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Original scientific article

ASSOCIATION STUDIES IN PEA FOR YIELD AND YIELD ATTRIBUTING TRAITS

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The present study was conducted to find out correlation and path analysis for 10 yield and yield attributing traits using 159 diverse pea genotypes. Correlation studies revealed that the days to 50% flowering, node at which 1st pod appears, number of pods/plant, number of seeds/pod, pod length, pod weight and days to 1st picking had significant and positive correlation with total yield/plant while, plant height and shelling percentage were negatively correlated with total yield/plant. The inter-correlation was observed between days to 50% flowering, days to 1stpicking and node at which 1stpod appears; shelling percentage with number of seeds/pod and pod length; plant height with number of pods/plant and days to 1st picking. It is concluded that there is positive and inter-correlation of total yield/plant with the number of pods/plant, pod length, number of seeds/pod, days to 50% flowering, days to 1stpicking. The positive association suggested that selection should be oriented towards more number of pods per plant, pod length, more number of seeds per pod which would consequently leads to higher pod yield per

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plant. The Path analysis studies revealed that the number of pods per plant exhibit highest positive effect on yield per plant.

Keywords: Correlation, path analysis, garden pea, traits, yield

INTRODUCTION

Garden pea (*Pisum sativum* L.) is a leguminous vegetable grown throughout the world for its fresh and processed forms. Globally, India is the second largest producer of peas with a production of 64.99 lakh tonnes, after China (FAOSTAT, 2020). In Punjab, it ranks second in area among vegetable crops after potato and occupies an area of 43.89 thousand hectares with an annual production of 467.01 thousand tons (ANONYMOUS, 2022).

Breeder's interest in association studies through correlation and path analysis exert selection pressure more profitably regarding effective and rapid yield gains (GRAFIUS, 1959). Economic yield is considered as superior and complex trait which resulted from multiplicative interaction of yield attributing components. Therefore, yield attributing traits should be taken into consideration due to their complexity with yield through association studies. Correlation coefficient study provides opportunity to measure the magnitude and direction of association between yield and its attributing traits. However, path analysis studies gives information about the direct and indirect contribution of the independent variable on the dependent variable. Hence, the present study was conducted to know the association between different yield attributing traits in 159 genetically diverse pea genotypes so that the selection methodology on highly associated traits will be applied to improve the yield potential of the crop.

MATERIALS AND METHODS

Experiment material

The present study was conducted to evaluate the 159 genotypes (table 1) for correlation and path analysis at vegetable research farm, Punjab Agricultural University, Ludhiana. The genotypes were sown in Randomized Block Design during 2018-19 and 2019-20 in three replications with row to row spacing of 30 cm and plant to plant spacing of 7.5 cm. The 45 kg Urea and 155 kg Superphosphate per acre was applied before sowing. For weed control, Stomp 30 EC (pendimethalin) @1.0 litre per acre was applied within 1 days of sowing by dissolving in 150-200 litres of water. The crop was raised with recommended agronomic practices as mentioned in the Package of Practices of Vegetable crops, Punjab Agricultural University, Ludhiana (ANONYMOUS, 2020b). The observations on 10 morphological traits viz. node at which 1stpod appears, plant height (cm), number of pods/plant, number of seeds/pod, pod weight (g), shelling percentage, pod length (cm), and total yield/plant (g) were recorded by tagging five competitive plants from each plot while plot basis observations were made for days to 50% flowering and days to 1st picking.

Location and climatic conditions

The location for study is at 30˚ 54' 26" N latitude and 75˚ 47' 38" E longitude at an altitude 247 meters above sea level at central zone of Punjab with semi-arid conditions. The average rainfall is 726 mm for this zone. As climatic conditions has an effect on growth and development of crop as well as on disease development, therefore, meteorological data on

temperature, relative humidity and rainfall was recorded during the whole cropping period i.e. from October to April during 2018-19 (figure 1) and 2019-20 (figure 2).

