations (F_2 or F_3) an important consideration is the performance of these selection in F_3 or F_4 generations when most of the lines are approaching homozygosity. In the present study, the progenies of 33 F_2 plants, selected on the basis of high yield and powdery mildew resistance, were evaluated in F_3 and F_4 generations. The response to selection and realised heritability were higher in F_4 than in F_3 generation. The predicted response based on narrow sense heritability was at par in the F_4 and F_5 generations (Table 1). Similarly, the progenies of 39 selections were evaluated in F_4 and F_5 generations. The response to selection was higher in F_5 generation than in the F_4. The predicted response to selection was at par in F_4 and F_5 generation (Table 1).

Table 1. Estimates of various parameters in relation to selection response in different generations of pea

Parameter		F_2 selections	F_3 selections
Total plants		220.00	390.00
No. of plants selected		33.00	39.00
Mean yield of base population (g)		10.89	11.95
Mean yield of selection plants (g)		15.11	18.78
Selection differential (g)		4.22	6.83
Realised heritability:	F_3	0.37	0.00
	F_4	0.58	0.57
	F_5	0.00	0.67
Predicted response (%):	F_3	14.98	0.00
	F_4	23.10	30.93
	F_5	0.00	36.93
Observed response (%):	F_3	14.50	0.00
	F_4	22.58	32.97
	F_5	0.00	38.24

The estimates of selection differential showed that at higher selection intensity, selection differential was high and low at lower selection intensity. It is also interesting to note that the observed response has shown correspondence with the predicted response both for F_2 and F_3 selections. The agreement between the predicted and observed response was demonstrated by Rodin [3]. The main factors affecting the predictive value of

any early generation selection are heterozygosity for some genes and variability within the line. In case of poor relationship it is advisable to test the progenies from F_3 and F_4 onwards. Greater homozygosity is expected in later generations than in early generations. Masoga [4] also emphasized that F_4 performance could be satisfactorily predicted from the parental means or from, F_2 generation. Maximization of genetic advance at high selection intensity has been reported by Fasoulas [5].

The early generation evaluation was compared with late generation performance through correlation coefficients between different generation. The F_2 selected plants did not show any association with their progenies in F_3 and F_4 generation for seed yield, pods/plant, 100-seed weight, and harvest index, whereas plants selected for powdery mildew resistance showed consistancy in F_3 and F_4 generations. The relationship can be well understood by their significant positive correlation in subsequent generations (Table 2). However, the F_3 selections showed significant correspondence with their performance in F_4 and F_5

Table 2. Correlation coefficients (r) among different generations for seed yield and other economic traits in selections of pea

Trait	F_2 selections			F_3 selections	
	F_2–F_3	F_2–F_4	F_3–F_4	F_3–F_5	F_4–F_5
Seed yield	0.09	0.20	0.37*	0.59*	0.79*
Pod/plant	0.13	0.22	0.56*	0.68*	0.74*
100-seed weight	0.17	0.23	0.46*	0.57*	0.71*
Harvest index	0.08	0.15	0.28	0.45*	0.69*
Powdery mildew resistance	0.62*	0.65*	0.72*	0.79*	0.84*

*Significant at 5% level.

generations even for quantitative traits like seed yield, pods/plant, 100-seed weight, and reaction to powdery mildew but no such correspondence was recorded for harvest index. The F_4 selections showed positive correlation even for harvest index in F_5 generation. The correspondence between performance in the later generations was much greater than between early generations. Based on this, harvest index seems to be a more complex trait than others. The correlation between expression of various traits in subsequent generation increased as the generations are advanced, because the proportion of homozygous plants and loci will be small in early generations but would increase in the later generations depending upon the genes dispersion between parents [1]. In contrast to other traits, there was little increase in correlation between later generations for monogenic traits such as

reaction to powdery mildew which may happen because of high proportion of homzygous loci in early generations and less segregation in later generations. Thorne [6] has reported significant positive correlation of F_3 selections with F_5 in soybean. Sneep [7] suggested the introduction of F_3 yield tests. The relationship of F_2 selections with F_3 or later generations has also been reported for seed yield and harvest index in wheat by Whan and Rathjan [8].

In general, the results on response to selection revealed that F_3 based selection have yielded high selection differential, realised heritability, and better selection response for F_3 selections. Therefore, it indicates that yield of F_4 and F_5 generations is predictable on the basis of F_3 selections. It is also advisable that selection for retaining high yielding lines should be practised as early as in F_3 generation.

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