

SOME STATISTICAL MODLES TO DETECT THE RELATION BETWEEN YIELD AND ITS COMPONENTS FOR INTERCROPPING EXPERIMENTS.

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ABSTRACT

Two field trials were carried out at Ismaelia Agricultural Research Station in summer of 2002 and 2003 seasons to estimate the relative contributions of yield components for intercropping sesame (Giza 32) on groundnut (Giza5) varieties using simple correlation , multiple regression and stepwise regression analysis procedures. Results of simple correlation analysis for sesame cleared that significant positive correlation was found between seed yield kg/fed. (y1) and each of oil quantity , No.of capsules , seed yield / plant and stand plant with r- values being 0.940 ,0.695 ,0.682 and 0.660, respectively . There were highly significant positive correlations between quantity of oil (y2) and each of No.of capsules ,seed yield /plant and percentage of stand plant with r- values of 0.665, 0.608 and 0.578, respectively . The multiple regression analysis cleared that the relative contributions for all characters were 92.8% and 76.5% in the total variation for seed yield and quantity of oil ,respectively . Stepwise regression analysis selected four variables out of ten contributing by 92.8% in the variance of seed yield . These factors were quantity of oil /seed (x7), stand plant ratio (x10), seed yield/plant (x8) and plant height (x6) with R² of 88.4 , 2 , 1.2 and 1%, respectively, in total variation of seed yield . Stepwise also selected six out of nine variables contributing by 75.3% from the variance of quantity of oil and these variables were No. of capsules/plant (x4), plant height (x6), stand of plant (x9), No. of leaves/plant (x5), weight of 1000 seeds (x8) and seed yield/plant (x7) with R² being 44.3, 15.9, 6.4, 4.4, 2.6 and 1.7%, respectively .

For groundnut , results of simple correlation analysis cleared significant positive correlation between yield kg/fed and each of oil quantity, weight of pod / plant and weight of 100 seeds , with r- values of 0.803 , 0.760 and 0.633, respectively . Multiple regression analysis indicated that the relative contributions for all characters were 80.2% from the total variation for yield kg/fed. Results of stepwise regression analysis revealed that three out of eleven variables contributed by 74.8% in the total variation for yield kg/fed. . These variables were quantity of oil /seed (x7), weight of 100seeds (x9) and weight of pod/plant (x10) with R² being 64.6, 6.8 and 3.4% , respectively .

INTRODUCTION

Increasing the area under oil seed crops is an important target to reduce oil deficiency gap. Intercropping is an approach to reduce this gap by intercropping a number of different crops on the same piece of land at the same time or in part of their life cycles like sesame and groundnut as major oil crops in the world and had important rank in seed oil crops grown in Egypt especially in the new reclaimed land. In Egypt, expansion of groundnut and sesame acreage crops is of great importance to increase exportation of peanut and decrease sesame importation . Intercropping some field crops

with groundnut is a promising practice with main objectives to reduce labours peaks , minimize crop failure risk , reduce the adverse effects of pests and provides farmers higher returns from land and labour. The merits of intercropping sesame with groundnut have been indicated by several investigators, EL-Mihi *et al.* (1990),El-Gamel *et al.* (1990), Gaber *et al.* (1993), Khistaria *et al.* (1998) , who studied groundnut and sesame in pure stands and as intercrops .They found that groundnut-equivalent yield , land equivalent ratio and monetary returns gave the highest rate .

The aim of this study is to investigate the variables which having the greatest effect on the yield and their relative contributions to variation in the yield for sesame and groundnut of intercropping experiments.

