index (2.065193) indicating the build up of population (Table 2).

To determine each factor's ultimate contribution to survivorship of population of the cohorts, their k values were summed over the development period and expressed as a percentage over the total (Table 3). Despite all these adverse effects, a positive trend index was noticed indicating population build up.

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EFFECT OF NITROGEN AND PHOSPHORUS ON GROWTH AND YIELD OF SOME VARIETIES OF PEA

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ABSTRACT

The varieties tested were significantly different among themselves for all growth and yield characters. Nitrogen levels influenced the time for first flowering, the time marketable maturity, pod lengths, pod yield per plot, 100- seed weight and shelling percentage significantly but phosphorus levels had significant influence on pod yield per plot only. The interactions (V x N x P) were found to be significant for most of characters.

KEY WORDS : Nitrogen, Phosphorus, Effect, Pea

Pea (*Pisum sativum* L.) is a widely grown protein rich and nutritious vegetable crop in India. Application of fertilizers, particularly nitrogen (N) and phosphorus (P) to pea affects its yield substantially. N requirement of the high yielding [illegible] and P is known to enhance the activity of *Rhizobia* and thus atmospheric nitrogen fixation. The most of the Indian soils are deficient in these two nutrient elements. The present study was undertaken to find out suitability of some pea varieties for the mid-hill conditions of

Himachal Pradesh and to workout the optimum doses of N and P for the most suitable variety.

MATERIALS AND METHODS

The present investigation was conducted at the Pandah Vegetable Experimental Farm of the Dr. Y.S.Parmar University of Horticulture and Forestry, Solan (30^0 5IN 70^0 11 E; 1400 MSL). The climate of the site, in general, is sub-temperate characterised by mild summer and cold winter. The weather condition during crop season in the second year was slightly unfavourable the minimum temperature remaining about 2^0c above normal, resulting in poor crop growth and yield. The soil of the experimental plot was well drained, neutural, silt loam and medium in available N and high in available P and K. The experiment was conducted in split plot design with four varieties (Lincoln, Bonneville, GC 141 and Kinnauri) in main plots and all 16 possible combinations of 4 levels of N (0, 20,30 and 40 kg/ha) and 4 levels of P (0,30,60 and 90 kg/ha) in sub-plots. Half of N and whole of P and K doses were applied basaly and the balance of N was topdressed just before flowering.

The crop was sown on 9 November and 23 November in the first (1982-83) and the second year (1983-84) respectively, at a spacing of 60 cm X 10 cm. Hundred plants were maintained in each sub-plots (3m X 2m). The stacking was done in varieties Bonneville and Kinnauri. Growth characters (Table 1) were studied. Plant height of the selected plants was measured at the time of last picking, days to first flowering were counted from the date of sowing of the seed to the date when first flower opened, days to marketable maturity were counted from the date of sowing to the first picking of the pods, length of picked pods from tagged plants was measured from the point of detachment to the tip of the pod and pod width was taken as mean of the width measured at midpoint of the pods which were assessed for recording the pod length, number of seeds per pod were recorded from the same pods. The number of pods per plant was taken by totalling pods at all the harvests. For 10 green pod weight, pods from selected plants were weighted. Yield per plant was workedout from weight of pods from selected plants from three central rows at each harvest. For 100 seed weight, random samples of 100 green seeds from

Table 1. Performance of pea varieties in respect of plant height, maturity characters, pod yield and its attributes

