American-Eurasian J. Agric. & Environ. Sci., 10 (6): 972-977, 2011
ISSN 1818-6769

Comparing Economic Coefficients to Select the Optimum Selection Index in Peanuts

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Abstract: In order to appoint desirable indices to select dominant genotype, an experiment with 40 peanut varieties was conducted in 2007 in a Randomized Complete Block Design with three replications at the Tobacco Research Institute, Rasht, Iran. For formation of selection indices, traits were selected by means of stepwise regression. In this study, we used optimum indices. Economic weights that we used included unit, phenotypic correlation, genotypic correlation, heritability, direct effects in path analysis and first factor loading in factor analysis. Results showed that if we use unit coefficient for optimum selection index, we would have the highest genetic advance for all traits among all selection indices. In addition, this selection index had high correlation with genotypic worth. Evaluating selecting index efficiency for oil percentage at the index base, compare with direct election of trait showed that if we use this selection index, response to selection by selection index would be higher than respond to selection of trait. However, response to direct selection of oil yield and grain yield will be higher than respond to selection-by-selection index. Genotypes such as 15, 29, 27, 9 and 22, had the highest index value by using this selection index respectively.

Key words: Economical coefficients · Optimum selection indices · Genetic advance · Oil yield · Peanut

INTRODUCTION

Yield is a trait that is controlled by a number of genes and so indirect selection would relate to improvement. One of the effective ways for indirect selection is using selection index [1,2]. Selection index is one of the most beneficent tools for breeders to select the best genotypes. On the base of these indices, synchronic selection was down on the base of number of traits according to their phenotypic and genotypic value, phenotypic and genotypic correlation among these traits and a figure that called trait economic value.

Sometimes multi variate regression coefficients or traits heritability are used as relative values. Also sometimes path coefficients are used as economic values. By using selection index and according to these points for each genotype, line or cultivar, a figure is suggested which is used as a particular parameter for selecting and thus according to this index, each line on genotype which has the highest value of index will have the first selection preference. The aim of distinction of an index is helping us to find a linear combination of phenotypic values until expected benefit reach to the maximum [3]. By increasing number of traits, selection index would be more efficient than periodic selection and when traits have the same importance and selection intensity is less than 0.5 percentages, the selection index has the highest efficiency.

Increase of yield would be possible by selecting the traits that are effective on yield. [4]. An experiment by Zhu *et al.* [5] on wheat showed that output of synchronic selection of some traits is more than direct selection of each trait. Fazlalipur *et al.* [6] used genetic path coefficients for calculating optimum selection index and base selection index in rice and in order to distinct, the best selection indices for breeding yield and its component, ten different selection indices on the base of these two indices, were evaluated.

Results showed that selection on the base of traits such as biological yield and harvest index which are distinct as effective traits on grain yield in genetic analysis, according to their direct genetic effect (genetic

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path coefficient) as economical values, could be useful. On the other hand using genetic correlation coefficient as economical value for traits that have more heritability than yield, could release to better and more appropriate indices for population breeding. Safari *et al*. [7] at evaluating selection indices in peanut reported that among optimum and base selection indices, indices that are calculated by unit economic coefficient and factor coefficient, would improve peanut oil yield.

Although, there is a positive relation among yield and some of its contents, but negative relations among some other component could not be useful factor for increasing crested wheatgrass yield [8]. But if simple correlation among traits divide to direct and indirect effects by Path analysis, the importance of each traits that effect yield will be distinct and thus according to this importance indirect selection increasing in grain yield will be double [3,8,9].

The aim of this research is to compare different selection indices according to their different economic coefficients and estimate the best selection index and at last select the best peanut cultivars by using calculated indices.

MATERIALS AND METHODS

In order to distinct, the best selection index, for selecting the best genotype, an experiment with 40 peanut varieties was conducted in 2007 in a randomized completed block design with three replications. This experiment was conducted at the tobacco research institute, Rasht, Iran. According to climatology division, this area is warm and semi-mediated and has warm summer and moderate winter. Experimental units were created at 2*1 meter and 50 centimeter distance from next experimental unit. Between each replicate was 1-meter distance. Planting was down superficial 6 May and at the same day.

