ASSET Series A (2003) 3 (4):155-162

ISSN 1595-9694 9
UNAAB 2003

CORRELATION STUDY ON GREEN PEA *(Pisum sativum* L.) GROWN UNDER IRRIGATION IN SAMARU, ZARIA

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ABSTRACT

The success of any yield improvement strategy requires the knowledge on how the various traits interact to influence the final yield, especially for crops that are introduced into a new environment. Correlation study was undertaken on green pea *(Pisum sativum L.)* in the 1994/95 and 1995/96 dry seasons at Samaru, northern Guinea savanna of Nigeria. Data were taken from an experiment that consisted of factorial combinations of four levels of N (0, 30, 60 and 90 kg N/ha) and four P levels (0, 13, 26 and 39 kgP/ha) laid in a randomized complete block design with four replicates. Results show that seed yield was positively correlated with all the growth and yield characters studied. Vine length, leaf and index (LAI) and number of pods and seed weight had the greatest direct/indirect effect on yield. Haulm weight had negative direct and indirect effect on yield in 1994/95. Pod number and LAI made the maximum percent sole contribution to seed yield., followed by number of seeds in both seasons, haulm weight in 1994/95 and vine length in 1995/96. Join contributions by LAI and number of pods with the other parameters were also high, except with haulm weight in 1994/95.

Keywords: Correlation, green pea, irrigation

INTRODUCTION

Green pea is grown for its seed, which is consumed fresh or canned. Pea seed contains about 22% protein (Key, 1979) and this, is comparable to those of common legumes such as cowpea, soybean and groundnut. Pea can therefore substantially substitute the protein sources of people on a starchy diet, particularly in a place like northern Nigeria, where most of the diets are carbohydrate-based. This explains why the introduction of green pea as an irrigated legume has received wide acceptance in northern Nigeria. However, yields from the fanners' plots and the trial reported by Kuchinda and Lawal (2001) are very low compared to those obtained in the temperate regions. Thus there is the need to improve on these yields. Any effort that is aimed at improving the yield of pea would also require information on the relationships between its yield attributes and growth characters. Kuchinda (1991) observed that seed yield of green pea was positively correlated with leaf area index (LAI), haulm weight, number of seeds per pod, seed size weight and number of pods per plant. However, relationships between the growth and yield characters in terms of correlations do not give a complete picture of the basis of their association. Path analysis is used to elucidate the relationships between the phenotypic and genotypic variables (Bhatt, 1973; Gravois and McNew, 1993). Strategies to increase yields of green pea would be enhanced by an understanding of how the growth and yield characters interact with one another in influencing yield at both phenotypic d genotypic levels.

The objective of this study was therefore to determine the relative importance of some growth and yield characters in influencing seed yield of irrigated green a at Samaru, located in the northern guinea savanna of Nigeria.

MATERIALS AND METHODS

Field trials were conducted under irrigation in 1994/95 and 1995/96 dry se ns (November-March) at the irrigation site the Institute for Agricultural Research, Samaru (Lat. 1 I %; 11 'N ; Long. 7% 38 'E; 686 s above sea level) in the northern Guinea savanna of Nigeria. The experiment consisted of factorial combinations of four nit- n (N) levels (0, 30, 60 and 90 kgN/ha) and four phosphorus (P) levels (0, 13,26 and 3 g/ha). The N and p sources were calcium ammonium nitrate and single super-phosphate respectively. The fertilizers were applied once at sowing in grooves, about 5 cm away s each seed row. The treatments were laid in a randomized complete block design with four replicates. The seedbeds were prepared in furrows to facilitate irrigation. Three seeds of green pea (Cv. Onward) were sown per hill at 75 cm by 10 cm spacing, and thinned to two plants per stand at two weeks after sowing (W AS). From seed sowing t the last pod picking, the field was irrigated at five days intervals.

