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Correlation of some onion (Allium cepa L.) traits

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Abstract

The research was carried out in 1977 and 1978. Investigations on the correlation of 6 bulb traits showed that bulb weight was determine by bulb diameter in particular. The bulb diameter increased together with the increase in bulb hegiht, collar thickness and diameter of the root disc.

INTRODUCTION

The economic value of onion varieties depends both on high yield and good quality of other, numerous, practical characteristics. High yield is determined mainly by high bulb weight. The bulb shape is determined by the ratio of its height to diameter. The market value of onions depends both on the desired bulb shape and on collar thickness, dry skin thickness, bulb firmness and root disc diameter. Studies on the interdependencies of several onion traits were undertaken to obtain sufficient information on what type of interdependency exists between important practical traits and which of them are the most important in setting breeding in the right direction towards the improvement of onion quality.

The interdependencies of some traits were studied by Hanson (1963), Mc Collum (1966, 1968), Dowker and Fennell (1974), Schweisguth (1974), Thamburay et al. (1976), El-Shafie and Ahmed (1977) and Singh and Joshi (1978). However, the results obtained until now have not been sufficient for the appropriate design of a breeding program and for selecting the best lines for use as starting material for breeding F_1 hybrids and onion cultivars.

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The value of the linear regression coefficient y/x, for the

Line and hybrid	Weight in dag: bulb height in cm	bulb diameter in cm	collar thickness	dry skin thickness	root disc diameter	Height: bulb diameter	collar thickness
A-6	2.79**	3.48**	5.96**	2.47**	10.64**	0.21*	0.65**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-6 × C-177a)	3.53**	4.48**	11.23**	1.90**	12.24**	0.74**	2.54**
F_2 (A-6 + C-177a)	2.48**	3.68**	10.52**	5.36**	10.20**	0.38**	1.92**
A-16	4.01**	4.58**	5.54**	—2.15**	10.56**	0.62**	0.96**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-16 × C-177a)	5.53**	5.07**	14.25**	2.72**	18.67**	0.52**	1.88**
F_2 (A-16 × C-177a)	3.46**	3.88**	13.37**	7.52**	12.27**	0.56**	2.65**
A-54	3.88**	5.52**	7.52**	5.56**	11.02**	0.37**	1.27**
C-177a	2.87**	3.74**	6.90**	0.74**	4.54**	0.42**	1.40**
F_1 (A-54 × C-177a)	4.14**	4.99**	12.94**	1.82**	13.67**	0.47**	2.16**
F_2 (A-54 × C-177a)	1.79**	3.18**	11.49**	5.63**	10.96**	0.43**	2.30**
A-58	4.36**	5.26**	12.07**	15.08**	11.19**	0 56**	2.50**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-58 × 177a)	4.10**	4.80**	13.10**	11.42**	17.52**	0.62**	2.74**
A-125	3.94**	4.60**	10.23**	—0.15	12.34**	0.61**	1.80**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-125 × C-177a)	3.52**	5.35**	6.91**	7.34**	12.65**	0.50**	1.48**
F_2 (A-125 × C-177a)	3.86**	4.08**	13.77**	13.63**	16.70**	0.48**	2.19**
A-19	5.44**	4.03**	0.14	6 77**	13.30**	0.46**	1.63**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-19 × C-177a)	5.07**	5.49**	11.50**	3.24**	20.30**	0.74**	1.96**
A-181	8.10**	5.25**	15.02**	12.61**	18.84**	0.47**	1.64**
C-177a	2.87**	3.74**	6.90**	—0.74**	4.54**	0.42**	1.40**
F_1 (A-181 × 177a)	4.68**	5.00**	11.43**	6.19**	17.40**	0.47**	2.12**
A-63	3.30**	3.85**	5.69**	1.21**	9.46**	0.31**	0.87**
C-177b	3.70**	4.92**	9.87**	—1.96**	13.54**	0.83**	2.19**
F_1 (A-63 × C-177b)	4.73**	5.06**	12.73**	0.14	12.13**	0.59**	2.03**
F_2 (A-63 × C-177b)	3.54**	4.67**	14.77**	12.92**	20.03**	0.71**	2.97**
A-16	4.01**	4.58**	5.54**	—2.15**	10.56**	0.62**	0.96**
C-141	2.72**	4.91**	8.32**	4.59**	7.28**	1.22**	2.36**
F_1 (A-16 × C-141)	3.90**	5.52**	12.01**	13.60**	15.54**	0.73**	2.33**
F_2 (A-16 × C-141)	2.05**	4.52**	16.69**	10.05**	17.67**	0.29**	3.58**
A-58	4.36**	5.26**	12.07**	15.08**	11.19**	0.56**	2.50**
C-141	2.72**	4.91**	8.32**	4.59**	7.28**	1.22**	2.36**
F_1 (A-58 × C-141)	3.04**	5.71**	10.78**	11.26**	18.13**	0.63**	2.41**
A-125	3.94**	4.60**	10.23**	—0.15	12.34**	0.61**	1.80**
C-181	2.89**	5.57**	6.42**	6.81**	12.73**	0.35**	0.67**