Required nitrogen as base fertilizer was supplied from ammonium phosphate source at the beginning of the culture up to 70 kg/ha. Also for supplying the plant requirement Ca and S, stucco up to 70 kg/ha at the beginning of the culture and up to 140 kg/ha at the middle of the plant growth step was mixed with soil and was used around the plant. Plants irrigate lightly immediately after planting and the next irrigation established according to plant water requirement. In these experiment 39 peanut varieties, which supplied from Iran plant gene bank, with North Carolina variety (NC2) used as a control variety. Varieties codes with their number at gene bank that is shown in Table 1. Yield of all plots harvested separately at the same time and saved in Tobacco Research Institute heater at 30°C temperature to achieve 14% humidity. For correct sampling and deleting marginal effects, the plants of brink rows of plots omitted. Also out of type plants were omitted at harvest time as they omitted at growth period. In order to measure studied traits, five plants at middle of the plot selected randomly at harvest time and their pods were segregate separately. In order to measuring yield and its component, all of the plants were use for measuring. All the measuring was done according to peanut description [10]. These traits included number of pods per plant, number of empty pods, full pods to empty pods ratio, length width and diameter of pod, pod length to pod width ratio, number of grains per pod, number of grain per plant, length width and diameter of grain, grain length to grain width ratio, plant pods weight, plant empty pods weight, plant grains weight, plot grains weight, plot pods weight, one hundred pods weight,

Table 1: Genotypes with their code of investigated traits

Code	Group A	Code	Group B	Code	Group D	Code	Group E
1	ICGV 92049	13	ICGV 92022	22	ICGV 92113	33	ICGV 92195
2	ICGV 92050	14	ICGV 92023	23	ICGV 92116	34	ICGV 92267
3	ICGV 92052	15	ICGV 92027	24	ICGV 92118	35	ICGV 93382
4	ICGV 92054	16	ICGV 92028	25	ICGV 92120	36	ICGV 93392
5	ICGV 92064	17	ICGV 92040	26	ICGV 92121	37	ICGV 93420
6	ICGV 92071	18	ICGV 93128	27	ICGV 93233	38	ICGV 94361
7	ICGV 92076	19	ICGV 93133	28	ICGV 93260	39	Chico
8	ICGV 93152	20	ICGV 93135	29	ICGV 93261		
9	ICGV 93155	21	ICGV 93136	30	ICGV 93269		
10	ICGV 93162			31	ICGV 93277		
11	ICGV 93163			32	ICGV 86635		
12	ICGV 93171						
40	NC2(Control)						

one hundred grains weight, grain percentage to pod percentage ratio, pod yield, grain yield, pod volume to grain volume ratio, grain oil percentage and oil yield. Because it is very difficult to enter number of traits at selection index and maybe it is practically impossible, traits that had high correlation with oil yield were calculated by stepwise regression with SPSS version 11.5 were used at selection index creation.

Optimum Index: Generally, optimum index is [11]:

$$I = b_1P_1 + \ldots + b_iP_i + \ldots + b_nP_n \quad (1)$$

Optimum index coefficients are calculated by:

$$b = P^{-1}Ga \quad (2)$$

In this equation, b is index vector coefficients, P^{-1} is reverse of phenotypic variance-covariance matrix, G is genotypic variance-covariance matrix and a, is economical index vector [11].

Four parameters were measured for calculating indices [11]:

- Correlation coefficient of index and breeding value (R_{HI}), that if it is the maximum, the maximum response will be achieved:

$$R_{HI} = \sigma_{HI} / \sqrt{(\sigma_I^2 \sigma_H^2)} = \sigma_I / \sigma_H \quad (2)$$

σ_I^2, σ_H^2 and σ_{HI} are index variance, breeding value variance and covariance of index and value respectively.

