Plant Res. 3(3) 206~210(2000)

Agronomic performance of 20 soybean recommended varieties in Korea

Yong-Ho Kim
Division of Life Sciences, Soonchunhyang University, Asan City, Chungnam 336-745, Korea

ABSTRACT

A total of 20 soybean recommended varieties which were developed until late 1980' s in Korea was evaluated at Suwon. Comprehensive evaluation and correlation analysis were conducted on the agronomic characters. Great variations were found in these genotypes for branch number, pod number, and grain yield per plant. The variation in number of pods/plant ranged from 53 to 164, and in grain yield from 25.9 to 68.8 g. The coefficient of variation for most of the characters had a wide range. In correlation coefficient, grain yield per plant showed a positive phenotypic association with weight of pods, pod number of branches, and weight of stem. Multiple regression analysis was done to formulate selection criteria. It indicated that stout and medium-stature genotypes with more branches, resulting in varieties with more pods per plant but with medium-size seeds are available to obtain high-yielding varieties.

Key Words : Soybean, Agronomic character, Yield, Correlation coefficient, Multiple regression,

INTRODUCTION

The soybean seed, which contains about 40 % protein and 20 % oil on a dry weight basis, provides approximately 60 % of the world supply of vegetable protein and 30 % of the oil(Foreign Agricultural Service, 1985; Hymowitz et al. 1972; Taira and Taira, 1971). In Korea, the soybean has been used for centuries in traditional foods as a major protein source.

The major goal of soybean improvement in Korea is the development of widely-adapted, high-yield, disease and insect pest-resistant varieties responsive to improved cultural practices and processing tolerance to adverse climatic conditions. Improved nutritional and cooking characteristics are equally important(Kim et al., 1995). Limited research has been carried out on simutaneous improvement of grain yield and protein content in soybean(Kim and Kim, 1998). But the highest priority in soybean cultivar development was increasing seed yield for the 1980' s in Korea. Seed yield is a quantitative character controlled by many genes and strongly influenced by the environment(Hartwig and Kilen, 1991; Brim and Burton, 1979; Weiss et al., 1952). The heritability of yield is the lowest and the most variable of the major agronomic traits considered in cultivar development, with estimates ranging from 3 to 58 % (Brim, 1973). Substantial genetic improvement for seed yield has been achieved during the 1980' s in Korea(Kim et al., 1994).

Breeding varieties with the potencial to produce high seed yields of acceptable quality is the principle

Corresponding author : **Yong-Ho Kim**, Phone:+82-41-530-1281 E-mail:yohokim@sch.ac.kr

objective in the breeding of soybeans. The availability of useful variability in a germplasm collection is essential for systematic breeding. But, a major effort to breed for high seed yield has not been emphasized since the early 1990' s because improved seed quality was a higher project at this time(Kim and Kim, 1998).

The present investigation was designed to evaluate 20 soybean recommended varieties which were developed until the late 1980' s in Korea and to assess their variability for economic characters and to identify lines having desirable traits.

MATERIALS AND METHODS

Field experiment were conducted at National Crop Experiment Station, Suwon in 1992. On 2 June, twenty recommended varieties of soybean in Korea were hand-planted in rows. Each plot consisted of four rows 5m long with 0.6m between rows. The seeds of one variety in each row were sown with spacing of 20cm between hills and then thinned to two plants per hill after seedling emergence. After thinning, ten plants within each row were randomly selected and tagged. All subsequent data were collected from these plants and recorded on plant height, plant dry weight, number of branches, number of nodes, pods per plant, 100-seeds weight, and grain yield. The total plant dry weight was derived from all plants part above ground including pods and grain. Plant dry weight and grain yield were obtained from a single harvest after air drying for about one week. Calculations were made from the mean of the 20 plants sampled. Means of various characters were

Table 1. Mean value of some agronomic characters in 20 soybean varieties.