MATERIALS AND METHODS

Two field experiments were carried out at Ismaelia Agricultural Research Station during the summer of 2002 and 2003 seasons . Each experiment included 54 treatments resulted from all possible combinations of two intercropping patterns ,planting sesame on the other side and on the top of groundnut ridge ,three planting dates for sesame (at the same date (first may) , after ten days and after twenty days) from planting groundnut , and three spaces between sesame hills (15, 20 and 25 cm). The design of experiment was a split- split plot with three replications, intercropping patterns occupied the main plot, whereas, date of planting and spaces between sesame hills occupied the sub plot and sub-sub plot , respectively. Groundnut seed variety Giza 5 and sesame seeds variety Giza 32 were used. Dependent variables for sesame were seed yield kg./fed. (y1) and quantity of oil (y2) and the independent variables were presented in Table 1 and Table 2. The dependent variable for groundnut was weight of pods (y1) and independent variables are presented in Table 3 .

Table 1: Independent variables that were related with seed yield kg./fed. (y1) in sesame .

Independent variables	
Dry weight / plant (g) .	X1
Height of .first capsule (C.m) .	X2
Leaf area index .	X3
Number of capsules / plant.	X4
Number of leaves / plant .	X5
Plant height (c m) .	X6
Quantity of oil /seed (g).	X7
Seed yield/plant(gm)	X8
Weight of 1000 seeds / (gm) .	X9
Stand plant ratio.	X10

Table 2: Independent variables that were related with quantity of oil (y2) in sesame .

Independent variables	
Dry weight / plant (g) .	X1
Height of .first capsule (C.m) .	X2
Leaf area index .	X3
Number of capsules / plant.	X4
Number of leaves / plant .	X5
Plant height (c m) .	X6
Seed yield/plant (gm).	X7
Weight of 1000 seeds / (gm) .	X8
Stand plant ratio.	X9

Table 3: Independent variables that were related with yield kg /fed(y1) in peanut .

Independent variables	
Dry weight /plant (g) .	X1
Leaf area index (cm ³) .	X2
Number of leaves / plant .	X3
Number of pods / plant .	X4
Number of branches .	X5
Plant height (cm) .	X6
Quantity of oil / seed .	X7
Percentage of three seed pods .	X8
Weight of 100 seeds (gm) .	X9
Weight of pods/plant	X10
Stand plant ratio .	X11

Statistical analysis:

Relationships among dependent and independent variables were studied using the following statistical techniques :

- 1-Simple correlation coefficient were calculated as applied by Snedecor and Cochran (1989) to estimate the correlation coefficient (r) between each of dependent and independent variables.
- 2-Multiple regression analysis was performed as outlined by Draper and Smith (1987) to calculate the coefficient of determination (R^2) to estimate relative contribution of independent variables for each dependent variable and to get the prediction equations.
- 3-Stepwise multiple regression analysis aims to determine the variables accounting for the majority of the total variability in dependent character . This procedure develops a sequence of multiple regression equation in a stepwise manner. One variable is added to the regression equation at each step. The added variable is the variable that has the greatest contribute in the error sum of squares. Also this variable has a highest partial correlation with the dependent variable for fixed values of those variables already added, and it is the variable that has the highest F value. The stepwise regression analysis was performed as described by Draper and Smith

(1987) . Multiple regression and stepwise analysis were applied to the data over 2002 and 2003 seasons .

RESULTS AND DISCUSSION

The results in Table 4 indicated that the relationship between seed yield kg / fed (y1) and 10 characters in sesame are discussed as follows :

1- Simple correlation:

Simple correlation coefficients among seed yield kg./fed. (y1) and related characters are shown in Table 4.

The results indicated that there was highly significant positive correlation between seed yield (y1) and quantity of oil (x7) , no .of capsules / plant (x4) ,seed yield / plant (x8) and stand plant (x10) ,with r- values were 0.940 , 0.695 , 0.682 and 0.660, respectively . On the other hand , Table 4 cleared that there was highly significant positive correlation among most characters that were studied and each of other.

2-Multiple regression :

Results of multiple regression analysis recorded in Table 5 cleared that the relative contributions R^2 for all variables in the total variation of seed yield (Y1) was 92.8 % . On the other hand , the residual value was 7.2 % , which indicates that the most characters were included this study .