The data collected for correlation and path analysis included LAI, vine length haulum weight, number of days to first flowering, number of pods per plant, number of seeds per pod, seed diameter (seed size), 100-seed weight and seed yield. Correlation analysis was carried out as described by Little and Hill (1978) to establish the magnitude of association between the growth and yield characters. Path coefficient analysis to determine the direct and indirect effects of these parameters on seed yield was done accordance with the formula suggested by Dewey and Lu (1959). The percentage individual and combined (paired) contributions to yield were determined using the formula suggested by Singh and Chaudhary (1979) as follows:

i. Percent individual contribution (X;) $= (P;)^2 \times 100$

ii. Percent combined (paired) contribution $(X1X2) = 2(P_1P2,r_{12},) \times 100$

Where:

P, = direct effect of character 1 P2 = direct effect of character 2 X1 = percent individual contribution of character I

$X_1.X2$ percent combined (paired) contributions of character 1 through character 2

R_{12} = correlation coefficient between 1 & 2

RESULTS

Correlation's

There was strong positive correlation (POGO) between seed yield and al' the other parameters of green pea evaluated (Table X). The correlation coefficients among the growth characters *vim;* LAX, vine length and hauls weight and the yield attributes s such as number, size and weight of seeds and number of pods were also positive and significant.

The direct and indirect effects of the growth and yield characters on see yield are

Table 1. Pooled correlation coefficient among the growth and yield characters of green pea during the 1994/95 and 1995/96 dry seasons at Samaru

	Correlation coefficient						
Growth character	; 1	' 2	4 1 5	6		8	9
1. Seed yield	1.00						
2. LAI	0.66*	1.00					
3. Vine length	0.64* 3	0.50** 1.00					
4. Haulm weight	? 0.55** (	0.75** 0.60**	. 1.00				
5. No. of days to flowering	0.86**	0.45** 0.51 **	0.53** / 1.00				
6. No. of pods/plant	0.68**	0.53** € 0.54**	'0.44** 0.38**	1.00			
7. No. of seeds/pod	! 0.48**	0.53** 0.42**	0.41** 0.38**	0.21	1.00		
8. Seed size	0.69**	0.49** 0.31*	0.46** 0.48**	0.24	0.22	1.00	
9. 100-seed weight	0.51**	0.31** 0.18	0.23 0.40**	0.35 *	0.11	0.22	1.00

*, ** r-value significant at 0.05 and 0.01 probability level, respectively.

presented in Tables 2-5, while the individual and combined factor (s) contributions of these characters to the yield are presented in Tables 6 and 7. The greatest dire effect on yield was by vine length (r = 0.325) in 1994/95 and LAI (r = 0.943) in 1995/9 (+Tables 2 and 3). The direct effects of number of days to first flowering (r =0.317 and LAI (.=0.288) in 1994/95 and vine length (r = 0.557) and number of days to first flowering (0.353) in 199596 were also high. The lowest direct effect was by haulm eight in 1994/95 (r = 0.134) and 1995/96 (-0.723). However, in 1994/95, the highest indirect effect of 0.208 was by haulm weight via vine length, while the highest indirect effect of 0.820 in 1995/96 was by haulm weight via LAI. These were followed by vine length via LAI in the two seasons.

The greatest direct effect of the yield components on yield was by number of pods (r = 0.455, 0.588), followed by

Table 2. The direct and indirect effects of some growth characters on seed yield of green pea in 1994/95 dry season at Samaru

	Indirect effect via:					
Growth character	Direct effect			3	4	Total correlation
1. LAII	0.288			0.084	0.098	0.649**
2. Vine weight	0.325	0.158		0.086		0.629**
3. Haulm weight	0.134	0.181				0.599**
4. No. of days to flowering	0.317	0.089	0.062			0.500**

r-value significant at 0.01 probability level

Table 3. The direct and indirect effects of some growth characters on seed yield of green pea in 1995/96 dry season at Samaru

		Indirect effect via:			
Growth character	1 Direct effect	2	3		Total correlation
1. LAII	0.943	0.251	-0.629 10.106		0.671 **
2. Vine weight	; 0.557	10.424	-0.405	0.064	0.640**
3. Haulm weight	-0.723	10.820	0.312	0.081	, 0.490**
4. No. of days to flowering	10.353	0.283	0.100	0.166	- 0.570**