Figure 1. Meteorological data for year 2018-19 during experimental period

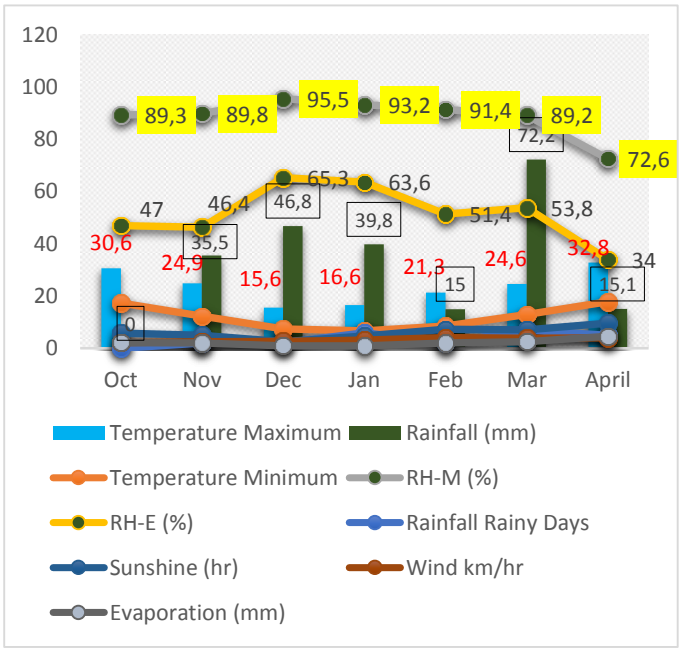

Figure 2. Meteorological data for year 2019-20 during experimental period

Table 1. List of pea genotypes used in present study

S. No.	Genotype	S. No.	Genotype	S. No.	Genotype	S. No.	Genotype
1.	PB-87	41.	Aryaveer	81.	Darl-404	121.	2016/PEVAR-8
2.	PB-89	42.	Angoori	82.	NDVP-104	122.	2016/PMVAR-1
3.	PB-90	43.	Vasundhra	83.	NDVP-8	123.	2016/PMVAR-2
4.	Espirit	44.	Sugar Snappy	84.	JP-179	124.	2016/PMVAR-3
5.	Sparkle	45.	Legacy	85.	JP-62	125.	2008/PMVAR-1
6.	Larex	46.	Electra	86.	JP-19	126.	2008/PMVAR-3
7.	Mithi Phali	47.	Namdhari (Afila)	87.	JP-825	127.	2008/PMVAR-4
8.	Tiger	48.	Arka Sampoorna	88.	JP-625	128.	2008/PMVAR-5
9.	Seena	49.	U-N-53-6-W	89.	JP-20	129.	2010/PMVAR-1
10.	Nepal	50.	Palam Priya	90.	JP-501	130.	2010/PMVAR-3
11.	Heildi	51.	Sugar Bon	91.	MA-6	131.	2011/PEVAR-1
12.	Boogie	52.	Airtel	92.	MA-7	132.	2011/PEVAR-5
13.	Ambassador	53.	Sugar Daddy	93.	2012/PMVAR-5	133.	2011/PEVAR-9
14.	Bliss	54.	Kinnouri	94.	2014/PEVAR-1	134.	2011/PMVAR-2
15.	C-308	55.	Tardio	95.	2014/PEVAR-2	135.	2012/PEVAR-4
16.	PSM-3	56.	IC-36	96.	2009/PMVAR-7	136.	2012/PMVAR-3
17.	PS-8	57.	Buddy	97.	2009/PMVAR-6	137.	2012/PMVAR-4
18.	PS-11	58.	Marina	98.	2009/PMVAR-2	138.	2016/PMVAR-4
19.	PS-19	59.	Dwarf Grey Sugar	99.	2014/PEVAR-3	139.	2016/PMVAR-5
20.	PS-24	60.	E-1	100	2014/PEVAR-5	140.	2016/PMVAR-6
21.	PM 65	61.	CHP-1	101.	2014/PEVAR-6	141.	2016/PMVAR-7
22.	PM 69	62.	CHP-2	102.	2014/PEVAR-7	142.	2016/PMVAR-8
23.	PMR-19	63.	C-400	103.	2014/PMVAR-1	143.	2016/PMVAR-9
24.	PMR-20	64.	KS-20	104.	2014/PMVAR-2	144.	2017/PEVAR-3
25.	PMR-62	65.	KS-205	105.	2014/PMVAR-3	145.	2017/PEVAR-5
26.	PEW-9	66.	GP No.1	106.	2014/PMVAR-4	146.	2017/PEVAR-6
27.	Nirali	67.	GP No.2	107.	2014/PMVAR-5	147.	2017/PEVAR-7
28.	DGP 207	68.	GP No. 3	108.	2014/PMVAR-6	148.	2017/PMVAR-1
29.	JM-1	69.	GP No.6	109.	2015/PEVAR-3	149.	2017/PMVAR-2
30.	JM-5	70.	CHPMR 2	110.	2015/PEVAR-4	150.	2017/PMVAR-3
31.	Bilaspur Lincoln	71.	VRP-6	111.	2015/PEVAR-5	151.	2017/PMVAR-4
32.	Cascatia	72.	VRP-7	112.	2015/PEVAR-6	152.	2017/PMVAR-5
33.	Tarvedo Sugar	73.	VRP-22	113.	2015/PEVAR-7	153.	2017/PMVAR-6
34.	Tarvedo Sugar-II	74.	VRP-233	114.	2016/PEVAR-1	154.	2017/PMVAR-7
35.	Organ Sugar Pod	75.	VP-434	115.	2016/PEVAR-2	155.	2018/PEVAR-1
36.	Easy Peasy	76.	LPF 48	116.	2016/PEVAR-3	156.	2018/PEVAR-2
37.	Jagatpura	77.	K-T-P-8	117.	2016/PEVAR-4	157.	2018/PEVAR-3
38.	Arka Ajit	78.	NS-1202	118.	2016/PEVAR-5	158.	2018/PEVAR-5
39.	Little Marvel	79.	Darl-405	119.	2016/PEVAR-6	159.	2018/PMVAR-4
40.	AP-3	80.	Darl-104	120.	2016/PEVAR-7		