This correlation coefficient at its matrix form is calculated by

$$R_{HI} = v(b' Pb / a' Ga)$$

- Genetic advance of all traits for each index (ΔH)

$$\Delta H = kr_{HI}\sigma_H$$

In this formula, k is selection intensity; R_{HI} is correlation of index and breeding value and σ_H is standard deviation of breeding value. Selection intensity was supposed 5%, thus k is 2.06.

- Expected response for each trait by using index (R_I) and selecting the self-trait (R_A).
- Relative efficiency (RE) of index to direct selecting of trait and its highness means that by using this index, genetic advance will be achieved than direct selection of trait.

$$RE = R_I / R_A = (r_{G(A)} I) / h_{(A)}$$

R_I is expected response for trait (A) on the base of selection index and R_A is expected response by direct selection of trait.

$$R_I = k\, r_{G(A)I}\, \sigma_{G(A)}$$

$$R_A = kh_{(A)}\, \sigma_{G(A)}$$

$r_{G(A)}$ is correlation between genotypic value of trait (A) and index and $\sigma_{G(A)}$ is genotype standard deviation for trait (A).

In this study, unit coefficients, phenotypic and genotypic correlation coefficients, heritability, direct effects in path analysis and factor coefficients, were used as economical coefficients. All of the calculation was down by SAS version 9.0.

RESULT AND DISCUSSION

For distinct perfect indices to selecting the best genotypes and calculating relative efficiency, correlation between traits and index and prospected answer for each traits, broad heritability, genetic and phonotypic variance and covariance for oil yield, grain yield and oil percentage that are shown at Table 2,3 and 4.

According to phenotypic and genotypic variance and covariance matrix, phenotypic and genotypic correlation coefficients were calculated (Table 5).

Economic value for studied traits was considered on the base of unit value phenotypic and genotypic correlation, direct effects of path analysis, broad heritability of traits and factor coefficients for evaluating optimum and base indices (Table 6).

According to economic value of traits, index coefficients (b), prospected advanced genetic for all traits by using index (ΔH). Genetic correlation coefficient of index with breeding value (R_{HI}), prospected answer from each trait by using index (RI) and selection efficiency on the base of index than trait direct selection (RE) in index are calculated and (6) were shown at Table 7, 8, 9 and 10 respectively.

Table 2: Average of phenotypic value and heritability of investigated traits of peanut genotypes

Traits	m ± SD	Broad heritability h^2_b
Oil yield (ton per hectare)	0.992±0.249	0.177
Grain yield (ton per hectare)	2.495± 0.592	0.608
Oil percentage	39.832±4.356	0.537

Table 3: Genotypic variance and covariance matrix (G) of investigated traits of peanut genotypes. The values on diameter are variance and values out of diameter are covariance of duplex complex of traits

Traits	Oil yield	Grain yield	Oil percentage
Oil yield	0.0233	0.0433	0.3223
Grain yield	0.0433	0.1102	-0.0463
Oil percentage	0.3223	-0.0463	14.5960

Table 4: Phenotypic variance and covariance matrix (P) of investigated traits of peanut genotypes. The values on diameter are variance and values out of diameter are covariance of duplex complex of traits

Traits	Oil yield	Grain yield	Oil percentage
Oil yield	0.1333	0.3033	0.5287
Grain yield	0.3033	0.799	0.2237
Oil percentage	0.5287	0.2237	27.2630

Table 5: Genotypic and phenotypic correlation coefficients among investigated traits of peanut genotypes. The values at the top of diameter are phenotypic correlation (r_p) and the values at the bottom of diameter are genotypic correlation (r_g)

Traits	Oil yield	Grain yield	Oil percentage
Oil yield	1	0.929	0.227
Grain yield	0.854	1	0.047
Oil percentage	0.552	-0.036	1

Table 6: Relative economic values for selection indices

	1	2	3	4	5	6
Traits	Unit	Phenotypic correlation	Genotypic correlation	Direct effect of path analysis	Broad heritability	Factor coefficient
Oil yield	1	1	1	1	0.177	0.913
Grain yield	1	0.929	0.854	0.928	0.608	0.811
Oil percentage	1	0.277	0.552	0.421	0.537	-0.417