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correlation between the studied onion traits

in cm	Diameter in cm		Collar thickness in cm		Firmness			Root disc diameter in cm
root disc diameter	collar thickness	root disc diameter	bulb diameter	root disc diameter	dry skin thickness	collar thickness	root disc diameter	collar thickness
1.10**	1.50**	2.66**	0.26**	1.11**	10.86**	—0.49**	—2.40**	0.44**
0.57**	1.64**	1.17**	0.24**	0.29**	—0.33**	0.01	0.54**	0.24*
2.14**	2.21**	2.61**	0.26**	0.77**	7.24**	3.43**	4.07**	0.50**
0.96**	2.47**	2.71**	0.20**	0.64**	—0.24*	3.01**	7.66**	0.51**
1.67**	0.98**	2.24**	0.14	0.34**	0.25**	—1.53**	2.05**	0.16
0.57**	1.64**	1.17**	0.24**	0.29**	—0.33**	0.01	0.54**	0.24*
2.66**	2.56**	3.31**	0,24*	1.08**	1.39**	1.80**	2.51**	0.46**
2.11**	3.15**	3.09**	0.20*	0.73**	11.69**	2.31**	1.05**	0.51**
0.88**	0.91**	1.51**	0.13	0.55**	1.81**	2.46**	11.40**	0.31**
0.57**	1.64**	1.17**	0.24**	0.29**	—0.33**	0.01	0.54**	0.24*
2.18**	2.02**	2.32**	0.21*	0.96**	6.81**	1.67**	1.33**	0.46**
2.32**	3.35**	3.31**	0.15	0,65**	2.71**	—5.33**	—3.52**	0.70**
1.60**	2.13**	2.30**	0.14	0.60**	6.35**	3.16**	6.87**	0.49**
0.57**	1.64**	1.17**	0.25*	0.29**	—0.33**	0.01	0.54**	0.2 .*
3.32**	2.37**	3.47**	0.17	0.74**	32.16**	12.51**	7.60**	0.31**
1.65**	1.92**	2.37**	0.28**	0.75**	6.64**	1.26**	1.95**	0.24**
0.57**	1.64**	1.17**	0.24*	0.29**	—0.33**	0.01	0.54**	0.24*
1.99**	0.90**	2.08**	0.18	0.52**	9.34**	3.39**	1.03**	0.16
2.11**	3.01**	3.80**	0.22*	0.93**	11.41**	3.15**	3.67**	0.62**
1.83**	3.14**	3.18**	0.14	0.49**	3.35**	—0.39**	0.69**	0.44*
0.57**	1.64**	1.17**	0.24*	0.29**	—0.33**	0.01	0.54**	0.24*
3.24**	1.80**	3.26**	0.29**	1.35**	2.80**	1.70**	4.25**	0.37**
1.76**	2.72**	3.57**	0.22*	0.89**	16.03**	2.85**	3.14**	0.38**
0.57**	1.64**	1.17**	0.24*	0.29**	—0.33**	0.01	0.54**	0.24*
2.01**	1.77**	3.28**	0.19	0.66**	7.52**	2.24**	1.70**	0.29**
1.46**	1.32**	2.39**	0.24**	1.09**	0.36**	—0.37**	1.53**	0.33**
3.37**	1.76**	2.40**	0.34**	1.10**	0.10	0.83**	0.28**	0.26*
1.44**	2.24**	2.33**	0.22**	0.33**	2.76**	—2.20**	—2.85**	0.18
3.40**	2.87**	4.21**	0.25*	1.17**	4.27**	—0.41**	—1.41**	0.60**
1.67**	0.98**	2.24**	0.14	0.34**	0.25*	—1.53** a	2.05**	0.16
1.87**	1.48**	1.38**	0.20*	0.50**	3.36**	0.15	—2.42**	0.53**
2.70**	1.90**	2.66**	0.26*	0.99**	12.51**	—2.20**	—2.78**	0.41**
2.68**	2.81**	3.52**	0.14	0.75**	8.54**	4.29**	0.93**	0.56**
1.60**	2.13**	2.30**	0.14	0.60**	6.35**	3.16**	6.87**	0.49**
1.87**	1.48**	1.38**	0.20*	0.50**	3.36**	0.15	—2.42**	0.53**
2.08**	1.52**	2.96**	0.22*	0.95**	16.14**	3.19**	2.13**	0.38**
1.65**	1.92**	2.37**	0.28**	0.75**	6.64**	1.26**	1.95**	0.24*
1.21**	1.12**	2.19**	0.31**	1.11**	9.23**	—3.02**	—3.73**	0.33**