Correlation analysis

Correlation and path coefficients for all possible combinations were estimated by using formulae suggested by AL-JIBOURI *et al*. (1958) and DEWEY and LU *et al.* (1959) respectively.

Phenotypic correlation {r xy (p)} $=\frac{Covxy\,(p)}{[Var\,x(p).Var\,y\,(P)]^{\frac{1}{2}}}$

Genotypic correlation {r xy (g)} $=\frac{Covab\,(g)}{[Var\,x(g).Var\,y\,(g)]^{\frac{1}{2}}}$

Where,

Covxy (p) and Covxy (g) = phenotypic and genotypic covariance, respectively between trait X and Y respectively.

Var x (p) and Var x (g) = phenotypic and genotypic variances respectively for trait X

Var y (p) and Var y (g) = phenotypic and genotypic variances respectively for trait Y.

Testing of significance of correlation coefficients 'r' was estimated by using the formulae suggested by SNEDECOR and COCHRAN (1980) as follows:

If 't' cal ≥ 't' tab

Then 'r' is significant.

Where,

T_{cal}=calculated value of 't'

T_{tab} =table value of 't'

't' cal = $r\sqrt{\frac{n-2}{1-r^2}}$

Where, r= Sxy$\sqrt{Sxx}\times\sqrt{Syy}$

Where, Sxy = Measure of joint variability between X and Y.

Sxx = Measure of variability between X.

Syy = Measure of variability between Y.

N= number of genotype

Sxy = $\frac{1}{n-1}\left[\sum xy^2-\left(\frac{\sum xy}{n}\right)\right]$

Sxy = $\frac{1}{n-1}\left[\sum x^2-\left(\frac{\sum x2}{n}\right)\right]$

Sxy = $\frac{1}{n-1}\left[\sum y^2-\left(\frac{\sum y2}{n}\right)\right]$

The correlation and path analysis was performed using MVM computer software programme. The results were interpreted on the basis of yield.

