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热带大豆的指数选择*

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摘　要

本试验采用25个新的大豆品系为材料，用Robinson等的公式计算了选择指数的遗传进展；用Johnson等的公式计算了直接选择产量的遗传进展；用选择指数的遗传进展占直接选择产量的遗传进展的百分率表示选择指数的相对选择效率；用判别函数求得选择指数的公式。

试验结果表明：除了单因子指数选择的效率低于直接选择产量的效率外，所有的指数选择效率都高于直接选择产量。包括所有10个性状的指数选择效的相对效率最高(115.25%)。从经济和简便的角度出发，我们认为包括5个性状(小区产量，熟期，株高，每株荚数，百粒重)的指数选择是可行的。它的相对选择效率是114.07%。

INDEX SELECTION FOR YIELD IMPROVEMENT IN SOYBEAN IN THE TROPICS

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The need for simultaneous selection for several traits at a time have been discussed by Gardner (1977) and Comstock (1977). This type of selection is a statistical one which is first developed by Fisher (1936), later applied in plant selection by Smith (1936), in animal by Hazel (1943) and has been used with various degree of success in whest (Simolet, 1947), in maize (Robinson et al., 1951; Cotton (Manning, 1956, Miller et al., 1958) and in cowpea (Singh and Mehndiratta, 1970).

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In soybean, there are several reports on using of index selection, but the results are still contradictory. We, therefore, further evaluated the various selection indices for yield improvement by incorporating several characters.

Materials and Methods

The expreimental material comprised 25 newly developed breeding lines of soybean. These were sown in a randomised block design with 4 replications during rainy season 1988 at Crop Research Center of Pantnagar University (India). Each plot consisted of 5 rows, 4 m long and spaced at 60 cm between rows, 5 cm within rows. At maturity, the following observations were recorded randomly on five plant basis in each plot.

X_1—maturity
X_2—plant height
X_3—pods/plant
X_4—seeds/pod
X_5—height to lowest pod
X_6—number of nodes to the lowest pod
X_7—number of nodes on main stem
X_8—number of primary branches/plant
X_9—100 seed weight
X_{10}—yield/plot(kg/7.2 m^2) was recorded on 3 central rows of each plot

The method used in index construction and expected genetic advance from the use of selection index were computed with the help of formula suggested by Robinson et al. (1951). The expected genetic advance through selection for yield itself was calculated as per formula suggested by Johnson et al. (1955 b). In order to determine relative efficiency of various selection indices, the expected genetic advance of these indices was expressed as percentage of genetic advance expected from selection on the basis of yield alone.

Results and discussion

The different combinations of selection indices with genetic advance and relative efficiency over straight selection for yield are given in Table 1.

In general, the selection index based on single component character was less efficient than straight selection for yield alone. However, comparison of relative efficiencies among the component characters revealed that plant height had maximum efficiency (87.65%) followed by the height to the lowest pod(66.34%). Plant height had tendency to increase genetic advance when considered in combination with other characters. Thus, in two variable selection indices, plant height and yield/plot gave the highest relative efficiency (112.10%). This result was different from those reported by Singh and Mehndiratta (1970), Malhotra (1973), Bains and Sood (1980), (who reported pods/plant and primary branches or pods/plant and seeds/pod, pods/plant and early vigour, grains/pod and 100 seed weight, respectively). The efficiency was improved to 12.75%, 12.57%, 12.44% when the third character such as nodes to the lowest pod or maturity or seeds/pod was incorporated in this index respectively. Among 4 variable selection indices, the once based on seed yield, plant height, maturity, pods/plant showed maximum gain (113.56%).

Table 1 Selection indices along with their genetic advance and relative efficiency in soybean

Selection index	G. A.	R. E. %
Straight selection for yield	0.413	100
$-0.231X_1$	0.166	40.19
$-0.008X_2$	0.362	87.65
$0.001X_3$	0.056	13.48
$-0.018X_4$	0.009	2.18
$-0.016X_5$	0.274	66.34
$-0.054X_6$	0.264	63.92
$-0.039X_7$	0.246	59.56
$-0.086X_8$	0.260	62.95
$-0.005X_9$	0.012	2.90
$0.594X_{10} \quad -0.009X_1$	0.417	101.15
$0.469X_{10} \quad -0.005X_2$	0.462	112.10
$0.629X_{10} \quad -0.001X_3$	0.421	101.96
$0.620X_{10} \quad +0.027X_4$	0.413	100.10
$0.541X_{10} \quad -0.007X_5$	0.428	103.55
$0.549X_{10} \quad -0.023X_6$	0.425	103.07
$0.588X_{10} \quad -0.021X_7$	0.431	104.33
$0.551X_{10} \quad -0.040X_8$	0.428	103.63
$0.619X_{10} \quad -0.005X_9$	0.413	100.10
$0.449X_{10} \quad -0.006X_1 \quad -0.005X_2$	0.465	112.57
$0.467X_{10} \quad -0.005X_2 \quad -0.051X_4$	0.463	112.24
$0.439X_{10} \quad -0.005X_2 \quad -0.012X_6$	0.466	112.75
$0.530X_{10} \quad -0.014X_6 \quad -0.016X_7$	0.434	105.08