Characters	Year	V_1	V_2	V_3	V_4	S.Ed	CD 5%
Plant height (cm)	1982-83	56.31	90.88	121.78	50.32	4.90	12.00
	1983-84	31.17	63.37	75.88	34.87	3.20	7.84
Days taken to	1982-83	111.21	111.77	118.29	107.90	0.74	1.82
first flower	1983-84	111.56	110.88	114.44	110.69	0.50	1.23
Days taken to	1982-83	150.98	149.69	153.69	148.46	0.49	1.19
marketable maturity	1983-84	138.88	136.96	140.29	134.00	0.53	1.30
Pod length (cm)	1982-83	8.58	7.50	6.96	8.03	0.11	0.23
	1983-84	7.90	6.86	6.90	7.13	0.11	0.26
Pod width (cm)	1982-83	1.43	1.47	1.50	1.57	0.04	0.09
	1983-84	1.49	1.43	1.40	1.51	0.02	0.06
No. of pods per	1982-83	13.48	14.26	18.51	12.32	2.53	NS
plant	1983-84	8.02	10.87	16.11	8.13	0.91	2.22
No. of seeds per pod	1982-83	6.75	5.58	5.20	6.30	0.15	0.57
	1983-84	7.24	6.22	6.15	6.93	0.23	0.57
Weight of 10 green	1982-83	68.10	54.59	43.25	65.49	1.69	4.14
pods (g)	1983-84	46.35	44.10	41.25	46.15	1.60	N.S.
Pod yield per plant	1982-83	90.36	74.56	80.84	83.13	14.05	N.S.
(g)	1983-84	37.45	46.95	62.73	38.39	3.38	8.27
Pod yield per plot	1982-83	3.84	3.08	3.46	3.59	0.33	N.S.
(kg)	1983-84	1.55	2.22	2.57	1.62	0.11	0.28
Hundred seed	1982-83	46.04	34.60	33.29	50.40	4.07	9.95
weight (g)	1983-84	39.60	35.73	39.73	36.06	1.03	2.53
Shelling percentage	1982-83	61.40	55.41	53.96	61.57	4.07	N.S.
	1983-84	47.25	48.62	52.95	48.25	1.36	3.32

V_1 = Lincoln; V_2 = Bonneville; V_3 = Kinnauri; V_4 = GC 141

all the pods of the selected plants were taken. Shelling percentage was calculated by the following formula:

$$\text{Shelling percentage} = \frac{\text{Weight of green seeds from 100 pods}}{\text{Weight of 100 pods}} \times 100$$

RESULTS AND DISCUSSION

During both the crop seasons, plants of the varieties Bonneville and Kinnauri were significantly taller than those of the varieties Lincoln and GC 141 (Table 1) Kinnauri produced the tallest plants and GC 141 the smallest, though GC 141 and Lincoln were on par with respect to the plant height. Significant differences among the varieties in all the characters studied were observed. Varietal diversity in pea has been reported by Schmelcz (1985). The days taken to first flower and days for marketable maturity were significantly less in variety GC 141 than those in other varieties during the year 1982-83. The tall varieties put up vegetative growth in the beginning and then flowered, whereas in the dwarf varieties the flowering was enhanced by about 4 to 11 days The findings conform to those of Pate (1978), who reported the first flowering in early and late varieties within the range 5 to 10 nodes and 5 to 50 nodes, respectively.

The varietal performance regarding pod characters and yield is presented in Table 1 . The variety Lincoln followed by GC 1 41 produced pods with maximum length in both the years. Pod width was significantly more in GC 141 than in other varieties. Varieties Bonneville and Kinnauri produced significantly more pods than the other. Variety Lincolon produced significantly more number of seeds per pod than the other. Though pod size and weight were more in Liocoln and GC 141, still greater pod bearing varieties Bonneville and Kinnauri recorded higher yield in 1993-84. There were much more branches and fruit bearing nodes in tall varieties than in dwarf once, thus the farmer resulting in higher number of pods and higher yield. The variety Bonneville has been reported to out yield all dwarf varieties in earlier studies too, (Anon., 1984).

Table 2. Effect of nitrogen levels on plant height, maturity characters, pod yield and its attributes