Line and hybrid	Weight in dag					Height	
	bulb height in cm	bulb diameter in cm	collar thickness	dry skin thickness	root disc diameter	bulb diameter	collar thickness
F_1 (A-125 × C-181)	3.22**	5.39**	12.15**	3.70**	13.96**	0.48**	1.85**
F_2 (A-125 × C-181)	3.11**	3.90**	13.63**	6.20**	11.81**	0.75**	3.46**
A-16	4.01**	4.58**	5.54**	—2.15**	10.56**	0.62**	0.96**
C-16	5.16**	5.34**	11.79**	3.37**	16.92**	0.42**	1.80**
F_1 (A-16 × C-16)	4.50**	5.54**	12.78**	17.54**	21.74**	0.38**	1.96**
F_2 (A-16 × C-16)	4.57**	5.27**	21.88**	7.55**	22.01**	0.52**	3.11**
A-6	2.79**	3.48**	5.96**	2.47**	10.64**	0.21**	0.65**
C-6	2.17**	3.31**	7.04**	3.29**	4.47**	0.44**	2.27**
F_1 (A-6 × C-6)	3.08**	4.72**	8.60**	6.76**	14.04**	0.65**	2.04**
F_2 (A-6 × C-6)	3.12**	4.34**	12.65**	—0.81**	14.04**	0.50**	2.63**
A-125	3.94**	4.60**	10.23**	—0.15	12.34**	0.61**	1.80**
C-199	4.32**	4.84**	8.90**	—0.13	9.09**	0.49**	1.24**
F_1 (A-125 × C-199)	4.46**	4.93**	12.44**	3.11**	17.39**	0.55**	1.87**
F_2 (A-125 × C-199)	3.68**	4.68**	13.71**	3.36**	15.14**	0.73**	2.76**
A-19	5.44**	4.03**	0.14	6.77**	13.30**	0.46**	1.63**
C-19	1.88**	4.11**	4.81**	1.66**	3.46**	0.21*	1.50**
F_1 (A-19 × C-19)	5.46**	5.85**	15.58**	18.09**	25.20**	0.37**	1.55**
F_2 (A-19 × C-19)	3.89**	4.84**	17.38**	4.61**	24.93**	0.41**	2.51**

MATERIALS AND METHODS

The experiments were done in 1977-1978 at the Research Institute of Vegetable Crops in Skierniewice. The materials used were described in the first part of this series of papers (Doruchowski, 1986).