* r-value significant at 0.01 probability level

Table 4. The direct and indirect effects of some yield attributes on seed yield of green pea in 1994/95 dry season at Samaru

		Indirect effect via:			
Yield attributes	Direct effect 1 1	2	3	4	Total correlation
1. Pods number	10.455 -	0.164	0.041	0.171	0.831 **
2. No. of seeds/pod	10.420 0.177		0.024	0.089	0.710**
3. Seed size	0.113 0.164	10.088	-	0.085	0.450**
4. Seed weight	10.371 0.209	0.101	0.026		0 707** j

** r-value significant at 0.01 probability level

number of seeds per pod (r =0.420, 0.339) in the two seasons (Tables 4 and 5). The greatest indirect effect was by seed weight via number, of pods in the two trials (r = 0.209, 0.279). followed by number of seeds per pod via number of pods in 1994/95 (r =0.177) and seed size via number of pods in 1994/96 (r - 212). The indirect effects of seed size in 1994195 and number of seeds per pod via number of pods in 1995/96 were greater than all the remaining indirect effects.

Considering the sole and combined contributions of the growth factors to see yield, LAI made the greatest individual contribution in the two trials (88.8%, 83.0%) (Tables 6 and 7). These were followed by haulm weight (52.3%) in 1994/95 and vine length (10.6%) in 1995/96. The least contribution to seed yield was by number of days to flowering in 1994/95 and haulm weight in 1995196. The highest combined (joint) contribution was by vine length in conjunction with LAI, followed by number of days to flowering and LAI. There were negative joint contributions to seed yield by haulm weight and L (-118.8%) and vine length (45.2%) in 1994/95. Haulm weight in

Table 5. The direct and indirect effects of some yield attributes on seed yield of green pea in 1995/96 dry season at Samara

1 Yield attributes	Direct effect	Indirect effect via: 1	2	3	Total	correlation
1. Pods number	0.559			-4	10.12	
2. No. of seeds/pod	0.339	3. Seed size	0.164	4.		
		0.206				
Seed weight	0.209	10.212	0.068	-		
				0.062	10.135	0.880**
		0.279	0.078			
				0.033	0.062	0.640**
					0.056	0.500**
				0.034		
					0.660**	

** r-value significant at 0.01 probability level

Table 6. Percentage contributions of some growth characters to seed yield of green pea in 1994/95 and 1995/96 dry seasons at Samara

Growth character	1994/95				1995/96				
	Individual				Individual	Combined			
			Combir	3	4		1	2	3	4
1. LAI	88.8 3					83.0	-			
2. Vine length			-			10.6	10.3	-		
3. Haulum weight				-		1.8	4.9	3.9	-	
4. Days to flowering					-	10.0	5.7	5.6	2.0	-
Residual								36.9		
	. 12.5	20.0	7.1	-5.9						

Methodology: Singh & Chaudhary, 1979

association with LA1, vine length and number of days to first flowering made the least contribution to seed yield in 1995/96.

Table 7 revealed that number of pods per plant made the greatest individual contribution to seed yield in the two seasons (31.1%, 20.7%). This was followed by number of seeds per pod. The least individual contribution came from seed size. The greatest join contribution was by 100-seed weight and number of pods (15.0%, 15.6%),

followed by number of

pods and number of seeds per pod (14.0%, 14.9) in the two seasons. The latest joint contribution in the two seasons was by seed size and 100-seed weight. The unaccounted (residual) contributions were 10.6% and 36.9% for the growth characters and 4.4% and 1.0% for yield attributes.