Path coefficient Analysis

Path coefficient analysis was based on method proposed by DEWAY and LU (1959). The direct and indirect effects were calculated by solving the following set of simultaneously equation:

$Py_1 + Py_2 r_{12} + Py_3 r_{13} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + Py_n r_{1n} = ry_1$
$Py_2 r_{12} + Py_2 + Py_3 r_{23} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + Py_n r_{2n} = ry_1$
$- \quad - - - - - - - - - - - - - - - - - -$
$- \quad - - - - - - - - - - - - - - - - - -$
$- \quad - - - - - - - - - - - - - - - - - -$
$Py_1 r_{1n} + Py_2 r_{2n} + Py_3 r_{3n} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + Py_n = ry_n$

Where,

$Py_1, Py_2, Py_3, \ldots\ldots\ldots\ldots, Py_n$ are the direct path effects of 1,2, and 3 ……n values on dependent variable 'y'.

$r_{12}, r_{13}, r_{14} \ldots\ldots\ldots r\ (r\text{-}n)_n$ are the genotypic correlation coefficients between various independent variables.

$ry_1, ry_2 \ldots\ldots\ldots r\ y_n$ are the genotypic correlation coefficients of independent variables with dependent variables 'y'.

$Py_1 r_{12} + Py_3 r_{23} \ldots\ldots\ldots\ldots Py_n r_{2n}$ are the indirect effects.

The degree of determination (P^2yx) of such variable (s) on dependent variable was calculated as follows:

$P^2yx = 1 - (P^2y_1 + 2Py_1Py_2r_{12} + 2Py_1Py_3 \ldots\ldots\ldots + P^2y_2 + 2Py_1Py_3r_{23} + P^2y_3 + 2Py_3 Py_4r_{34} \ldots\ldots\ldots\ldots P_2y_n)$

And

Residual effect (R^2) = P^2yx

RESULTS AND DISCUSSION

Correlation Studies

In present study, genotypic coefficients were higher than phenotypic coefficients this might be due to a strong inherent association between different traits (Table 2). Correlation analysis revealed that there was positive and highly significant correlation for total yield per plant with its attributing traits viz. days to 50% flowering (rg=0.414, rp=0.411), node at which 1st pod appears (rg=0.282, rp=0.269), number of pod/plant (rg=0.405,rp=0.401), number of seeds/pod (rg=0.164, rp= 0.159), pod weight (rg=0.306, rp=0.302), pod length (rg=0.216, rp=0.212) and days to 1stpicking. These results suggest that yield can be improved through simultaneous improvement of above mentioned yield attributing traits. Similar findings were reported by SINGH *et al.* (2019), SINGH *et al.* (2018), LAL *et al.* (2018), AMEEN *et al.* (2013) in various yield attributing traits. While, plant height showed negative correlation with total yield per plant (rg= -0.070, rp=0.069) and results found agreement with findings of SINGH *et al.* (2019), BHUVANESWARI *et al.* (2017), KHAN *et al.* (2017).

Table 2. Simple correlation coefficients among different traits in garden pea genotypes