Table 7: Calculated coefficients, expected genetic advance with using optimum selection index on the base of selection intensity 5% (k = 2.06) for peanut genotypes

	Index coefficients					
Traits	b_1	b_2	b_3	b_4	b_5	B_6
Oil yield	9.7058	2.9704	5.5068	4.3128	5.170	-3.5214
Grain yield	-3.6585	-0.9918	-2.0107	-1.5255	-1.9575	1.5665
Oil percentage	0.38730	0.1090	0.2156	0.1647	0.2043	-0.1584
?H	6.2286	1.8351	3.4988	2.7073	3.297	2.4636
R_{HI}	0.7712	0.7338	0.7643	0.7553	0.7727	0.7594
R^2	0.5947	0.5384	0.5841	0.5704	0.5970	0.5766

Table 8: The value of expected response from each traits with using index (RI) and trait selection efficiency on the base of index to trait direct selection (RE) in optimum selection indices

	Index											
	I_1		I_2		I_3		I_4		I_5		I_6	
Traits	RE	RI	RE	RI	RE	RI	RE	RI	RE	RI	RE	RI
Oil yield	0.993	0.131	1.075	0.142	1.016	0.134	1.039	0.137	0.984	0.130	-0.851	-0.112
Grain yield	0.002	-0.0005	0.128	0.032	0.008	0.248	0.067	0.017	-0.003	-0.001	0.184	0.047
Oil percentage	1.058	6.097	1.041	6.000	1.055	6.081	1.051	6.058	1.058	6.098	-1.052	-6.061

Table 9: The index value (I) for the 5 best peanut genotype with selecting by optimum selection indices. (Digits in bracket are number of genotypes)

Code	I_1	I_2	I_3	I_4	I_5	I_6
1	(15) 20.861	(29) 6.240	(15) 11.766	(15) 9.116	(15) 11.001	(15)-7.954
2	(29) 20.577	(15) 6.184	(29) 11.677	(29) 9.103	(29) 10.844	(29)-7.582
3	(27) 20.000	(27) 5.998	(27) 11.316	(27) 8.796	(27) 10.542	(27)-7.493
4	(9) 19.646	(9) 5.896	(9)11.118	(9) 8.643	(9) 10.354	(9)-7.354
5	(22) 19.154	(22) 5.726	(22) 10.828	(22) 8.409	(22) 10.095	(22)-7.212

According to Table 7, if unit economic coefficient (1) use for calculating optimum index, highest genetic advance for all traits (?H= 0.228) in all calculated optimum index, will be achieved. This index had high genetic correlation with breeding value (R_{HI}= 0.771). Answer to selection of oil yield on the base of index was (RI= 0.131). On the other hand, it means that the maximum genetic advance for oil yield by using this index would be 0.131. Whereas answer to selection for oil yield by using direct selection, was 0.132. Calculating selection efficiency for oil percentage on the base of index than trait direct selection showed that if this index is used, answer to selection on the base of index for this trait will be more than direct selection of this trait. Although answer to selection on the base of index for oil yield and grain yield will be less than selection of these traits (0.993 and-0.002). By using this index, genotypes 15, 29, 27, 9 and 22 showed the highest value of index (Table 9).

If phenotypic correlation coefficients are used as economic coefficients in calculating base index, genetic advance for all of the traits will be high (R_{HI}= 0.733). In this index, selection efficiency on the base of indices for oil yield and oil percentage were more than direct selection of this traits (RE= 1.045 and 1.075), but about grain yield, direct selection of this trait showed more efficiency (RE= 0.128). By using this index, genotypes 29, 15, 27, 9, 22 will have the highest value of index (Table 9).