Table 4: Simple correlation coefficient between all characters that were studied and seed yield kg/fed (Y1) in sesame.

Simple correlation coefficient between xi and y1 and its significant of t tailed											
	Y1	X1	X2	X3	X4	X5	x6	x7	x8	x9	x10
Y1	1.000	0.334	0.328	0.570	0.695	0.361	0.383	0.940	0.682	0.493	0.660
Sign.		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
X1		1.000	0.642	0.094	0.203	0.458	0.702	0.443	0.292	0.005	0.101
Sign.			.000	0.131	0.007	.007	.000	.000	.000	0.478	0.114
X2			1.000	0.300	0.141	0.652	0.843	0.419	0.253	0.010	0.237
Sign.				.000	0.046	0.000	.000	.000	0.001	0.451	0.002
X3				1.000	0.369	0.519	0.378	0.522	0.558	0.205	0.567
Sign.					.000	.000	.000	.000	.000	0.007	0.000
X4					1.000	0.230	0.188	0.665	0.643	0.437	0.448
Sign.						.000	0.012	.000	.000	0.000	0.000
X5						1.000	0.787	0.415	0.399	-.009	0.347
Sign.							.000	.000	.000	0.458	.000
X6							1.000	0.517	0.273	-.014	0.224
Sign.								.000	.000	0.434	0.003
X7								1.000	0.608	0.466	0.578
Sign.									.000	.000	0.000
X8									1.000	0.220	0.513
Sign.										0.004	.000
X9										1.000	0.326
Sign.											0.000
X10											1.000

3-Stepwise regression analysis :

Data in Table 5 showed that 4 variables out of 10 were accepted as significantly contributing variables to variation in sesame seed yield. These accepted variables were quantity of oil / seed , stand plant , seed yield / plant and plant height with R² being 88.4% , 2 % ,1.2% and 1% according to stepwise analysis , respectively .

Table 5: Multiple regression and stepwise regression analysis for seed yield kg/fed (Y1) as affected by all characters that were studied and its components in sesame.

Prediction equation according to multiple regression	
Y=a+bx1+bx2+bx3+bx4+bx5+bx6+bx7+bx8+bx9+bx10	
Y=-608.695-0.061x1+0.340x2+5.510x3+0.324x4-0.078x5-0.627x6+1.893x7+3.249x8+7.229x9+5.135x10	
Relative contribution (R ²) for all variables according to full model regression.	92.8%
Prediction equation according to stepwise	
Y=a+bx7+bx10+bx8+bx6	
Y=-657.399+1.972x7+6.258x10+3.807x8-.524x6	
Relative contribution (R ²) for each of accepted variables according to stepwise regression	
X7 quantity of oil/seed (g)	88.4%
X10 stand of plant	2%
X8 seed yield / plant (g)	1.2%
X6 plant height	1%
The total relative contribution (R ²) for all accepted variables according to stepwise regression	92.5%
The relative contribution (R ²) for all removed variables according to stepwise regression	0.3%
The relative contribution (R ²) for residual variables according to stepwise regression	7.2%
Total effect (accepted, removed and residual)	100%

These results indicated that stepwise analysis develops a sequence of multiple regression equation by removing 6 from the full model equation with relative contribution of 0.3% .

1-Simple correlation :

Table 6 showed the relation between quantity of oil / seed (Y2) as affected by 9 characters in sesame. The r-values indicated that there was highly significant positive correlation between quantity of oil (y2) and No .of capsules (x4) ,seed yield / plant (x7) and stand plant (x9) with r - values being 0.665 , 0.608 and 0.578, respectively . Also Table 6 showed that there was highly significant positive correlation among most characters and each of other.

Table 6: Simple correlation coefficient between all characters that were studied and quantity of oil / seed gm. (Y2) in sesame.