Trait		Days to 50% flowering	Node at which 1st pod appears	Plant height	No. of pods/plant	No. of seeds/pod	Pod weight	Shelling %	Pod length	Days to 1st picking	Total yield/ plant
Days to 50% flowering	G	1.000	0.634**	0.307**	0.405**	-0.103*	-0.039	-0.115*	-0.027	0.901**	0.414**
	P	1.000	0.601**	0.305**	0.401**	-0.098*	-0.040	-0.114**	-0.026	0.893**	0.411**
Node at which 1st pod appears	G		1.000	0.518**	0.323**	-0.094*	0.117**	-0.169**	-0.106*	0.558**	0.282**
	P		1.000	0.495**	0.308**	-0.090*	0.110*	-0.160**	-0.103	0.532**	0.269**
Plant height	G			1.000	0.297**	-0.229**	-0.184**	-0.006	-0.397**	0.266**	-0.070
	P			1.000	0.296**	-0.220**	-0.182**	-0.006	-0.389**	0.265**	-0.069
No. of pods/plant	G				1.000	-0.132**	-0.224**	-0.124**	-0.217**	0.428**	0.405**
	P				1.000	-0.126**	-0.220**	-0.123**	-0.210**	0.425**	0.401**
No. of seeds/pod	G					1.000	0.289**	0.248**	0.586**	-0.145**	0.164**
	P					1.000	0.276**	0.239**	0.550**	-0.140**	0.159**
Pod weight	G						1.000	-0.315**	0.371**	-0.048	0.306**
	P						1.000	-0.308**	0.358**	-0.048	0.302**
Shelling %	G							1.000	0.142**	-0.147**	-0.170**
	P							1.000	0.137**	-0.145**	-0.167**
Pod length	G								1.000	-0.078	0.216**
	P								1.000	-0.075	0.212**
Days to 1st picking	G									1.000	0.445**
	P									1.000	0.443**
Total yield/ plant	G										1.000
	P										1.000

Days to 50% flowering

Days to 50% flowering showed positive significant correlation with node at which pod 1st appears (rg=0.634, rp=0.601), plant height (rg=0.307, rp=305), number of pods/plant (rg=0.405, rp=0.401) and days to first picking (rg=0.901, rp=0.893). Similar results were found by AZAM *et al.* (2020), SINGH *et al.* (2018) and KATOCH *et al.* (2016) for days to flowering. However, number of seeds/pod, pod weight, shelling percentage and pod length had a negative correlation with days to 50% flowering at both genotypic and phenotypic level. Similar findings were observed by SRIVASTAVA *et al.* (2018) and KUMAWAT *et al.* (2018).

Node at which 1st pod appears

The significant and positive correlation was observed for node at which 1st pod appears with days to 50% flowering (rg=0.634, rp=0.601), plant height (rg=0.518, rp=0.495), number of pods per plant pods (rg=0.323, rp=0.308), pod weight (rg=0.117, rp=0.110) and days to 1stpicking (rg=0.558, rp=0.532).While, node at which 1stpod appears showed negative and significant correlation with number of seeds per plant, shelling percentage and pod length at both genotypic and phenotypic level.

Plant height

Plant height showed positive and significant correlation with days to 50%flowering (rg=0.307, rp=305), node at which 1stpod appears (rg=0.518, rp=0.495), number of pods per plant (rg=0.297, rp=0.296), days to 1stpicking (rg=0.266, rp= 0.265). Results of present investigation were found to be in agreement with observations of KUMAVAT *et al.* (2018), and SINGH *et al.* (2017). However, number of seeds per pod, pod weight, shelling percentage and pod length showed negative correlation with plant height at both genotypic and phenotypic level. Similar results were observed by BAN *et al.* (2019), BHUVANESWARI *et al.* (2017) and KHAN *et al.* (2017) for plant height.

Number of pods per plant

Number of pods per plant had positive and significant correlation with days to 50% flowering (rg=0.405, rp=0.401), node at which pod appears (rg=0.323, rp=0.308), plant height (rg=0.297, rp=0.296) and pod length ((rg=0.428, rp=0.425). While, number of seeds per pod, pod weight, pod length and shelling percentage showed significant negative correlation with number of seeds per plant at both genotypic and phenotypic level. The results reported by KUMAWAT *et al.* (2018), OFGA and PETROS *et al.* (2017) and SRIVASTAVA *et al.* (2018) were in agreement with the results observed in our study.

