Studies on the Selection Aduzki Bean Breeding

IV. Phenotypic and genotypic correlations in Adzuki bean cross

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Introduction

Heritability estimates and estimates of genotypic and phenotypic correlations among characters are useful in planning and evaluating breeding programs.

In recent years, many research workers have attempted to understand the genetic relationship between characters in terms of genotypic correlation, and the knowledge thus gained should furnish many important and useful information for the planning of breeding, selection, and interpretation of the results. The genotypic correlation is the result of pleiotropy, linkage of genes (6, 7, 10, 13, 16) and natural of artificial selection (9).

The objectives of this investigation were to estimate the genotypic and phenotypic correlations between all possible pairs of eight characters in an Adzuki bean cross, and the degree to which certain characters or combinations of characters may be useful as the indicator of high yield.

Robinson et al (13) in corn, Weber and Moorthy (17), Johnson et al. (10), Horie et al(8), Sheth(14), Ozaki and Fujimori (12), Anand (1)Kwon (11, Chang (2, 3, 4) in soybean, Wallace et al. (16) in oats, Iyama (9)and Syakudo et al. (15)in rice, Chang(5) in Adzuki bean found that, in general, the genotypic correlations were higher than the phenotypic correlations. Weiss et al. (18)reported significant positive correlations among means of five varieties of soybean for the following characters: large seed and low iodine number of the oil; lateness of maturity and high oil cont.; lateness and low protein cont. high protein content and low iodine number: and high protein content; high protein content and low iodine number; and high protein content and low oil content of soybean Weber and Moorthy (17) reported the positive genotypic correlations between flowering and maturity, yield and maturity, yield and plant height, yield and seed weight, and negative genotypic correlations between maturity and oil content, and oil content and seed weight of soybean.

Johnson et al. (10) studied the genotypic and phenotypic correlations among24 chararacters of soybean and concluded that selection based entirely on a long period, lateness, heavy seed, low protein, high oil and resistance to lodging would be effective in increasing yield. Sheth (14) and Kwon (11) found the following positive associations among characters; height and matu-

rity, yield and leaf g, yield and fruiting period, low protein content and high oil comtent, and yield and low protein comtent.

Ozaki amd Fujimori (12) reported the positive genotypic correlations between yield and stem length (plant height), yield and podmumber, and yield and bran ch mumber of soybean characters. Chang (2,3,4) reported that the positive genotypic correlations were observed between yield and following characters namely flowering time, matuurity, branch number per plant, stem diameter, plant weight, pod number per plant and grain number per plant of soybean. Chang (5) also reported that Adzuki bean yield was genetically assoiated with two characters, i.e. pod number per plant and grain number per plant, and are effected more in Adzuki bean yield than the other agronomic characters.

Materials and Method

F4. progenies of an Adzuki bean cross, Jukdoo (korean local variety) X Nesumimochi (Japanese variety), were used as materials in this study. Cross was made in the Experimental Farm, Chinju National Agricul ural College, in 1963, and F_1 hybrids and the succee dimg generations were grown in the same farm from 1964 to 1967.

Fourty F4 progeny lines from selected F3plants were grown in a randomized block design with three replications under June sowing conditions. Seeds were planted on 26th, June in 1967, with 75 Cm width in row and 40 Cm apart. Two seeds were planted in each hill and later thinned out one plant per space.

The traits measured on a plot basis were as follows 1) flowering time (days to flowerlng): recorded as the number of days from sowing to the date when approximately half of the plants in the row were flowering, 2) duration of flowering: days from the first flowering to the latest flowering were setting in the row, 3) maturity date (days to maturity) : days from sowing to the date when approximately 95% of the pod were ripe and the most of leaves had dropped, 4) p-number per plant, 5) grain number per plant, 6) grain weight: recorded in grams per plot, and 7) 100 grain weight, etc Data on those items were based on a sample of 25 plants per plot

For the population of fourty F_4 lines, all possible pairs of characters were analyzed by analysis of covariance and individual characters by analysis of variance methods. Phenotypic, genotypic and environmental correlations were calculated from phonotypic variances and covariances, genotypic variances and covariances, and environmental variances and covariances, respectively.

Phenotypic correlations were estimated in the following manner:

$$rph = \frac{Cov.\ XY}{\sqrt{\partial^2 X \cdot \partial}}$$

Where cov. XY is the Phenotypic covariance between two traits, X and Y. $\partial^2 X$ and $\partial^2 Y$ refer to phenotypic variance of the character X and Y, respectively.