	Plant height(cm)	Branc-hes (No.)	Nodes (No.)	Pods (No.)	Total plant wt.(g)	Stem wt. (g)	Pods (g)	100 seed wt.(g)	Yield/plant (g)
Hill	92±8.1*	9.8±2.4	15.5±0.7	164±46.4	105±32.3	39±8.5	65.7±25.0	14.6±1.1	43.0±16.5
Kwangkyo	80±7.4	5.1±1.0	18.0±0.8	94±33.2	77±17.9	22±5.9	48.9±19.2	25.7±1.0	30.7±8.1
Baekcheon	65±3.6	3.5±1.1	14.4±0.7	111±29.5	61±15.6	15±7.1	46.4±16.6	16.1±2.0	28.2±8.1
Jangyeobkong	71±7.6	4.4±1.2	15.6±1.3	61±18.4	64±18.8	15±4.6	47.2±10.7	30.3±1.8	35.7±9.6
Danyeobkong	86±7.3	5.3±2.5	18.3±1.6	114±54.4	74±25.6	19±5.5	55.2±21.1	15.4±1.3	35.6±11.6
Hwangkeumkong	73±6.2	6.2±1.8	18.5±1.4	118±19.5	126±24.8	26±5.0	100.4±20.5	31.5±2.0	68.7±13.4
Jangbaekkong	85±5.7	4.6±2.1	18.3±1.4	90±21.9	67±12.1	19±3.4	47.6±10.0	17.9±0.8	29.4±7.0
Namcheonkong	71±3.8	5.3±1.6	16.6±0.7	132±20.7	100±15.7	28±2.7	72.4±14.5	21.2±2.1	48.0±10.1
Togyukong	93±5.7	6.2±1.5	21.9±1.7	97±22.6	69±14.5	23±4.2	46.6±11.7	17.1±1.3	26.8±6.5
Milyangkong	114±5.3	3.4±1.2	19.5±1.3	88±36.5	81±26.4	24±7.6	57.0±19.2	23.9±1.2	38.0±12.4
Baekunkong	92±4.7	3.0±0.8	17.2±1.0	80±22.3	66±18.2	23±6.9	43.8±12.9	22.1±1.4	29.4±8.0
Bangsakong	66±3.5	5.5±1.2	16.7±1.1	160±34.1	78±15.1	21±3.3	57.3±12.8	13.8±1.0	38.4±8.6
Saealkong	83±4.2	5.3±1.9	17.9±1.7	108±32.2	103±26.3	28±7.3	75.2±21.1	26.9±1.1	48.5±15.1
Paldalkong	46±4.2	3.8±0.8	13.9±0.6	97±24.6	56±15.5	10±3.1	46.2±12.9	17.3±1.7	31.4±8.6
Bokwangkong	81±6.9	5.3±1.4	17.8±1.8	99±20.2	98±24.5	23±5.9	75.3±19.7	27.2±2.3	50.7±9.7
Dankyungkong	53±6.1	3.8±1.4	11.9±0.9	53±10.6	53±9.2	11±2.8	42.0±7.5	24.5±1.3	25.9±5.3
Eunhakong	81±9.7	5.7±1.3	17.0±1.6	121±20.7	68±12.5	19±3.7	49.5±9.1	13.3±0.8	32.3±5.7
Namhaekong	96±16.5	6.9±1.4	16.8±1.5	150±36.2	84±21.3	23±4.7	61.1±17.3	14.1±1.4	41.8±12.4
Jangkyungkong	100±9.4	4.3±1.5	20.9±1.8	76±22.1	74±24.8	24±10.2	50.1±15.2	25.1±1.7	34.0±9.0
Muhankong	137±28.2	3.8±1.8	21.6±2.0	67±14.5	75±14.8	22±3.9	53.0±12.6	22.9±1.2	31.9±6.8

* Mean ± Standard error

used to determine the association between various characters.

RESULTS AND DISCUSSION

Variability for some agronomic characters.