Simple correlation coefficient between xi and y1 and its significant of t tailed										
	Y2	x1	x2	X3	x4	x5	x6	x7	X8	x9
Y2	1.000	0.443	0.419	0.522	0.665	0.415	0.517	0.608	0.466	0.578
Sign.		.000	.000	.000	.000	.000	.000	.000	0.000	.000
X1		1.000	0.642	0.094	0.203	0.458	0.702	0.292	0.005	0.101
Sign.		.	.000	0.131	0.007	0.000	.000	.000	0.478	0.114
X2			1.000	0.300	0.141	0.652	0.843	0.253	0.010	0.237
Sign.			.	.000	0.046	0.000	.000	0.001	0.451	0.002
X3				1.000	0.369	0.519	0.378	0.558	0.205	0.567
Sign.				.	.000	.000	.000	.000	0.007	0.000
X4					1.000	0.320	0.188	0.643	0.437	0.448
Sign.					.	.000	0.012	.000	0.000	0.000
X5						1.000	0.787	0.399	-.009	0.347
Sign.						.	.000	0.000	0.458	.000
X6							1.000	0.273	-.014	0.224
Sign.							.	.000	0.434	0.003
X7								1.000	0.220	0.513
Sign.								.	.004	0.000
X8									1.000	.326
Sign.									.	.000
X9										1.000

2- Multiple regression :

Estimate of R² for independent variables in quantity of oil (y2) were cleared in Table 7 . All variables contributed by 76.5% in the total variation . The residual value was 23.5% which indicated that the most characters were included in this study

Stepwise regression analysis :

Data in Table 7 showed that the stepwise analysis develops a sequence of full model equation by accepting six variables out of nine .These variables were no. of capsules / plant , plant height , stand of plant ,no. of leaves / plant , weight of 1000 seeds and seed yield / plant with relative contributions (R²) of 44.3% ,15.9 % , 6.4% ,4.4% ,2.6% and 1.7 % ,respectively . On the other hand , the R² for removed variables were 1.2% from the total variance of quantity of oil .

1- Simple correlation :

The simple correlation values (r) between yield kg /fed. (y1) and 11 characters are shown in Table 8 . This values indicated that there was highly significant positive correlation between yield kg./fed. (y1) and quantity of oil / seed (x7) ,weight of pod /plant (x10) , and weight of 100 seeds (x9) , with r-values of 0.803 , 0.760, and 0.633 respectively .On the other side , the correlation coefficient between yield kg./fed. (y1) and dry weight (x1) , stand plant (x11) , and number of leaves /plant (x3) was not significant . Also results cleared that there were highly significant negative correlation between yield kg./fed. (Y1) and x5 .

Table 7: Multiple regression and stepwise regression analysis for quantity of oil / seed gm (Y2) as affected by all characters that were studied and its components in sesame.

Prediction equation according to multiple regression	
$Y = a + bx_1 + bx_2 + bx_3 + bx_4 + bx_5 + bx_6 + bx_7 + bx_8 + bx_9$	
$Y = -499.890 + 0.728x_1 - 0.436x_2 + 5.508x_3 + 1.950x_4 - 2.139x_5 + 1.202x_6 + 1.597x_7 + 19.414x_8 + 4.641x_9$	
Relative contribution (R2) for all variables according to full model regression.	76.5%
Prediction equation according to stepwise	
$Y = a + bx_4 + bx_6 + bx_9 + bx_5 + bx_8 + bx_7$	
$Y = -547.809 + 1.950x_4 + 1.154x_6 + 5.100x_9 - 2.023x_5 + 20.018x_8 + 2.240x_7$	
Relative contribution (R2) for each of accepted variables according to stepwise regression	
X4 No. of capsules/plant	44.3%
X6 plant height	15.9%
X9 stand of plant	6.4%
X5 No. of leaves/plant	4.4%
X8 weight of 1000 seeds	2.6%
X7 seed yield/plant	1.7%
The total relative contribution (R2) for all accepted variables according to stepwise regression	
75.3%	
The relative contribution (R2) for all removed variables according to stepwise regression	
1.2%	
The relative contribution (R2) for residual variables according to stepwise regression	
23.5%	
Total effect (accepted, removed and residual)	
100%	

Table 8: Simple correlation coefficient between all characters that were studied and yield kg./fed. (Y1) in peanut.