Characters	Year	Nitrogen levels (kg/ha)				S.Ed	CD 5%
		0	20	40	60		
Plant height (cm)	1982-83	81.08	78.87	81.27	78.07	1.70	N.S.
	1983-84	49.49	50.35	52.53	52.71	1.60	N.S.
Days taken to	1982-83	111.92	111.77	112.27	113.19	0.63	1.26
first flower	1983-84	110.94	111.98	111.94	112.71	0.28	0.56
Days taken to	1982-83	150.58	150.85	150.71	150.67	0.35	N.S.
marketable maturity	1983-84	136.29	136.17	136.21	137.46	0.56	1.12
Pod length (cm)	1982-83	7.76	7.86	7.62	7.84	0.13	N.S.
	1983-84	7.13	7.05	7.38	7.23	0.10	0.20
Pod width (cm)	1982-83	1.48	1.51	1.49	1.50	0.01	N.S.
	1983-84	1.42	1.44	1.47	1.46	0.02	N.S.
No. of pods per	1982-83	14.72	14.42	14.43	14.99	0.49	N.S.
plant	1983-84	10.62	10.76	10.45	11.29	0.58	N.S.
No. of seeds per pod	1982-83	5.85	6.18	5.87	5.92	0.15	N.S.
	1983-84	6.48	6.50	6.56	6.50	0.13	N.S.
Weight of 10 green	1982-83	55.98	59.68	57.46	58.32	1.54	N.S.
pods (g)	1983-84	44.00	45.27	44.38	44.21	1.05	N.S.
Pod yield per plant	1982-83	81.00	87.07	78.47	82.34	3.17	N.S.
(g)	1983-84	45.05	47.16	45.10	48.20	2.30	N.S.
Pod yield per plot	1982-83	3.60	3.60	3.22	3.55	0.10	0.19
(kg)	1983-84	1.95	2.03	1.99	2.00	0.10	N.S.
Hundred seed	1982-83	41.52	40.52	40.69	41.60	1.32	N.S.
weight (g)	1983-84	36.31	36.65	35.19	34.33	0.69	1.36
Shelling percentage	1982-83	57.49	56.96	58.66	59.21	1.59	N.S.
	1983-84	50.14	49.94	49.43	47.56	0.95	1.89

Table 3. Effect of phosphorus levels on plant height, maturity characters, pod yield and its attributes of pea

Characters	Year	Phosphorus levels (kg/ha)				S.Ed	CD (0.05)
		0	30	60	90		
Plant height (cm)	1982-83	78.65	80.50	81.05	79.07	1.70	N.S.
	1983-84	51.44	50.86	51.03	51.95	1.60	N.S.
Days taken to	1982-83	112.60	112.04	112.23	112.29	0.63	N.S.
first flower	1983-84	112.04	111.42	112.02	112.08	0.28	N.S.
Days taken to	1982-83	150.56	151.02	150.83	150.40	0.35	N.S.
marketable maturity	1983-84	136.67	136.58	136.50	136.38	0.56	N.S.
Pod length (cm)	1982-83	7.78	7.63	7.78	7.88	0.12	N.S.
	1983-84	7.13	7.20	7.33	7.12	0.10	N.S.
Pod width (cm)	1982-83	1.49	1.49	1.50	1.50	0.02	N.S.
	1983-84	1.44	1.44	1.46	1.45	0.02	N.S.
No. of pods per	1982-83	15.00	14.55	14.47	14.54	0.49	N.S.
plant	1983-84	10.16	10.95	11.11	10.91	0.58	N.S.
No. of seeds per pod	1982-83	5.95	5.77	6.03	6.07	0.15	N.S.
	1983-84	6.46	6.55	6.43	6.61	0.13	N.S.
Weight of 10 green	1982-83	56.76	57.56	57.77	59.37	1.54	N.S.
pods (g)	1983-84	43.79	45.38	45.06	43.63	1.05	N.S.
Pod yield per plant	1982-83	82.02	79.89	81.79	85.18	3.17	N.S.
(g)	1983-84	44.85	47.62	48.14	44.92	2.30	N.S.
Pod yield per plot	1982-83	3.46	3.30	3.47	3.73	0.10	0.19
(kg)	1983-84	1.98	1.99	2.08	1.91	0.10	N.S.
Hundred seed	1982-83	40.92	41.63	41.02	40.77	1.33	N.S.
weight (g)	1983-84	35.21	35.29	36.77	35.21	0.69	N.S.
Shelling percentage	1982-83	57.83	58.33	57.57	58.60	1.59	N.S.
	1983-84	50.08	49.08	48.00	49.91	0.95	N.S.

The 40 kg N/ha seemed to be the most effective in increasing plant height in the year 1982-83. Whereas in 1983-84, plant height increased with the increasing rate of N upto 60 kg N/ha (Table2). N levels produced significant effect on daystaken to first flower in both the years and 60 kg N application significantly delayed the flowering, while the other levels showed no significant effect. The poor response of pea to N has been reported by Amma (1971). The flowering and maturity were advanced with the increase in N levels. Similar observations were made earlier by many workers (Cutcliffe and Munro, 1980).

N increased the pod length during 1983-84, which was maximum at 40 kg N/ha. Yield parameters, too, showed an increasing trend with increase in N levels. However, there were not much gains in the ultimate green pod yield on either per plant or per plot basis as the maximum yield was recorded with no N application. This could probably be due to medium status of N availability in the experimental plots. Similar observations were made by Berry (1973) also.