The mean value for different characters of 20 recommended soybean varieties which were developed until the early 1990' s in Korea are given in Table 1. For yield components, i.e., number of branches, number of pods, grain weight per plant, and 100-seeds weight, there were wide variations among varieties. Variation in agronomic characters were also observed. Plant height ranged from 46 to 137 cm, with a mean of 83 cm. The number of nodes on the main stem also had a wide range, but averaged about 17 nodes. Pods were cylindrical, flat, and round. The colour of ripe pods was either black, dark grey, or brown but mainly was dark brown. Pods/plant ranged from 53 to 164, 100-seed weight from 13.3 to 30.3 g and yield/plant from 25.9 to 68.7 g.

The differences among the genotypes were significant for all the chaeacters studied. The phenotypic coefficient of variation was of the higher magnitude per plant for branches, grain yield, pods number and pods weight. Number of nodes and 100-seeds weight had the lowest phenotypic coefficient of variation(Table 2). Coefficients of variation of branches, pods per plant, 100-seeds weight and grain yield per plant were 30.3 %, 26.3 %, 7.2 %, and 25.6%, respectively. These facts indicated that among the different characters, plant height and 100-seed weight are relatively more stable as observed by other researchers(Kokubun and Watanabe 1981, Miura and

Table 2. Average of coefficient of variations in 20 soybean varieties evaluated.

	Plant height (cm)	Branches /plant (No.)	Nodes/ plant (No.)	Pods/ plant (No.)	Total plant wt.(g)	Stem wt. (g)	Pods wt. (g)	100- seeds wt.(g)	Yield/ plant (g)
Coefficient of variation (%)	8.9	30.3	7.2	26.3	23.1	25.4	27.4	7.2	25.6

Table 3. Phenotypic correlations among different characters in 20 soybean varieties.

	No. of branches	Pods / plant	Pods / stem	Pod No branch	Weight of pods	Yield / plant	Weight of stem	No. of nodes	100- seeds wt.
PH*	0.04	-0.11	0.00	-0.10	0.02	-0.02	0.47*	0.80**	0.03
NB		0.73**	-0.39	0.84**	0.46*	0.42	0.68**	0.04	-0.31
PP			0.11	0.95**	0.43	0.41	0.52*	-0.09	-0.60**
PS				-0.22	-0.11	-0.13	-0.02	0.24	-0.23
PB					0.46*	0.44*	0.52*	-0.16	-0.51*
WP						0.98**	0.58**	0.21	0.37
YP							0.53*	0.16	0.42
WS								0.43	0.02
NN									0.18

* PH = Plant height; NB = No. of branches; PP = Pods per plant; PS = Pods per stem; PB = Pods per branch; WP = Weight of pods; YP = Yield per plant; WS = Weight of stem; NN = Number of nodes

Genma 1986), and that the low correlation among those components may be due to their lower sensitivity to the environment.

Correlation coefficients among grain yield and its components were also calculated. The correlations among different traits are given in Table 3. Grain yield per plant showed a positive phenotypic association with weight of pods, pod number of branches, and weight of stem. Among characters surveyed, the relationship of weight of pods and grain yield was the strongest. Apart from grain yield, 100-seeds weight showed a positive relationships with pod length and a negative relationships with days to flowering and maturity(data not shown). This indicates that early-flowering and early-maturing varieties may possess bolder seeds compared to the late-flowering ones. And 100-seeds weight showed a negative relationships with pods per plant, thereby indicating that number of pods may reduce the seed weight. Pods per plant had a positive relationships with number of branches, and weight of stem but no relationships with pods per stem, plant weight, plant height, and nodes number. This suggests that multi-branch types having bolder seeds could be combined with types with a greater number of pods per plant in order to attain higher yield. Among the traits studied, branch number was the best indicator of pods per plant.

In leguminous crop, the highly significant association of number of pods per plant with grain yield is consistent with the results of other works(Kenji 1993, Fransisco and Maeda 1989, Kokubun and Watanabe 1981). In this experiment, the strong correlation of grain yield with number of pods per plant was recognized(r=0.783***). This strong relationship between grain weight and number of pods per plant could be then attributed primarily to the increase in the number of pods per stem and grains per pod. This is supported in the present experiment by their high values of correlation coefficient(r=0.768** and 0.63** in pods per plant and grains/pod, respectively).