Simple correlation coefficient between xi and y1 and its significant of t tailed												
	Y1	X1	X2	x3	x4	X5	x6	x7	x8	x9	x10	x11
Y1	1.000	0.015	-.241	0.069	0.256	-.549	0.313	0.803	0.283	0.633	0.760	0.029
Sign.		.465	.078	.345	.066	.000	.031	.000	.047	.000	.000	.433
X1		1.000	0.099	-.074	.044	.012	.168	-.006	.019	.004	.076	.261
Sign.			.283	.333	.399	.472	.164	.485	.456	.490	.331	.062
X2			1.000	.555	-.241	.462	.313	-.387	-.107	-.075	-.396	-.283
Sign.				.000	.079	.002	.032	.010	.266	.331	.008	.047
X3				1.000	-.038	.097	.195	-.059	-.045	.113	-.094	-.357
Sign.					.414	.287	.127	.367	.397	.257	.293	.016
X4					1.000	-.238	-.106	.136	.357	.086	.378	.114
Sign.						.081	.270	.215	.016	.310	.011	.254
X5						1.000	.032	-.637	-.412	-.435	-.691	-.303
Sign.							.427	.000	.006	.004	.000	.036
X6							1.000	.189	-.234	.112	.301	-.120
Sign.								.135	.085	.257	.037	.243
X7								1.000	.200	.507	.765	.122
Sign.									.121	.001	.000	.239
X8									1.000	.160	.329	.354
Sign.										.175	.025	.017
X9										1.000	.484	.080
Sign.											.001	.321
X10											1.000	.283
Sign.												.047
X11												1.000

2- Multiple regression analysis :

Table 9 clears that the R^2 between (Y1) and studied characters was 80.2 %. On the other hand , the residual was 19.8 % which mean that the most characters were included in this study .

3-Stepwise regression analysis :

Data in Table 9 indicated that the stepwise analysis developed a sequence of multiple regression equation by excluding 8 variables from the full model equation with R^2 of 5.4% . Table 9 clears that the accepted variables were quantity of oil / seed , weight of 100 seeds and weight of pods / plant with relative contributions of 64.6 % ,6.8 % and 3.4% in the total variation of yield kg./fed. (y1) , respectively .

Table 9: Multiple regression and stepwise regression analysis for yield kg./fed. (Y1) as affected by all characters that were studied and its components in peanut.

Prediction equation according to multiple regression	
$Y=a+bx_1+bx_2+bx_3+bx_4+bx_5+bx_6+bx_7+bx_8+bx_9+bx_{10}+bx_{11}$	
$Y=273.054+.445x_1-4.891x_2+0.410x_3+3.057x_4$	
$+11.692x_5+10.02x_6+0.873x_7 +57.114x_8+8.337x_9+ 6.362x_{10}-12.490x_{11}$	
Relative contribution (R2) for all variables according to full model regression.	80.2%
Prediction equation according to stepwise	
$Y=a+bx_7+bx_9+bx_{10}$	
$Y=-236.773+.813x_7+7.906x_9+10.039x_{10}$	
Relative contribution (R2) for each of accepted variables according to stepwise regression	
X7 quantity of oil/seed	64.6%
X9 weight of 100 seeds	6.8%
X10 weight of pod/plant	3.4%
The total relative contribution (R2) for all accepted variables according to stepwise regression	74.8%
The relative contribution (R2) for all removed variables according to stepwise regression	5.4%
The relative contribution (R2) for residual variables according to stepwise regression	19.8%
Total effect (accepted, removed and residual)	100%

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بعض النماذج الإحصائية لكشف العلاقة بين المحصول ومكوناته في تجارب التعميل.