The dependency of the traits listed below on the bulb weight was evaluated by the multiple regression method. The following characteristics were studied: weight (y), height (x_1), diameter (x_2), shape index — h/d (x_3), collar thickness (x_4) dry skin thickness (x_5), bulb firmness (x_6) and root disc diameter (x_7).

The regression equation (Table 1 according to Steel and Torrie, 1960) was determined for each of the studied parental lines and F_1 and F_2 hybrids on the basis of the observed phenotypic variability. The degree of agreement of the empirically determined points with the regression curve was evaluated with the aid of the determination coefficient $D\% = R^2 100$, where R is the multiple correlation coefficient.

Due to the different units employed in measuring onion traits, the

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in cm	Height in cm		Diameter in cm	Collar thickness in cm			Firmness	Root disc diameter in cm
root disc diameter	collar thickness	root disc diameter	bulb diometer	root disc diameter	dry skin thickness	collar thickness	root disc diameter	collar thickness
2.18**	1.77**	2.09**	0.23*	0.76**	5.70**	2.80**	0.50**	0.43**
2.39**	2.90**	2.85**	0.16	0.69**	13.48**	4.51**	4.34**	0.57**
1.67**	0.98**	2.24**	0.14	0.34**	0.25*	—1.53**	2.05**	0.16
1.81**	1.94**	3.17**	0.19	0.95**	—0.34**	—0.53**	—1.29**	0.32**
2.10**	1.93**	3.76**	0.18	0.83**	13.20**	1.01**	4.16**	0.26**
2.56**	3.85**	3.93**	0.12	0.55**	8.96**	4.25**	2.33**	0.46**
1.10**	1.50**	2.66**	0.26**	1.11**	10.86**	—0.49**	—2.40**	0.44**
0.88**	1.47**	1.21**	0.17	0.38**	—1.45**	—0.19	3.53**	0.20*
2.50**	1.51**	2.72**	0.28**	1.12**	1.91**	0.82**	2.39**	0.35**
2.16**	2.40**	3.12**	0.16	0.54**	9.71**	0.75**	—0.76**	0.30**
1.65**	1.92**	2.37**	0.28**	0.75**	6.64**	1.26**	1.95**	0.24**
1.45**	1.71**	1.82**	0.30**	0.78**	1.44**	0.96**	2.17**	0.32**
2.37**	2.21**	3.06**	0.26*	0.98**	3.07**	4.11**	5.93**	0.29**
2.89**	2.62**	2.99**	0.23*	0.84**	0.93**	—0.75**	1.22**	0.70**
1.83**	3.14**	3.18**	0.14	0.49**	3.35**	—0.39**	0.69**	0.44**
0.54**	0.68**	0.72**	0.20*	0.49**	—0.50**	—2.94**	—0.18	0.15
1.90**	2.40**	4.15**	0.25*	1.23**	6.49**	—1.49**	—3.97**	0.40**
2.16**	3.23**	5.16**	0.16	1.07**	8.64**	0.61**	1.36**	0.38**

standard multiple regression equation was used for the final evaluation of the dependence of the traits on weight. The regression coefficients in that equation are expressed in standard deviation units. The values of the coefficients calculated in that way express the dependence of the variables ($x_1 \dots x_7$) on weight. The significance of those coefficients was evaluated by Student's *t* test, assuming a significance level of $\alpha = 0.05$ * and $\alpha = 0.01$ ** (Table 1). In Table 2, the parental components, F_1 hybrids and F_2 generation are compiled in the range in which the values of the correlation coefficients exceeded 0.75.