However, the correlation with plant height was no significant. The none significant association between plant height and grain yield indicated that taller plants may not always be higher yielders. On the contrary, the number of effective flowering branches and effective flowers per node may be real determinants to the yield potential of a plant. In fact plants with medium stature, erect growth habit, short internodes and more effective flowering nodes may utilize solar energy more efficiently compared to the taller types.

MULTIPLE REGRESSION

The estimation of partial regression coefficients was done for five charaters, viz. pods per plant, branch number, stem weight, node number, and 100-seed weight which showed positive association with grain yield. The partial regression of grain yield on pods per plant(1.113 ± 0.07) and 100-seeds weight(1.068 ± 0.26)was significant, whereas the partial regression coefficients for branch number, stem weight, and node number were not significant. Hence partial regression coefficients were again estimated by including pods per plant and 100-seeds weight only. Pods per plant gave a highly significant partial regression coefficient and indicated greater importance of this character. This multiple regression coefficient based on these two characters was as follows ;

Expected grain yield = -37.759 + 1.023 X1 + 1.027 X2 ;

where X1 = pods per plant and X2 = 100-seed weight.

The partial regression analysis revealed that only pods per plant and 100-seeds weight were significantly contributing towards grain yield. It indicated that stout and medium-stature plants with more branches bearing not-too-many pods on nodes would add to grain yield and that types having shorter flowering duration and grain-filling period would be more productive.

LITERATURE CITED

1. Brim C.A. and Burton J.W. 1979. Recurrent selection in soybeans. Ⅱ.Selectiom for increased percent protein in seeds. Crop Sci. 19:494-498
2. Brim C.A. 1973. Quantitative genetics and breeding. Soybeans: Improvement, production, and uses. pp. 155-186. Am. Soc. of Agron., Inc., Madison. Wis
3. Foreign Agricultural Service. 1985. Foreign Agricultural Circular FOP-1-85, USDA., Washington, D.C.
4. Fransisco P. B. Jr. and Maeda K. 1989. Agro-physiological studies on the yield performance of mungbean. Japan J. crop Science 58: 704 - 711
5. Hartwig E.E. and Kilen T.C. 1991. Yield and composition of soybean seed from parents with different protein, similar yield. Crop Sci. 31:290-292
6. Hymowitz T., Panczner F.I. , Collins J. and Walker W.M. 1972. Relationship between the content of oil, protein, and sugar in soybean seed. Agron. J. 64:613-616
7. Kenji T. 1993. Variations of ecological and yield characters in lanfraces of white azuki bean. Crop Production and Improvement Technology in Asia(Proceedings of the First Asian Crop Science Conference, 1992). pp 495 - 505.
8. Kim S.D., Choe B.H. , Hong E.H. and Ha Y.W. 1994. breeding strategy for quality improvement and diversity in upland crop. Korean J. Breeding. 26(S):16-35
9. Kim Y.H., Kim S.D. and Hong E.H. 1995. Present status and perspectives of soybean breeding program for high seed quality in Korea. Korea soybean digest. 12(1):1-20
10. Kim Y.H. and Kim S.D. 1998. Current achivements and perspectives of seed quality improvement in soybean. Korean J. Crop Sci. 43(S):29-39
11. Kokubun M. and Watanabe K. 1981. Analysis of the yield-determing process of field-grown soybeans in relation to canopy structure. Japan J. Crop science 52: 215 - 219
12. Miura H. and Genma T. 1986. Effect of square planting on yield and its components of soybean under different levels of planting density. Japan J. Crop Sci. 55: 484 - 488
13. Taira H. and Taira H. 1971. Influence of location on the chemical composition of soybean seeds. Proc. Crop Sci. J. 20:530-543
14. Weiss M.G., Weber C.R., Williams L.F. and Probst A.M. 1952. Correlation of agronomic characters and temperature with seed compositional characters in soybeans, as influenced by variety and time of planting. Agron. J. 44:289-297

Received 2000. 7. 30

Accepted 2000. 9. 30