If factor coefficient use as economic coefficient in calculating optimum index, genetic advance will be low (?H= 2.7073) and correlation between index and breeding value of all traits (R_{HI}= 0.755) will be high. Selection efficiency on the base of index for oil yield and oil percentage was more than direct selection of these traits (1.039 and 1.051). Also in this index direct selection of grain yield was more efficient (RE= 0.067). In this index genotypes 29, 15, 27, 9 and 22 had the highest value of index too (Table 9). Using broad heritability of traits as economical coefficients in calculating optimum index release to relatively low genetic advance (?H= 3.297) and high correlation between index and breeding value of all traits (R_{HI}= 0.775). Selection efficiency on the base of index for oil yield and grain yield were less than direct selection of these traits (0.984 and 0.003). However, selecting oil percentage on the base of index than direct selection of this trait was more efficient. (RE= 1.058). In this index, genotypes 15, 29, 27, 9 and 22 had the highest value of index (Table 9).

Using factor coefficients as economic coefficients in calculating optimum index, release to low genetic advance (?H= 2.463) and high correlation between index and breeding value of all traits (R_{HI}= 0.759). Selection efficiency on the base of index for oil percentage was more (RE=-1.052) and for oil yield and grain yield was less than direct selection of these traits (-0.851 and 0.184). In this index, genotypes 29, 15, 27, 9 and 22 had the highest value of index (Table 9).

CONCLUSION

Results showed that if unit economical coefficients were used for calculating optimum index, maximum genetic advance for all traits among all of the calculated optimum indices would be achieved. This index also had high correlation with breeding value. Results of Safari *et al.*, 2008 confirm our results. Direct selection for grain yield than selecting of this trait on the base of all of the calculated indices had more efficiency, although selecting oil yield on the base of indices which genotypic and phenotypic correlation coefficients and direct effects in path analysis were used for calculating them as economical coefficients, had more efficiency than direct selection of these traits. About oil percentage, selecting this trait on the base of all of the calculated indices, than direct select of this trait, had more efficiency. Results of Safari *et al*, (2008) and Fazlalipur *et al*. (2007) confirm our results. Anyway, all of the calculated indices suggested the same genotypes as the best genotypes.

REFERENCES

1. Modaresi, M., M. Asad and M. Kheradnam, 2003. Determination Of Selection Indices In Corn (*Zea mays* L.) Cultivars For Increasing Grain Yield. Journal of olumo fonume keshavarzi va manabe tabiee, 7(4): 71-81.

2. Smith, O.S., A.R. Hallauer and W.A. Russell, 1981. Use of Index Selection in Recurrent Selection Programs in Maize. Euphytica, 30: 611-618.
3. Abuzari Gazaferudi, A., 2002. Studying On Genetic Diversity And Correlation Among Morphological Traits and Data of Storage Protein Electrophoresis in Rice Cultivars. Master of Science Thesis. Facuality of agriculture. University of Guilan. Iran.
4. Maiti, R. and P. Wesche-Ebeling, 2000. The peanut (*Arachis hypogaea*) crop. Science Publishers, Inc.
5. Zhu, X.P., Z. Zhang and G.X. Wang, 1991. A Study Of Genetic Variation And Selection Index In The Progenies Of Laser-Treated Whest. J. Southwest. Agricultural university, 13: 421-423.
6. Fazlalipur, M., B. Rabiee, H. Samizadeh and H. Rahim Sorush, 2007. Using Genetic Path Coefficient For Optimum And Base Selection Indices. Journal of Daneshe keshavarzi, 17(4): 97-112.
7. Safari, P., R. Honarnejad and M. Esfahani, 2008. Evaluation of Selection Indices in Peanut (*Arachis hypogaea* L.) Cultivars. Journal of Daneshe Keshavarzi, 18(3): 137-147.
8. Dewey, D.R. and K.H. Lu, 1959. A Correlation And Path-Coefficient Analysis of Components of Crested Wheatgrass Seed Production. Agron. J., 51: 515-518.
9. Rabiee, B.M., Valizadeh B. Ghareyazie and M. Moghaddam, 2004. Evaluation Of Selection Indices For Improving Rice Grain Shape. Field Crops Research, 89: 359-367
10. Anonymous., 1981. Groundnut Descriptors. IBGR and ICRISAT. AGP IPGR/80/66.
11. Baker, R.J., 1986. Selection Indices In Plant Breeding. CRC Press. Inc., pp: 218.