Number of seeds per pod

There was significant and positive correlation was observed for number of seeds per pod with pod weight (rg=0.289, rp=0.276), pod length (rg=0.586, rp=0.550) and shelling percentage (rg=0.248, rp=0.239). Similar observations were reported by NAEEM *et al.* (2020), SRIVASTAVA *et al.* (2018) and KUMAWAT *et al.* (2018). Significant negative correlation was found with days to 50% flowering, plant height, node at which first pod appears, days to first picking and number of pods per plant for number of seeds per pod. Similar findings were

observed by NAEEM *et al.* (2020) and KUMAWAT *et al.* (2018) for number of pods per plant.

Pod weight

Positive and significant correlation was observed for pod weight with pod length (rg=0.371, rp=0.358), number of seeds per pod (rg=0.289, rp=0.276) and node at which 1st pod appears (rg=0.117, rp=0.110). Similar results were observed by KUMAWAT *et al.* (2018). Pod weight was observed to be negatively correlated with days to 50% flowering, plant height, number of pods per plant, shelling percentage and days to 1stpicking.

Shelling percentage

Shelling percentage was found to be positively correlated with pod length (rg=0.142, rp=0.137) and number of seeds per pod (rg=0.248, rp=0.239). Its negative correlation was observed with remaining traits. Results showed agreement with KATOCH *et al.* (2016).

Pod length

Significant and positive correlation was found for pod length with number of seeds per pod (rg=0.586, rp=0.550), shelling percentage (rg=0.142, rp=0.137) and pod weight (rg=0.371, rp=0.358). Similar observations were seen by NAEEM *et al.* (2020). Plant height, number of pods per plant, node at which first pod appears, days to 50% flowering and days to first picking showed negative correlation with pod length. Similar results were corroborated by KHAN *et al.* (2017) and BAN *et al.* (2019).

Days to first picking

There was positive and significant correlation for days to first picking with days to 50% flowering (rg=0.901, rp=0.893), node at which first pod appears (rg=0.558, rp=0.532), plant height (rg=0.266, rp=0.265) and number of pods per plant (rg=0.428, rp=0.425). Our results were in agreement with the observed results of KUMAWAT *et al.* (2018) and KATOCH *et al.* (2016) and SHARMA *et al.* (2007). The negative correlation of days to first picking was observed with number of seeds per pod, pod weight, shelling percentage and pod length.

Path analysis studies

Path analysis was performed to estimate the direct and indirect effect of different yield components on total yield per plant because correlation studies alone were not adequate to depict clear association among various traits. The involvement of more variables in correlation analysis leads to complex indirect association among various traits than only two or three traits under study at a time (SHARMA and SHARMA, 2012). So, path analysis is effective measurement in these circumstances for critical examination of relative importance of each trait for another trait.

In present study, number of pods per plant (0.403) exhibit highest positive effect on yield per plant followed by pod weight (0.313) (Table 3). Similar results were found by AMEEN *et al.* (2013) for number of pods per plant (0.558). Pod weight had significant positive correlation (r =0.302**) with direct effect of 0.313 which is mainly due to indirect effects through number of seeds per pod (0.021), plant height (0.033) and pod length (0.034). Days to 50 % flowering had also significant positive correlation (0.411) with yield per plant butits direct

effect was low in magnitude (0.037). This trait also showed positive indirect effect via node at which first pod appears (0.021), number of pods per plant (0.162) and days to first picking (0.269). Plant height had negative and non-significant correlation with yield per plant (r =-0.069) with direct effect of -0.186. Similar results were corroborated by SINGH *et al.* (2019). No doubt, shelling percentage had negative direct effect on total yield (-0.001) but it contributed via pod length (0.0131) and number of seeds per pod (0.018). The residual effect of path analysis also found positive (0.537) and indicator of that other attributing traits were also important and their critical role may be useful in improvement pea breeding programmes

Table 3. Direct and indirect effects of yield attributing traits on yield in garden pea