RESULTS

The results obtained in this study (Table 1 and 2), showed that there is a significant dependence of bulb weight on the height, diameter, collar thickness and root disc diameter in the parents as well as in F_1 hybrids and F_2 generations. As the bulb weight grew, so did its diameter, which is shown by the high value of the linear regression coefficient in most of the parental lines, F_1 hybrids and F_2 generations (Table 1).

Table 2

The number of parental lines, F_1 and F_2 hybrids for which the linear correlation coefficient (r) for the interdependency between traits assumed a value within the limits given below

Relationship between traits	1977							1978					
	r			parental lines and F_1, F_2 hybrids for which $r > 0.75$				r			parental lines and F_1 hybrids for which $r > 0.75$		
	<0.5	0.5—0.75	>0.75	maternal line A	paternal line C	F_1	F_2	<0.5	0.5—0.75	>0.75	maternal line A	paternal line C	F_1
Bulb weight × bulb height	1	28	17	A-19 A-181 A-125 A-16	C-141 C-177a	F_1 (A-19 × C-177a) F_1 (A-181 × C-177a) F_1 (A-58 × C-177a) F_1 (A-6 × C-177a) F_1 (A-16 × C-177a) F_1 (A-16 × C-141) F_1 (A-63 × C-177b)	F_2 (A-16 × C-177a) F_2 (A-125 × C-199) F_2 (A-125 × C-181) F_2 (A-63 × C-177b)	—	9	15	A-54 A-101 A-125	C-9 C-16 C-141 C-177a C-181	F_1 (A-16 × C-16) F_1 (A-16 × C-177a) F_1 (A-125 × C-177a) F_1 (A-125 × C-181) F_1 (A-181 × C-177a) F_1 (A-16 × C-9) F_1 (A-181 × C-9)
Bulb weight × bulb diameter	—	—	44	A-19 A-181 A-54 A-58 A-6 A-125 A-16 A-63	C-177a C-141 C-199 C-181 C-177b C-6 C-16 C-19	F_1 (A-19 × C-177a) F_1 (A-181 × C-177a) F_1 (A-54 × C-177a) F_1 (A-58 × C-177a) F_1 (A-58 × C-141) F_1 (A-6, × C-177a) F_1 (A-125 × C-177a) F_1 (A-54 × C-177a) F_1 (A-16 × C-177a) F_1 (A-16 × C-141) F_1 (A-125 × C-199) F_1 (A-125 × C-181) F_1 (A-63 × C-177b) F_1 (A-6 × C-6)	F_2 (A-6 × C-177a) F_2 (A-125 × C-177a) F_2 (A-54 × C-177a) F_2 (A-16 × C-177a) F_2 (A-16 × C-141) F_2 (A-125 × C-199) F_2 (A-125 × C-181) F_2 (A-63 × C-177b) F_2 (A-16 × C-141) F_2 (A-6 × C-6) F_2 (A-16 × C-16) F_2 (A-19 × C-19)	—	—	24	A-12 A-16 A-54 A-58 A-101 A-125 A-181	C-9 C-16 C-141 C-177a C-181	F_1 (A-16 × C-16) F_1 (A-16 × C-177a) F_1 (A-54 × C-177a) F_1 (A-58 × C-141) F_1 (A-125 × C-177a) F_1 (A-125 × C-181) F_1 (A-181 × C-177a) F_1 (A-12 × C-141) F_1 (A-16 × C-9) F_1 (A-101 × C-9) F_1 (A-181 × C-9) F_1 (A-181 × C-181)