P produced significant effect only on pod yield (Table 3). Days taken to first flowering tended to decrease with the increasing level of P as has been reported by Jain *et al.* (1977) Similarly, characters like length and width of the pod, number of seeds per pod, weight of 10 pods and shelling percentage improved with increasing P levels leading to more pod yield per plot. These are inconformity with the findings of Gubbels *et al.* (1982). The attributes like number of pods per plant showed a negative trend with P levels and other yield attributes improved at the cost of this one. However, the net result was an increase in the pod yield per plot upto 90 kg P/ha which might be due to the favourable effect of P on pod characters (Svoboda, 1974).

There way interactions of V x N x, P (Table 4) were significant for the characters like plant height, days taken to marketable maturity, weight of 10 green pods, pod yield per plant and also per plot. Bonneville, with 20 kg N/ha and no P took the maximum number of days to pod maturity while in Lincoln pot maturity was the earliest with 60 kg N/ha and no P. The absence of P fertilization seemed to have been supplemented by high P status

Table 4. Effect of variety, nitrogen and phosphorus interaction (V x N x P) on plant height, maturity characters yield and its attributes of pea

Phosphorus (k/ha)	Varieties																	
	V_1 Lincoln				V_2 Bonnaville				V_3 Kinnauri				V_4 (GC 141)					
	Nitrogen levels kg/ha																	
	0	20	40	60	0	20	40	60	0	20	40	60	0	20	40	60	S.Ed	C.D. 5%
	Plant height (cm) 1982-83																	
0	57.47	59.37	55.50	80.93	90.30	83.50	93.30	86.17	127.40	130.47	113.10	106.63	50.90	48.17	47.20	48.00	12.40	6.72
30	59.60	51.47	58.70	48.37	98.13	90.93	99.73	97.93	118.40	131.97	128.97	109.00	46.90	44.93	50.73	52.23		
40	59.60	55.97	55.73	55.27	92.47	79.53	94.77	97.00	124.90	117.53	132.93	118.80	48.53	54.93	55.87	54.00		
60	54.20	58.20	57.00	53.57	89.23	87.73	83.00	90.33	125.13	121.87	118.83	122.60	54.10	45.33	55.80	48.23		
	Days taken to marketable maturity 1982-83																	
0	153.33	151.00	150.00	148.00	150.00	147.00	147.00	151.00	153.00	152.00	152.00	154.33	148.00	148.00	151.00	151.33	±0.69	1.37
30	154.33	151.00	150.00	150.33	147.00	149.00	148.00	153.00	155.66	155.66	155.66	152.00	149.00	149.00	151.00	151.00		
60	151.00	151.00	152.00	153.33	149.00	150.00	149.00	151.00	152.00	152.00	154.33	157.00	148.00	148.00	147.00	149.00		
90	151.00	152.00	151.00	149.00	150.00	152.00	151.00	147.00	151.00	157.00	154.33	151.00	147.00	147.00	148.00	148.00		
	Weight of 10 green pods 1983-84																	
0	38.33	50.33	41.00	55.66	43.33	41.66	48.33	44.00	45.00	40.66	44.33	37.33	43.33	43.33	41.66	45.68	±2.10	4.26
30	40.20	49.00	38.00	55.00	43.33	41.66	43.33	36.66	44.66	42.00	39.66	43.00	45.00	51.66	50.00	44.33		
60	48.33	53.00	48.33	40.00	44.33	47.66	48.33	40.00	36.66	42.33	42.00	36.00	51.66	45.00	43.33	45.00		
90	43.33	41.66	40.00	37.66	45.80	46.66	44.00	47.33	42.00	44.33	39.00	42.00	48.33	45.00	45.66	48.33		
	Yield per plant 1982-83																	
0	105.71	94.70	91.47	91.87	74.33	76.60	68.57	65.60	89.30	106.37	72.79	81.97	67.87	87.13	73.00	64.17	±6.39	12.56
30	88.93	86.50	93.03	92.63	63.90	80.23	74.60	83.20	63.76	88.33	84.10	76.27	62.70	71.60	68.97	96.17		
60	74.53	91.60	80.87	95.70	57.17	94.10	60.57	68.63	79.53	56.60	83.30	70.20	114.93	102.23	86.90	91.83		
90	94.57	107.96	66.77	100.50	93.03	71.40	59.10	93.20	76.40	100.47	93.23	74.67	87.33	92.23	96.40	64.53		
	Yield per plant 1983-84																	
0	26.47	31.63	43.43	37.23	42.97	46.60	28.20	49.13	69.10	73.30	46.43	69.07	38.47	32.70	41.17	41.63	±4.59	9.09
30	38.13	42.80	40.00	30.37	34.00	37.80	43.60	63.30	58.77	76.43	64.53	79.03	41.30	42.37	40.20	27.43		
60	28.63	39.33	42.90	35.57	51.13	59.27	44.40	69.80	68.86	50.66	68.47	55.00	37.13	34.33	42.73	41.00		
90	54.33	49.43	33.07	26.10	35.93	32.57	51.70	58.17	54.53	71.63	50.53	47.23	38.30	33.73	40.47	41.20		
	Yield per plot (kg) 1982-83																	
0	4.63	4.25	3.66	4.46	2.98	3.06	2.74	3.01	4.39	4.25	2.92	3.28	3.83	2.95	2.92	2.56	±0.19	0.38
30	3.55	3.46	3.72	4.33	2.56	3.21	2.98	3.62	2.91	3.37	3.35	3.70	2.36	2.86	2.76	3.85		
60	2.98	3.66	3.24	3.83	2.29	3.78	2.66	2.74	4.12	2.50	3.33	2.81	4.59	5.05	3.48	4.51		
90	4.56	3.95	3.05	4.02	4.19	2.86	2.37	4.18	3.61	4.64	3.73	2.46	4.35	3.69	4.64	3.43		
	Yield per plot (kg) 1983-84																	
0	1.06	1.26	1.60	1,82	2.15	1.86	2.80	2.16	2.77	2.93	1.86	2.76	2.01	1.30	1.65	1.67	±0.19	0.38
30	1.52	1.71	1.65	1.21	2.05	1.51	2.92	2.53	1.65	3.06	2.58	3.16	1.72	1.69	1.61	1.23		
60	1.15	2.10	1.55	1.69	2.22	2.37	1.78	2.72	2.76	3.23	2.74	2.53	1.46	1.71	1.71	1.64		
90	1.51	1.93	1.32	1.04	2.72	1.30	2.06	2.34	2.19	2.87	2.35	1.75	1.53	1.55	1.69	1.71		