The genotypic correlations were estimated in a similar manner:

$$rG = \frac{Cov.\ GXY}{\sqrt{\partial^2 G \cdot \partial^2 YG}}$$

Where cov. GXY is the genotypic covariance between two traits, X and Y. $\partial g^2 X$ and $\partial g^2 Y$ refer to genotypic variance of the character X and genotypic variance of the character Y, respectively.

The environmental correlations were also estimated in a similar manner as follows:

$$rE = \frac{Cov.\ EXY}{\sqrt{\partial E^2 \cdot \partial E^2 Y}}$$

Where cov. E XY is the environmental covariance between two traits, Xand Y. $\partial E^2 X$ and $\partial E^2 Y$ refer to environmental variance of the character X and Y, respectively.

Results and Discussion

Phenotypic, genotypic and environmental coveriances among all possible pairs of characters are shown in table 1. Phenotypic variances for each character are also shown in parentheses in same table (Table 1).

Phenotypic, genotypic and environmental correlations among all pairs of eight agronomic characters used are shown in table 2.

In general, the genotypic covariances among characters were slightly higher than the phenotypic covariances, and the gentoypic correlations among all pairs of

characters were slightly higher than the corresponding phenotypic correlations. Similar results were obtained by Robinson et al. (13) in corn, by Weber and Moorthy (17), Johnson et al. (10)Horie et al. (8), Sheth (14), Ozaki and Fujimori (12)Anand (1), Kwon (11) and Chang (2, 3, 4) in soydean, by Iyama (9) and Syakudo etal. (15) in rice, by Chang (5)in Adzuki bean, respectively.

They were explained that lower phenotypic correlations are due to the making or modifying effects of environment on the genetic association between traits. Genetic associations varied considerably for most characters in different environments. These variations in genotypic correlation may be ascribed to acomplicated interaction of genotype and environment to a sampling error or both.

It was observed that seed yield showed moderately high positive phenotypic and genotypic correlations with pod number per plant.

Simultaneously, the highly genetic associations bet

Tadle1. Phenotypic, Genotypic and Enuironlmuironmentel Couariances
(Cphenotypic uariances are iw parentheses)

		①	②	③	④	⑤	⑥	⑦	⑧
①	Cov. ph								
	Cov. G	(9.677)							
	Cov. E								
②	Cov. ph	2.70							
	Cov. G	2.31	(38.785)						
	Cov. E	0.76							
③	Cov. ph	0.12	0.17						
	Cov. G	0.12	0.11	(0.010)					
	Cov. E	0.01	0.19						
④	Cov. ph	0.59	0.90	0.03					
	Cov. G	0.57	0.70	0.02	(0.548)				
	Cov. E	0.05	0.16	0.01					
⑤	Cov. ph	-22.01	3.46	-0.17	0.32				
	Cov. G	-13.38	-11.33	-0.11	-0.88	(172.770)			
	Cov. E	-8.04	11.42	-.07	1.01				
⑥	Cov. ph	- 7.27	6.06	0.0005	0.92	124.12			
	Cov. G	- 6.49	-9.75	0.0003	-0.01	40.38	(110.387)		
	Cov. E	- 0.29	13.69	-0.0050	0.81	77.89			
⑦	Cov. ph	124.80	146.12	3.79	24.66	-484.65	-273.20		
	Cov. G	106.37	86.54	2.65	21.26	-328.86	-206.35	(4162.007)	
	Cov. E	18.15	68.74	1.24	13.13	-143.97	-58.91		
⑧	Cov. ph	1.25	0.64	0.05	0.27	-7.00	-4.32	47.17	
	Cov. G	1.49	0.54	0.06	0.22	-4.94	-3.00	39.73	(1.573)
	Cov. E	-0.20	0.12	0.01	0.06	-2.35	-1.50	8.63	

Remarks : Cov. ph…Phenotypic covariance
Cov. G …Genotypic covariance
Cov. E …Envinonmental covariance

Chafacter ①…Days to flowering
②…Stem length
③…Stem diameter
④…Branch number perplant
⑤…Pod numbor per plant
⑥…Grain weight (yield)
⑦…Total plant weight
⑧…100 grain weight

ween flowering time and stem diameter, flowering time and total plantweight, stem diameter and total plant weight, and branch numper and total plant weight, etc, were also observed. The negative phenotypic and genotypic correlations were observed between some traits of characters, i.e. flowering time and pod number per plant, pod number per plant and total plant weight, and grain weight and total plant weight, etc.

These relationships suggest that that effective selecti on for lines possessing many pods and many grains.