Trait	Days to 50% flowering	Node at which 1st pod appears	Plant height	Number of pods per plant	Number of seeds per pod	Pod weight	Shelling percentage	Pod length	Days to 1st picking	Phenotypic Correlation with yield per plant
Days to 50% flowering	0.037	0.021	-0.056	0.162	-0.007	-0.012	-0.001	-0.002	0.269	0.411
Node at which 1st pod appears	0.022	0.036	-0.092	0.124	-0.007	0.034	0.001	0.009	0.160	0.269
Plant height	0.011	0.017	-0.186	0.119	-0.017	-0.056	0.000	-0.0373	0.079	-0.069
Number of pods per plant	0.014	0.010	-0.055	0.403	-0.009	-0.0686	0.001	-0.020	0.128	0.404
Number of seeds per pod	-0.003	-0.003	0.041	-0.051	0.079	0.086	-0.001	0.052	-0.042	0.159
Pod weight	-0.001	0.003	0.033	-0.088	0.021	0.313	0.001	0.034	-0.014	0.302
Shelling percentage	-0.004	-0.005	0.001	-0.049	0.018	-0.096	-0.001	0.0131	-0.043	-0.167
Pod length	-0.001	-0.003	0.072	-0.084	0.043	0.111	-0.001	0.096	-0.022	0.212
Days to 1st picking	0.033	0.01	-0.049	0.171	-0.010	-0.014	0.001	-0.007	0.302	0.443

Residual effect: 0.357

Significant and positive correlation of days to first picking with days to 50% flowering (0.901) and node at which first pod appears (0.558) at genotypic level suggested that early flowering varieties would be reliable and effective selection criterion for early marketable yield. The positive association suggested that selection should be oriented towards more number of

pods per plant, pod length which would have more number of seeds per pod consequently leads to higher pod yield per plant. Results suggested that these attributing traits could be considered for further improvement in garden pea. The inter-correlation among different attributing traits for yield may provide effective consequences of selection for improvement of desirable traits. The inter-correlation according to present study were days to first 50% flowering and days to first picking to with node at which first pod appears; shelling percentage with number of seeds per pod and pod length; plant height with number of pods per plant and days to first picking. The positive and significant relationship among these traits offered the scope for improvement of studied traits for better gain.

CONCLUSION

Association studies were carried out for yield and yield attributing traits using 159 pea genotypes. Correlation studies revealed that the number of pods/plant, pod length, number of seeds/pod, had significant and positive correlation with total yield/plant while; days to 50% flowering and days to 1stpicking were negatively correlated with total yield/plant. The Path analysis studies revealed that the number of pods per plant exhibit highest positive effect on yield per plant followed by pod weight.

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PROUČAVANJA ASOCIJACIJE U GRAŠKU ZA PRINOS I SVOJSTVA PRINOSA

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Izvod

Ova studija je sprovedena da bi se utvrdila korelacija i *Path* analiza za 10 osobina prinosa i samog prinosa korišćenjem 159 različitih genotipova graška. Studije korelacije su otkrile da su dani do 50% cvetanja, nodus u kom se pojavljuje prva mahuna, broj mahuna po biljci, broj semena po mahuni, dužina mahune, težina mahune i dani do prvog branja imali značajnu i pozitivnu korelaciju sa ukupnim prinosom po biljci dok su visina biljke i procenat ljuštenja bili u negativnoj korelaciji sa ukupnim prinosom po biljci. Međusobna korelacija je utvrđena između dana do 50% cvetanja, dana do prvog branja i nodusa na kome se pojavljuje prva mahuna; procenta ljuštenja sa brojem semena/mahuna i dužinom mahune; visine biljke sa brojem mahuna/biljci i danima do prvog branja. Zaključeno je da postoji pozitivna i međukorelacija ukupnog prinosa/biljci sa brojem mahuna/biljci, dužinom mahune, brojem semena/mahuni, danima do 50% cvetanja, danima do prvog branja. Pozitivna korelacija je sugerisala da selekciju treba orijentisati na veći broj mahuna po biljci, dužinu mahune, veći broj semena po mahuni što bi posledično dovelo do većeg prinosa mahuna po biljci. Studije *Path* analize su otkrile da broj mahuna po biljci pokazuje najveći pozitivan efekat na prinos po biljci.

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