						F_1 (A-16 × C-16)						
						F_1 (A-19 × C-19)		1	13	10	A-12	C-181	F_1 (A-54 × C-177a)
Bulb weight	3	23	19	A-181	C-177a	F_1 (A-19 × C-177a)	F_2 (A-6 × C-177a)				A-16		F_1 (A-58 × C-141)
× collar				A-125		F_1 (A-6 × C-177a)	F_2 (A-125 × C-177a)				A-54		F_1 (A-125 × C-181)
thickness						F_1 (A-54 × C-177a)	F_2 (A-16 × C-177a)				A-125		F_1 (A-101 × C-9)
						F_1 (A-16 × C-177a)	F_2 (A-125 × C-199)						F_1 (A-181 × C-9)
						F_1 (A-16 × C-141)	F_2 (A-125 × C-181)						
						F_1 (A-125 × C-199)	F_2 (A-63 × C-177b)						
						F_1 (A-63 × C-177b)	F_2 (A-16 × C-141)						
						F_1 (A-19 × C-19)	F_2 (A-19 × C-19)						
Bulb weight	6	36	4	—	—	—	F_2 (A-125 × C-177a)	2	17	5	A-101	C-181	F_1 (A-125 × C-181)
× root disc							F_2 (A-125 × C-199)						F_1 (A-101 × C-9)
diameter							F_2 (A-63 × C-177b)						F_1 (A-181 × C-9)
							F_2 (A-16 × C-141)						
Bulb height	20	24	2	A-181	—	F_1 (A-19 × C-177a)	—	3	14	7	—	C-141	F_1 (A-16 × C-16)
× bulb												C-181	F_1 (A-16 × C-177a)
diameter													F_1 (A-125 × C-177a)
													F_1 (A-16 × C-9)
													F_1 (A-181 × C-9)
Bulb height	5	32	9	A-181	C-177a	F_1 (A-19 × C-177a)	F_2 (A-16 × C-177a)	1	15	8	A-125	C-9	F_1 (A-125 × C-181)
× collat						F_1 (A-181 × C-177a)	F_2 (A-63 × C-177b)				A-181	C-16	F_1 (A-16 × C-9)
thickness						F_1 (A-54 × C-177a)						C-181	F_1 (A-181 × C-9)
						F_1 (A-58 × C-177a)							
						F_1 (A-6 × C-177a)							
Bulb diame-	10	34	2	A-181	—	F_1 (A-16 × C-141)	—	2	22	—	—	—	—
ter × shape													
coefficient													
Bulb diame-	6	29	11	A-181	C-177a	F_1 (A-6 × C-17 a)	F_2 (A-125 × C-177a)	2	14	8	A-12	C-181	F_1 (A-54 × C-177a)
ter × collar						F_1 (A-16 × C-177a)	F_2 (A-16 × C-177a)				A-125		F_1 (A-58 × C-141)
thickness						F_1 (A-125 × C-199)	F_2 (A-125 × C-199)						F_1 (A-125 × C-181)
						F_1 (A-16 × C-141)	F_2 (A-63 × C-177b)						F_1 (A-101 × C-9)
						F_1 (A-19 × C-19)							F_1 (A-181 × C-9)

Table 2 cont.

Relationship between traits	1977							1978					
	r			parental lines and F_1, F_2 hybrids for which $r > 0.75$				r			parental lines and F_1 hybrids for which $r > 0.75$		
	<0.5	0.5—0.75	>0.75	maternal line A	paternal line C	F_1	F_2	<0.5	0.5—0.75	>0.75	maternal line A	paternal line C	F_1
Bulb diameter × root disc diameter	6	36	4	—	—	F_1 (A-19 × C-19)	F_2 (A-125 × C-177a) F_2 (A-125 × C-199) F_2 (A-63 × C-177b)	1	19	4	—	C-181	F_1 (A-125 × C-181) F_1 (A-101 × C-9) F_1 (A-181 × C-9)
Collar thicknes × root disc diameter	15	27	4	—	—	—	F_2 (A-125 × C-177a) F_2 (A-125 × C-199) F_2 (A-63 × C-177b) F_2 (A-16 × C-141)	8	14	2	—	—	F_1 (A-125 × C-181) F_1 (A-181 × C-9)

