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RESEARCH ARTICLE

Association of characters and path of action in table pea (*Pisum sativum* L.)

■ **Pallavi Pathak and S.S. Gahalain**

SUMMARY

From the data generated from ten varieties/strains namely, AP-2, AP-4, AP-5, AP-1, KS-185, KS-218, KS-601, KS-701, KS-801 and AP-3 and their all possible combinations excluding reciprocals in table pea which were evaluated during 2015-16. The correlation co-efficient analysis revealed that green pod yield per plant showed positive and significant correlations with pod length (0.542), pod width (0.778), number of seeds per pod (0.615), number of pods per plant (0.404), seed shell ratio (0.331) and protein content (0.404). The positive and high direct effect of number of pods per plant (0.398) followed by pod length (0.252), seed shell ratio (0.251) and plant height (0.138) indicated their importance for selection base on it. Seeds per pod and protein content had positive but low direct effect on green pod yield. The major indirect positive effect of seeds per pod *via* pod length, pod width via number of first fruiting node, number of pods per plant *via* pod width and no. of seeds per pod, pod width via days to 50% flowering and number of fertile branches per plant *via* number of first fruiting node had positive and high indirect effects which indicated that effective selection can made indirectly based on these characters.

Key Words : Table pea, *Pisum sativum*, Selection parameters, Correlation, Path analysis, Pod yield

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The role of vegetables in vegetarian diet is well known as majority of the people of India are vegetarian in nature and the main source of minerals and vitamins in vegetarian diets mainly comes from vegetables and pulses. Table pea (*Pisum sativum* L.) is one of the most important favourable legume crops grown in India, during the winter seasons. The green pod and dry seed consider essential sources for protein and vitamin which used for human food as well as animal. Increasing yield of the crop/unit area and the pods quality could be gained by growing new and heavy pod yield cultivars and/or improving the cultural practices. In breeding programme for increasing productivity, three important decisions that faced by breeder to achieve their goals; Firstly, is to identifying germplasm for desired characteristics. Secondly, is to good choice for prospective parents should be used for hybridization.

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Finally, the breeder must limit which method could be used in handling the resulting segregating populations. The right decisions were easily made, when the breeding goals are to improving quantitative and quality traits.

In present Indian scenario when pulses prizes goes high and not affordable by a middleclass family in their daily diet but the table pea can play a significant role to fulfill the cheaper protein supplement in vegetarian diet. India is leading country in area and production while very poor in productivity. The informations regarding genetic/ selections studies of other vegetable crops have got more reliance but the genetic information in Table pea is extremely limited; hence the present investigation was conducted to determine the effective selection criteria for improving productivity of table pea yield and to estimate some genetic parameters in two simultaneous populations (parents +F_1s) of *Pisum sativum* L.