DISCUSSION

Seed yield in peas has been reported to be related to the size of leaf area an vegetative

Table 7. Percentage contributions of some yield components to seed yield of green pea in 1994/95 and 1995/96 dry seasons at Samaru

Yield components	Contribution to seed yield (%)									
	1994/95				1995/96					
	Individual		Combined		Individual		Combined			
1. Pod number	1.1	-	1	1 4	20.7	1				■
z			d							
12. No. of seeds/pod	11.5	14.0	-		17.6	14.9				
3. Seed size	2.7	6.9	1, 2.2		1.3	1 3.7	2.0	-		
j 4. Seed weight	7.2	15.0	14.2	1 8 -	13.8 _	15.6	7.5	1.9		
Residual			4.4				1.0			

Methodology: Singh & Chaudhary, 1979

growth (Eastin and Gritton, 1969; Milbourn and Meadly, (1970). In this stud seed yield of green pea was found to have high positive correlation with the growth parameters such as LAI, vine length, haulm weight and number of days to first flowering. Green pea is an indetermine crop with sympodial growth habit, thus any increase in morphological characters such as plant height and leaf size would provide more photosynthetic apparatus for the synthesis of assimilates that are essential in pod and see formation. Since LAI is a measure of the photosynthetic capacity per unit area of round. any increase in LAI would have definitely accelerated dry matter formation . and thus increased seed yield. Brougham (1956) observed that both percent so, r radiation interception and rate of dry matter production increased with leaf area index. he positive association amongst yield and its components, viz, number of pods (0.68). seed size (0.69) and seed weight (0.51) suggested that simultaneous improvement on these components to enhance yield improvement is feasible. But the consequences of compensating reactions among components should not be ignored.

There re positive correlations amongst the growth and yield parameters, which indicated the inter-related nature of these characters in influencing the final yield.

Although correlation analysis was able to bring out the type and magnitude of association amongst the characters, it did not give exact information on the relative importance of each causal factor, nor show the sole and combined contributions of the characters to yield. Path analysis became useful in elucidating the direct and indirect causes of association. Leaf area index, vine length, and numbers of pods and seeds had the greatest direct effect on seed yield in the two trials. This observation indicated the importance of these parameters in seed formation. Number of pods also had the greatest effect on yield. followed by seed number. In addition to direct effect, the indirect effect ° r p s number and seed number, seed size and weight were also remarkable. This result s gests that any progress in LAI, vine length and pods and number of seeds would enhance yield. Although haulm weight had a positive total correlation (r =0.49) with yield n 1995/96

(Table 3), it had the least and negative direct effect and indirect effects vi LAI, vine length and the vegetative phase. Haulm weight included leaf and stem weights. The negative relationship may possibly be due to the shading of stems by the leaf canopy, which might have rendered them mere assimilate sinks. In contrast, vine length did not show any negative effect on seed yield, probably because of a correspond in increase in the formation and expansion or the photosynthetic apparatus such as the leaves and their greater exposure to solar radiation as the crop grew taller. This explanation was confirmed by the indirect effect of haulm weight via LAI and vine length in this study. Due to the negative direct effect of haulm weight and the indirect effect LAI, vine length and number of days to flowering via haulm weight, the joint contributions of haulm weight with each of these characters was remarkably negative, despite its positive sole contribution. Among the growth and yield parameters, LAI and number of pods consistently made the greatest sole contributions to seed yield, followed by plant height and number of seeds. This result tallies with their direct and indirect effects on yield. The joint contributions of LAI with the other growth parameters, except haulm weight, were also high, confirming the reports by Milbourn and Meadly (1970) that a high leaf area was required for improved seed production in peas. Similarly, joint contributions by number of pods in conjunction with number of seeds and seed weight were high, indicating that pods production is a critical determinant of seed yield, followed by number and weight of seeds. Seed size was less important in terms of sole and joint contributions to pea yield. This observation is consistent with the correlation and direct and indirect effects of the parameters on yield. The compensatory influence of greater pods, and to a lesser extent, number of seeds and seed weight were probably adequate to obviate the consequence of smaller seed size.

This study has clearly demonstrated that any effort towards green pea improvement in the northern Guinea savanna of Nigeria is not likely to succeed without adopting strategies that would increase the phenotypic traits such as LAI and canopy height, well as the genotypic traits such as pods formation, and to a lesser extend, number a weight of seeds.

ACKNOWLEDGEMENT

The authors wish to express their appreciation to the management of the Institute for Agricultural Research, Samaru, for funding the project, and to the Director in particular, for permission to publish the findings.

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