The unit increase of bulb weight in respect to diameter equalled 3.18 in F_2 (A-54×C-177a) to 5.85 in F_1 (A-19×C-19) (Table 1). This means that the increase in bulb weight from 3.18 dag to 5.85 dag caused a 1 cm increase in bulb diameter (Table 1). Bulb height increased parallel with weight increase. Increased bulb weight was connected with collar thickening and increased root disc diameter. This relationship was seen especially clearly in line A, F_1 hybrids and F_2 generations. The smaller the weight increase, the thicker the dry skin of paternal lines C and some of the maternal lines A. Whereas, a significant increase in the bulb weight of F_1 hybrids and F_2 generations was connected with the slight increase of dry skin thickness. This is an especially important finding, because F_1 hybrids can give a high yield and produce a bulb with thick, strong dry skin. With the increase in bulb diameter, slight thickening of the collar and increase of root disc diameter took place. These results show, then that the large bulbs of F_1 hybrids can have a thicker dry skin, slightly thicker collar and larger root disc diameter than the small bulbs of their parental forms.

Bulb firmness in paternal forms (lines C) was connected with the increases in dry skin thickness, collar thickness and root disc diameter. The dry skin hickness in maternal lines A and F_1 hybrids rose as the bulb firmness increased. It is possible to obtain F_1 hybrids having hard bulbs with thick, strong dry skin e.g. F_1 (A-58×C-177a). Thick collars were slightly correlated with large root disc.

Table 2 presents the number of parental lines, F_1 hybrids and F_2 generations whose linear correlation coefficients (r) for the interdependence among traits had values in the ranges: to 0.5, from 0.05 to 0.75 and over 0.75. The correlation coefficients exceeding 0.75 applied to cases where over 50% of the variability — y (bulb weight) was determined by the variability of a given trait.

As can be seen from the data in Table 2, there is a strong connection between many traits in the same parental lines (A-181, C-177a and C-181) and F_1 hybrids, e.g. (A-19×C-19). The results of these studies made it possible to single out parental lines having the desired traits, from the point of view of interdependence of traits, for further selection and crossing.

DISCUSSION

McCollum (1966, 1968) and Dowker and Fennell (1974) demonstrated a similar linear dependence of bulb weight on shape and diameter in their native onion cultivars. In addition, McCollum (1968) and Schweisguth (1974) found a negative, genetic correlation between dry matter content and bulb size (weight). The results of these studies are important from the point of view of breeding work on developing cultivars and F_1 hybrids with a high dry matter content.

The results of this author are in agreement with those of Hanson (1963), Thamburay et al. (1976). These authors suggest that in order to obtain the desired bulb shape by breeding, both bulb shape and weight should be taken into account in selection and breeding.

Singh and Joshi (1978) found, similarly as this author, that bulb weight was positively correlated with bulb diameter and negatively with dry matter content.

Tall, and therefore elongated, bulbs rotted more easily but, at the same time, fewer sprouted during storage. Due to this, no correlation was found between bulb height and overall losses during storage. The higher dry matter content led to limited rotting, however, it did not have much effect on sprouting. Therefore, in order to develop on onion variety with minimized losses due to rotting and sprouting, and with a favorable dry matter content, average bulb diameter and weight should be retained.

The results of this author showed the negative correlation between the elongated shape of bulbs and their weight. In connection with this, as the height of bulbs in parental lines and F_1 hybrids having elongated bulbs grew, the bulb weight decreased. Whereas, in onions with spherical or transverse elliptic bulbs, the weight increased.