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أقيمت تجربتان حقليتان في محطة بحوث الإسماعيلية في موسمي ٢٠٠٢، ٢٠٠٣ لتقدير المساهمة النسبية للمحصول ومكوناته نتيجة لتعميل السمسم (صنف جيزة ٣٢) على القبول السوداني (صنف جيزة ٥) وأستخدم لدراسة تلك العلاقة معامل الارتباط البسيط ومعامل الانحدار المتعدد ومعامل الانحدار المتعدد المرهلي وقد لخصت النتائج كما يلي:-

أظهرت نتيجة تحليل معامل الارتباط البسيط للسمسم وجود ارتباط موجب عالي المعنوية بين محصول بذور السمسم/فدان وكل من كمية الزيت، عدد الكبسولات/النبات، محصول البذور للنبات و النباتات القائمة وكانت قيم هذا الارتباط هي ٩٤، ٦٩٥، ٦٨٢، ٦٦٠، على الترتيب. كما وجد ارتباط معنوي موجب بين كمية الزيت للسمسم وكل من عدد الكبسولات/النبات، محصول البذور للنبات و النباتات القائمة وكانت قيم الارتباط ٠،٦٦٥، ٠،٦٠٨، ٠،٥٧٨، على الترتيب. كما أظهرت نتيجة تحليل الانحدار المتعدد أن المساهمة النسبية لكل الصفات كمتغيرات مستقلة مجتمعة هو ٩٢،٨% في تباين محصول بذور السمسم/كجم فدان وكانت المساهمة النسبية لكل الصفات مجتمعة هو ٧٦،٥% في تباين كمية الزيت. كما كانت نتيجة تحليل الانحدار المتعدد المرهلي اختيار ٤ عوامل من ١٠ عوامل بنسبة مساهمة ٩٢،٥% لمحصول بذور السمسم وهذه العوامل هي كمية الزيت /بذور، النباتات القائمة، محصول البذور/النبات و ارتفاع النبات بنسبة ٨٨،٤%، ٢%، ١،٢%، ١% في تباين محصول بذور السمسم كجم للفدان. أيضا في تحليل الانحدار المتعدد تم اختيار ٦ عوامل من ٩ عوامل بنسبة مساهمة ٧٥،٣% في تباين كمية الزيت وكانت هذه العوامل هي عدد الكبسولات/النبات، ارتفاع النبات، النباتات القائمة، عدد الأوراق/النبات، وزن ١٠٠ بذرة ومحصول البذور/النبات بنسبة

٤٤،٣%، ١٥،٩%، ٦،٤%، ٤،٤%، ٢،٦% و ١،٧% في تباين كمية الزيت للسمسم. أظهرت نتيجة تحليل معامل الارتباط البسيط للقول السوداني وجود ارتباط موجب عالي المعنوية بين المحصول كجم / فدان وكل من كمية الزيت/البذور، وزن القرون للنبات ووزن ١٠٠ بذرة حيث كانت قيم هذا الارتباط هي ٠،٨٠٣، ٠،٧٦٠، ٠،٦٣٣ على الترتيب. كما أظهرت نتيجة تحليل الانحدار المتعدد أن المساهمة النسبية لكل الصفات كمتغيرات مستقلة مجتمعة هو ٨٠،٢% في تباين المحصول كجم/فدان . كما كانت نتيجة تحليل الانحدار المتعدد المرهلي أن ٣ عوامل من ١١ عامل تساهم بنسبة ٧٤،٨% في التباين الكلي للمحصول كجم / فدان وهذه العوامل هي كمية الزيت / بذور، وزن ١٠٠ بذرة ووزن القرون /النبات بنسبة إسهام ٦٤،٦%، ٦،٨%، ٣،٤% على الترتيب.