续表

$0.550X_{10}$	$-0.040X_8$	$+0.003X_9$									0.428	103.65
$0.461X_{10}$	$-0.007X_1$	$-0.005X_2$	$+0.001X_3$								0.469	113.56
$0.452X_{10}$	$-0.005X_2$	$+0.001X_3$	$-0.011X_6$								0.469	113.56
$0.556X_{10}$	$+0.001X_3$	$-0.011X_4$	$-0.007X_5$								0.433	104.84
$0.518X_{10}$	$-0.011X_6$	$-0.013X_7$	$-0.018X_8$								0.436	105.56
$0.464X_{10}$	$-0.007X_1$	$-0.001X_2$	$+0.001X_3$	$-0.006X_4$							0.469	113.80
$0.444X_{10}$	$-0.005X_1$	$-0.005X_2$	$+0.001X_3$	$-0.008X_6$							0.470	113.80
$0.454X_{10}$	$-0.008X_1$	$-0.005X_2$	$+0.001X_3$	$-0.015X_9$							0.471	114.07
$0.556X_{10}$	$+0.001X_3$	$-0.010X_4$	$-0.007X_6$	$-0.004X_9$							0.434	105.08
$0.447X_{10}$	$-0.015X_1$	$-0.006X_2$	$+0.001X_3$	$-0.069X_4$	$+0.007X_7$						0.473	114.61
$0.457X_{10}$	$-0.008X_1$	$-0.005X_2$	$+0.001X_3$	$-0.057X_4$	$+0.015X_9$						0.471	114.07
$0.524X_{10}$	$+0.001X_3$	$-0.003X_6$	$-0.008X_7$	$-0.028X_8$	$-0.004X_9$						0.444	107.62
$0.513X_{10}$	$-0.006X_5$	$+0.007X_6$	$-0.012X_7$	$-0.018X_8$	$+0.001X_9$						0.437	105.81
$0.453X_{10}$	$-0.006X_1$	$-0.005X_2$	$+0.001X_3$	$-0.052X_4$	$-0.002X_5$	$+0.008X_7$					0.471	114.05
$0.452X_{10}$	$-0.006X_2$	$+0.001X_3$	$+0.046X_4$	$+0.006X_5$	$-0.032X_6$	$+0.009X_7$					0.472	114.29
$0.538X_{10}$	$+0.002X_3$	$-0.004X_4$	$-0.006X_5$	$+0.005X_6$	$-0.014X_7$	$-0.001X_8$					0.440	106.63
$0.453X_{10}$	$-0.004X_2$	$+0.001X_3$	$-0.039X_4$	$-0.001X_5$	$-0.018X_8$	$+0.010X_9$					0.470	113.97
$0.444X_{10}$	$-0.006X_1$	$-0.006X_2$	$+0.001X_3$	$-0.053X_4$	$+0.007X_5$	$-0.031X_6$	$+0.010X_7$				0.473	114.52
$0.445X_{10}$	$-0.006X_2$	$+0.001X_3$	$-0.055X_4$	$+0.006X_5$	$-0.029X_6$	$+0.014X_7$	$-0.021X_8$				0.474	114.83
$0.452X_{10}$	$-0.006X_2$	$+0.001X_3$	$-0.047X_4$	$+0.006X_5$	$-0.031X_6$	$+0.009X_7$	$+0.003X_9$				0.472	114.25
$0.442X_{10}$	$-0.006X_1$	$-0.006X_2$	$+0.001X_3$	$-0.065X_4$	$-0.001X_5$	$+0.012X_7$	$-0.023X_8$	$+0.017X_9$			0.475	115.01
$0.444X_{10}$	$-0.006X_2$	$+0.001X_3$	$-0.058X_4$	$+0.006X_5$	$-0.025X_6$	$+0.014X_7$	$-0.024X_8$	$+0.008X_9$			0.475	115.01
$0.437X_{10}$	$-0.006X_1$	$-0.006X_2$	$+0.001X_3$	$-0.064X_4$	$+0.006X_4$	$+0.006X_5$	$-0.023X_6$	$+0.013X_7$	$-0.021X_8$	$-0.014X_9$	0.476	115.25

G. A. : Genetic advance R. E. : Relative efficiency

It was observed that by incorporation of every additional character in the index, the overall efficiency was increased but the proportionate rate of increase was in decreasing trend. Similar result was reported by Johnson et al., (1955 a), Bains and Sood (1980). The results further revealed that selection based on index always gave higher genetic gain than selection for yield it self. The higher genetic advance obtained by using index selection has been reported by Caldwell and Weber (1965), Malhotra (1973), Pritchard et al. (1973), Singh and Dalal (1979), Bain and Sood (1980) and Holbrook (1989). However, the present results were contrary to those reported by Byth (1966), Byth et al. (1969), Korczak and Bernard (1983), who showed that a discriminant function involving yield components was not more efficient over straight selection for yield alone. These conflicts may be due to substantial interaction between genotypes and environment (Byth et al., 1969).

In the present study, the index involving 10 characters gave the highest relative efficiency (115.25%). In practice, it would be unjustified to include as many as 10 characters at a time as the cost of collecting data is high (Pritchard et al., 1973). Thus, it would be desirable to use an index which would ensures maximum possible genetic gain by using the minimum number of characters. In the present investigation, an index involving 5 traits (yield/plot, maturity, plant height, pods/plant and 100 seed weight with 114.07% relative efficiency) would be the most desirable for improving the yield ability in soybean.

Conclusions

Selection indices were formulated in soybean using discriminant function technique. All indices were as good as or ever better than straight selection for yield alone except that of single variable which showed negative response over straight selection for yield. The highest relative efficiency was obtained when all 10 characters were involved (115.25%). For economy and simplicity of the procedure, a combination involving 5 traits is recommended i. e. yield/plot, maturity, plant heinht, pods/plant, 100 seed weight, which gives 114.07% more relative efficiency over selection foy yield alone.

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