Upon analysing these results, it seems that the environment has a large influence on the change in bulb shape. The existence of a relationship between bulb weight and shape may have an effect on the increase of variability evoked by environmental conditions. This is expressed mainly in changes in bulb weight and diameter. These interdependencies allow selection in the direction of large bulbs without a change in their shape to transverse narrow elliptic, as well as in the direction of high bulbs without decreasing their diameter.

Until now, there was a lack of experimental results on the relationship between bulb weight and dry skin thickness. The results of this author's studies indicate that the increase in dry skin thickness in paternal lines weakened by inbreeding in respect to weight, was probably caused by the slow increase in bulb weight. Whereas, in F_1 hybrids exhibiting high heterosis, bulb weight increase brought about the concurrent quick increase in dry skin thickness. This is a very favorable phenomenon since it becomes possible to obtain F_1 hybrids characterized by a high yield, thick, well adhering dry skin and very high bulb firmness. The latter trait was better in F_1 hybrids and was becoming less satisfactory in the paternal, inbred lines which exhibited lowered viability of plants due to inbreeding. In addition, it was found that the bulbs with the thicker necks and large root disc, and so, with a tendency to form thick necks, were soft. Therefore, there is a strict dependency of bulb firmness on collar thickness and dry skin thickness in F_1 hybrids.

Bulb firmness presently has become more important due to the introduction of a new storage technology in which bulbs are stored loosely in 4 m thick layers. In this way, bulbs not sufficiently hard which find themselves in the lower layers, are crushed and deformed. The discovery of such relationships between the studied traits will be very helpful in orientating further breeding work on onions, making achieving the set goals easier and quicker. It will be possible to cross parental forms in such a way as to allow them to introduce into the hybrid generation as many favorable traits as possible, such as: high weight, equal bulb shape, firmness, dry skin quality (thick, dark brown and well adhering), thin collar and high dry matter and sugar contents.

CONCLUSIONS

1. From among the studied onion traits (weight, height, diameter, collar shape, bulb firmness and root disc position), irregardless of the hybrid formula, bulb weight was determined mainly by bulb diameter.

— Bulb weight increased with the increase in height, diameter collar, thickness and root disc position.

— In parental forms, weakened by inbreeding, as the dry skin thickness increased, the bulb weight decreased in contrast with F_1 hybrids and F_2 generations in which both traits increased.

— Bulb height was only slightly correlated with the increases in bulb diameter, collar shape and root disc position.

— Bulb diameter was insignificantly correlated with increases in collar thickness and root disc size.

— A thick collar and large root disc were typical for bulbs with a lowered firmness.

— A large root disc was determined by collar thickness only to a very small degree.

2. The correlation found between the weight and shape of bulbs indicates the increase in the variability of these traits under the influence of environmental conditions and points to the possibility of increasing the efficacy of selection in the direction of obtaining large onions, with elongated bulbs without lowering their diameter.

The appropriate selection of the parental components creales the possibility of improving in F_1, first of all, weight, shape, dry skin thickness and adherence, next, bulb firmness, dry skin color, collar thickness, root disc position and dry matter and sugar contents.

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Współzależność niektórych cech użytkowych cebuli (*Allium cepa* L.)

Streszczenie

Badania przeprowadzono w Zakładzie Hodowli i Genetyki Instytutu Warzywnictwa w Skierniewicach w latach 1977-1978. Wyniki badań współzależności kilku cech cebuli (masa, wysokość, średnica, kształt szyjki, twardość i położenie piętki) wykazały, że masa cebul niezależnie od formuły mieszańca determinowana była głównie przez średnicę. Wraz ze wzrostem masy zwiększała się wysokość i średnica cebul oraz nieznacznie szyjka cebuli i średnica piętki. Wzrost masy cebul wiązał się ze wzrostem grubości suchej łuski u mieszańców F_1 i pokoleń F_2 w przeciwieństwie do linii wsobnych o osłabionej żywotności, u których stwierdzono grubienie łuski wraz z ograniczeniem masy cebul.