of the soil. The maximum pod weight in Lincoln was recorded with 40 kg + 30 kg P ha and in Bonneville 40 kg N + 60 kg P/ha though this attribute was not significantly affected either by main effects of N and P or their interactions. For pod yield again there was differential response of varieties to N and P levels. In Lincoln, application of 20 kg N + 60 kg P/ha recorded the highest yield while in Bonneville 40 kg + 30 kg P/ha was found to be optimum dose during, 1983-84. The differential response of varieties to the nutrients may be be attributed to the genotypic differences, as the dwarf varieties, in general require less amount of N for their growth but larger amount of P for the development of better size pods with bold grains and ultimately more yield.

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CORRELATION AND PATH ANALYSIS IN FODDER LABLAB

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ABSTRACT

An experiment on correlation and path analysis involving thirty six hybrid combinations of fodder lablab was conducted in *kharif* 1993. The results indicated positive significant association of the quantitative traits with green fodder yield except crude protein content. Selection for yield improvement based on dry matter yield, dry weight of leaf and dry weight of stem has been suggested for fodder yield.

KEY WORDS : Fodder lablab, Correlation, Path Analysis

Lablab (Lablab purpureus (L.) Sweet) is valued as an important fodder crop due to its fast growing habit, bushy nature and other foliage attributes. Its fodder yield is almost static as not much break through in genetic improvement has been achieved in our country. A knowledge on the nature of character association through path analysis can furnish a clue for partitioning of genetic associations of complex traits like fodder yield. In view of above, the present study was conducted in lablab.

MATERIALS AND METHODS

Thirteen genotypes were collected from the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore and crossed in line x tester mating design. Thirty six hybrid combinations along with their parents were grown in a randomised block design replicated thrice at the Agricultural College and Research Institute, Killikulam. Each genotype was sown in a single row with a spacing of 45 cm between rows and 30 cm between plants. Five plants were selected at random in each line for recording observations.