MATERIAL AND METHODS

The material for present study comprises of ten pea varieties/strains *i.e.* AP-2, AP-4, AP-5, AP-1, KS-185, KS-218, KS-601, KS-701, KS-801 and AP-3 were crossed in all possible combinations excluding reciprocals during rabi season of 2014-15. Final experiment was conducted at Vegetable Research Farm, Kalyanpur, Kanpur during *Rabi* of 2015-16 at same location. Each of parents and F_1s were planted in single row of 5.0 m long spaced at 45 x 15 cm apart between rows and plant, respectively replicated thrice. The experimental field was surrounded by three rows of AP-3 as boarder rows to minimize the boarder effects. All the recommended package of practices were adopted to raise a good crop. The observations were recorded on ten randomly selected plants from each F_1s from each replication for days to flowering, plant height (cm), length of first fruiting node, number of first fruiting nodes, number of fertile branches per plant, pod length, pod width, number of pods per plant, number of seeds per pod, seed-shell ratio, protein content and green pod yield per plant. The data so generated was analyzed for various statistical parameters as usual procedure. Correlations at genotypic and phenotypic level (Al-Jibouri *et al.*, 1958). The path analysis for parents and F_1 was performed using green pod yield as dependent character and other as independent character. The genotypic correlation values of yield per plant was further divided in to direct and indirect effect simply in terms of partial regression as elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The correlation co-efficient of yield per plant at genotypic level with pod length, pod width, number of seeds per pod, number of pods per plant, seed shell ratio and protein content was positive and significant which revealed that these characters are more effective for enhancing the yield. Similar reports were also observed earlier by Garima and Groopa (2012). In general, the genotypic associations were similar in direction but higher in magnitude than phenotypic ones (Table 1). Hence, the significant associations between the characters were primarily due to genetic cause. It indicates that the type of association between the characters is mainly due to pleiotropic effect of genes rather than due to linkage. Selection for the traits might be more effective based on these traits. Pod yield in table pea can be improved by selection of genotypes having more number of pods per plant and number of seeds per pod as also reported by Brijendra *et al*. (2013). In such conditions selection in early segregation population might be useful as an alternate tool for improving the yield. Bulk and/or pedigree selection for development of a new table pea genotypes. In present study the direct effect of pods per plant (0.398) followed by pod length (0.252), seed shell ratio (0.251), plant height (0.138), pod width (0.120) were positive. It indicated that these characters are helpful for increasing the green pod yield per plant. Seeds per pod and protein content had positive but low direct effect on green pod yield. Remaining characters had negative indirect effects indicating that these characters are trying to reduce the yield. The major positive indirect effect of Seeds per pod *via* pod length, pod width via number of first fruiting node, pod width and number of seeds per pod via number of pods per plant, pod width via days to 50% flowering and no. of fertile branches per plant *via* number of first fruiting node was observed as positive which indicated that selection based on these traits can also improve the pod yield which is an economic harvest in this crop as also reported by Kumar *et al*. (2010) and Brijendra *et al*. (2013). Other characters showed very little positive or negative indirect effects and had no any significant impact on selection.

As it is well accepted that the minimum combinations of heritability and correlation value are necessary for indirect selection to be more efficient then the direct selection for yield if self and informations obtained from path analysis have extensively been used in different crop plants as a tool for indirect selection of

Table 1 : Genotypic (Upper) and phenotypic (Lower) correlation co-efficient for 12 characters among P +F_1s derived from 10 parent's diallel cross in table pea (P+F_1)

Characters	1	2	3	4	5	6	7	8	9	10	11	12
Days to 50% flowering		0.580**	0.656**	0.683**	-0.474**	-0.320*	-1.024**	-0.514**	-0.306*	-0.231	-0.503**	-0.634**
Plant height (cm)	0.574**		0.678**	0.412**	-0.449**	-0.285*	-0.492**	-0.468**	-0.494**	-0.146	-0.009	-0.413**
Length of first fruiting node	0.649**	0.666**		0.644**	-0.241	-0.451**	-0.751**	-0.637**	-0.307*	-0.280*	-0.165	-0.581**
No. of first fruiting node	0.552**	0.325*	0.533**		-0.908**	-0.427**	-1.047**	-0.441**	-0.193	-0.324*	-0.531**	-0.661**
No. of fertile branches per plant	-0.105	-0.117	-0.009	0.080		0.440**	-0.906**	-0.375**	0.237	-0.002	0.226	0.017
Pod length (cm)	-0.258	-0.242	-0.366**	-0.162	0.027		0.336*	0.738**	0.084	0.314*	0.138	0.542**
Pod width (cm)	-0.505**	-0.237	-0.321*	-0.157	0.271	0.425**		0.595**	0.360**	0.308*	0.484**	0.778**
No. of Seeds per pod	-0.433**	-0.400**	-0.522**	-0.184	0.076	0.673**	0.491**		0.357**	0.283*	0.002	0.615**
No. of pods per plant	-0.283*	-0.476**	-0.276*	-0.093	0.147	0.125	0.282*	0.333*		-0.350*	0.037	0.404**
Seed-shell ratio (%)	-0.211	-0.138	-0.249	-0.175	0.105	0.327*	0.287*	0.299*	-0.310*		0.186	0.331*
Protein Content (%)	-0.452**	0.004	-0.124	-0.269	0.237	0.222	0.487**	0.075	0.074	0.219		0.404**
Green pod yield per plant (g)	-0.609**	-0.399**	-0.544**	-0.426**	0.086	0.527**	0.534**	0.572**	0.407**	0.338*	0.420**	