Tafle 2. Genotypic ,Phenotygic and Environmental Coryelations among the Characters

	①	②	③	④	⑤	⑥	⑦	⑧
①rph								
rG								
rE								
②rph	0.139							
rG	0.254							
rE	0.115							
③rph	0.395	0.275						
rG	0.691	0.559						
rE	0.098	0.149						
④rph	0.257	0.195	0.445					
rG	0.560	0.593	1.014					
rE	0.069	0.049	0.210					
⑤rph	-0.538	0.042	-0.126	0.033				
rG	-0.599	-0.457	-0.236	-0.302				
rE	-0.639	0.212	-0.082	0.154				
⑥rph	-0.222	0.093	0.001	0.118	0.899			
rG	-0.393	-0.532	0.001	-0.003	0.896			
rE	-0.027	0.300	-0.007	0.147	0.897			
⑦rph	0.622	0.364	0.587	0.516	-0.572	-0.403		
rG	0.640	0.470	0.771	0.569	-0.726	-0.616		
rE	0.513	0.453	0.530	0.714	-0.499	-0.241		
⑧rph	0.320	0.082	0.423	0.294	-0.425	-0.328	0.583	
rG	0.493	0.161	1.024	0.935	-0.599	-0.492	0.648	
rE	-0.232	0.033	0.276	0.130	-0.335	-0.252	0.437	

Remarks: Characters ①~⑧as in previous table 1.
rph...Phenotypic correlations.
rG ...Genotypic correlations.
rD ...Enuironmental correlations.
Phenotypic correlations of 0.31 and 0.42 are necessary to be significant at the 5% and 1% levels, respectiuely.

In soybean, Weber and Moorthy (17) reported the positive genotypic correlations between flowering and maturity, yield and maturity, yield and plant height yield and seed weight. In this study, the positive genotypic correlations between traits, for instance, between yield and flowering time, yield and stem diameter, and yield and branch number per plant were negative or negligible results compared with the reultss in soybean reported by Weber andMoorthy (17), Johnson etal. (10), Sheth (14) and Kwon (11).

The phenotypic and the genotypic correlations between seed yield (grain weight per plot) and pod number per plant were similar results tothe reports by Ozaki and Fujimori (12), Chang (2,3,4) in soybean, and the report by Chang (5) in Adzuki bean.

In Adzuki bean, in this study and in recent report by Chang (5), the phenotypic and genotypic correlations between seed yield grain weigh per plot and pod number per plant, and seed yield and grain number per plant were considerably high values. These results suggest that selection for high yield Adzuki bean lines may be effective by selecting plants which have many pods and grains, and these two characters, i.e. pod number per plant and grain number per plant, and thees are affected more in Adzuki bean yield than the other agronomic characters.

Summary

Fourty lines of F4 progenies of an Adzuki bean cross, Jukdoo (Korean local variety) X Nesumimochi (Japanese variety) were used as the material, and these lines were grown in replicated trials in 1967.

Phenotypic, genotypic and environmental covariances among all possible traits of eight characters are calculated as shown in table 1.

Phenotypic, genotypic and environmental correlations among all possible pairs of eight characters were calculated as shown in table 2.

In general, genotypic correlations were higher than the corresponding phenotypic corresponding phenotypic correlations. The genotypic correlations between seed yield (grain weight per plot) and ot-

er agronomic characters indicated that seed yield was genetically associated with the character of pod number per plant, and grain number per plant, which is closely correlated with pod number per plant, are affected more in Adzuki bean yield than the other agronomic characteracters.

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摘　　要

小豆의 形質相互間의 表現型相關, 遺傳相關 그리고 環境相關을 알고자 1963年 在來種 赤豆×日本種風餅을 交配하며 1967年 F4 世代 40系統을 材料로 選拔實驗을 하였다.

調査形質은 開花日數, 莖長, 莖直莖, 分枝數 1株莢數, 粒重, 全植物體重, 100粒重의 8個形質이었고 이들 各形質相互間의 表現型共分散, 遺傳共分散, 環境共分散과 各形質의 表現型分散을 본바 그 結果는 第1表와 같이 環境共分散과 表現型分散은 形質 또는 形質間의 組合에 따라 變動이 甚하나 大體로 遺傳共分散은 表現型共分散보다 多少 크다 (表 1)

各形質 相互間의 表現型相關, 遺傳相關, 環境相關을 計算한바 第2表와같이 大體로 遺傳相關의 값은 表現型相關보다 그값이 크다 (表 2), 收量과의 相關을 보면 1株莢數가 收量에 影響한다고 보이며 1株莢數가 많은것은 粒數도 많은것이 當然하므로 小豆는 大豆와 달리 收量과 開花日數 또는 收量과 莖直徑 間에는 相關이 보이지 아니하므로 1株 莢數와 1株粒數의 2個形質은 小豆의 多收系統, 選擇을 爲한 重要한 選擇形質이 될것으로 믿는다.