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Genotypic path for yield and its components for 12 characters derived from 10 parent's diallel cross in table pea (Parents + F_1s)

Character	1	2	3	4	5	6	7	8	9	10	11	Genotypic correlation with yield
Days to 50% flowering	**-0.132**	0.080	-0.046	-0.099	0.009	-0.081	-0.123	-0.014	-0.122	-0.058	-0.050	-0.634**
Plant height (cm)	-0.077	**0.138**	-0.047	-0.060	0.009	-0.072	-0.059	-0.012	-0.197	-0.037	-0.001	-0.413**
Length of first fruiting node (cm)	-0.087	0.094	**-0.069**	-0.094	0.005	-0.113	-0.090	-0.017	-0.122	-0.071	-0.016	-0.581**
No. of first fruiting nodes	-0.090	0.057	-0.045	**-0.145**	0.018	-0.107	-0.125	-0.012	-0.077	-0.081	-0.053	-0.661**
No. of fertile branches/Plant	0.063	-0.062	0.017	0.132	**-0.020**	-0.111	-0.109	-0.010	0.094	-0.001	0.023	0.017
Pod length (cm)	0.042	-0.039	0.031	0.062	0.009	**0.252**	0.040	0.019	0.033	0.079	0.014	0.542**
Pod width (cm)	0.135	-0.068	0.052	0.152	0.018	0.084	**0.120**	0.016	0.143	0.077	0.048	0.778**
No. of seeds per pod	0.068	-0.065	0.044	0.064	0.007	0.186	0.071	**0.026**	0.142	0.071	0.000	0.615**
No. of pods per plant	0.040	-0.068	0.021	0.028	-0.005	0.021	0.043	0.009	**0.398**	-0.088	0.004	0.404**
Seed- shell ratio %	0.031	-0.020	0.019	0.047	0.000	0.079	0.037	0.007	-0.139	**0.251**	0.019	0.331*
Protein content %	0.066	-0.001	0.011	0.077	-0.004	0.035	0.058	0.000	0.015	0.047	**0.100**	0.404**

* and ** indicate significance of values at P =0.05 and P = 0.01 Bold values showed direct effects Residual effect =0.307

yield and other economic traits Esposito *et al*. (2009). Selection for a component trait with a view to improve economic yield is called indirect selection and a greater yield response is obtained when the character for which indirect selection is practiced, has a high heritability and a significant association with yield (Breese and Haywards, 1972)

The phenotypic path was not considered in this study due to involvement of environmental interaction hence only genotypic path was estimated from the genotypic correlation co-efficient revealing that these characters are more important in order of merit while going for indirect selection aiming yield development in this crop as also reported by Bakheit and Metwali (2011), Garima and Groopa (2012). In present study major positive indirect effect on green pod yield per plant of pods per plant *via* number of fertile branches per plant followed by number of seeds per pod via pod length and pod width indicated that these characters are also considerable during making selections as also reported by Ceyhan and Onder(2001); Kumar *et al*. (2010) and Brijendra *et al*. (2013). Alternatively the material can advanced for effective selection in subsequent generations to get transgressive segregates and by planting in number of environments for improving the pod yield through rigorous selection.

The negative direct effect of days to 50% flowering, length of first fruiting node, number of first fruiting node

and no. of fertile branches per plant had very nominal effect on yield. The findings of Guleria *et al.* (2009) and Fares *et al.* (2013) are in closed accordance with these results.

The residual effect in this path was positive but low which indicated that the characters taken for improvement of pod yield were sufficient.

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