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Correlation and Path Coefficient Analysis of Yield Attributes in Grain Sorghum (*Sorghum bicolor L.*) Genotypes

Abd El-Raheem, O. A. Y. ; Aml A. Tag El-Din* and Y. M .Y .El kady

Department of Grain Sorghum Research, Field Crops Research Institute, Agriculture Research Center, Giza, Egypt

ABSTRACT

Path coefficient was computed to estimate the contribution of individual traits to yield in grain sorghum .An investigation was carried out with 24 restorer lines of sorghum and one check variety Dorado to asses association of grain yield components and their direct and indirect effects on grain yield/plant during 2019 and 2020 growing seasons *at* Shandweel Agric. Res. Station, Egypt under four levels of nitrogen fertilization *(60, 80 .100 .120 kg N / fed).* Results of combined analysis of variance showed that significant or highly significant variations were recorded for environments, genotypes, and their location for various studied morphological and yield traits. The results of correlation analysis indicated that 1000-grain weight, panicle length, panicle width and plant height positive and significant correlation with grain yield. Plant height had maximum positive direct effect on grain yield/plant followed by 1000-grain weight. The best genotype was Rsh-19 for grain yield / plant , Rsh-22 for 1000-grain weight , Adv-44 for panicle width , Rsh-20 for panicle length , Sel pop- 13 for earliness and Rsh-12 for plant height . The highest mean values for all traits except days to 50% flowering were obtained under high nitrogen level (120 Kg N/fed) in both two seasons while the reverse was obtained under low nitrogen level (60 Kg N/ fed) in both two growing seasons.

Keywords: Sorghum – Grain yield – Correlation – Path anylsis

INTRODUCTION

Grain sorghum (*Sorghum bicolor* L. Moench) is fifth in worldwide economic importance among the cereal crops. It is an important food, feed, forage and provides raw material for producing of starch, fiber, dextrose syrup, befoul and other products. It is cultivated in many parts of Asia and Africa, where its grains are used to make flat breads that form the staple food of many cultures. The species may be used as a source of ethanol fuel and may be better than maize or sugarcane in certain environments, as it can grow under harsher conditions. Grain yield is complex trait, depend on many attributes' traits. Yield ability followed by a suitable combination of characteristics has always been the key aim of the sorghum breeding program. Correlation measures the level of dependence traits and out of numerous correlation coefficient it is often difficult to determine the actual mutual effects among traits, *Ikanovic et al.* (2011). Due to the reciprocal cancellation of component traits, estimates of correlations alone can sometimes be misleading. Therefore, it becomes important to research path coefficient analysis, because of reciprocal cancellation of component traits, estimates of correlations alone may sometimes be misleading. So, it which takes in to account the casual relationship in addition to degree of relationship Mahajan *et al.* (2011). The path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various related variable characteristics and thus helps to determine both the cause-effect relationship and efficient selection. Path analysis is important for a deeper understanding of the associations between features and is a way of understanding the specificity of the genetic material. Knowledge of the association between yield and its component traits and among the component traits themselves can improve the efficiency of selection in plant breeding, Wankhede *et al.* (1985), Ambekar *et al.* (2000), Mallinath *et al.(* 2004), Lzge *et al.* (2006) and Mahajan *et al. (*2011) stated that panicle length, panicle width, plant height, number of primary branches/panicle, number of grains/panicle, test weight, harvest index and grain yield/panicle had showed positive significant association with grain yield. The objectives of this study were to determine the traits having greater interrelationship with grain yield utilizing the correlation and path analysis and determine the best genotypes.

MATERIALS AND METHODS

The experiment was conducted at Shandweel Agric. Res. Station, during the two summer seasons 2019 and 2020. Twenty-four genotypes derived from grain sorghum breeding program at Shandweel Agric. Res. Station and one check variety Dorado (Table 1) were evaluated under four levels of nitrogen fertilization in the form of Urea 46 % N (60,80,100 and 120 kg N/fed). A randomized complete block design with three replications was used. The experimental unit was one row, 4 meter long and 60 cm apart and 20 cm between hills. After full emergence, seedlings were thinned to secured two plants / hill. The other recommended cultural practices of sorghum production in the two years were implemented. Data were recorded on days to 50% flowering, plant height (cm), 1000 grain weight (g), grain yield per plant (g), panicle length (cm.) and panicle

* **Corresponding author.**
E-mail address: amltag@yahoo.com
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width (cm). The estimates of phenotypic and genotypic correlation coefficient were worked out by using the formulae suggested by Steel and Torrie (1980). Genotypic correlations were partitioned into path coefficient using the technique outlined by Dewey and Lu (1959). This technique involves partitioning of correlation coefficient to determine direct (unidirectional path–ways ('P') and indirect influence through alternate pathways (Pathway 'P'x correlation coefficient 'r) of various variables over grain yield/plant. Grain yield in sorghum was considered as the resultant variable and the others as causal variables. Standard error for genotypic correlation was calculated by using the formula given by Reeve (1955) and Robertson (1959). Statistically analysis and significance of phenotypic correlation coefficients was determined by using "t" test as described by Steel and Torrie (1980).

Table 1. Names, origin of the twenty-five grain sorghum genotypes used in the study.

No.	Name	Origin	No.	Name	Origin
1	Rsh - 11	Egypt	14	Sel pop. 7	Egypt
2	Rsh-12	Egypt	15	Sel pop. 13	Egypt
3	Rsh-14	Egypt	16	Adv-39	Egypt
4	Rsh-15	Egypt	17	Adv- 40	Egypt
5	Rsh-16	Egypt	18	Adv - 44	Egypt
6	Rsh-18	Egypt	19	Rsh- 53	Egypt
7	Rsh-19	Egypt	20	Rsh- 60	Egypt
8	Rsh- 20	Egypt	21	Adv-47	Egypt
9	Rsh- 22	Egypt	22	Rsh- 69	Egypt
10	Rsh- 23	Egypt	23	Rsh-70	Egypt
11	Rsh- 26	Egypt	24	Adv- 48	Egypt
12	Rsh- 28	Egypt	25	Dorado	USA
13	Rsh-.30	Egypt			

Rsh = restorer of shandweel
Sel pop = selection population

RESULTS AND DISCUSSION

For six traits across all environments are shown in (Table 2) combined analysis of variance for 25 genotypes of grain sorghum. The differences among genotypes were highly significant or significant for all the studied traits. The data regarding means of grain yield and other traits of twenty five genotypes of grain sorghum across eight environments are presented in (Table 3). The combined average across the two years under 120 Kg N/ fed indicated that the means of grain yield / plant for the genotypes over two years ranged from 56.83 (Rsh-18) to 92.33 g (Rsh-12) to, while under 100 Kg N / fed ranged from 55.67 (Rsh-18) to 92.03g (Rsh-23), under 80 Kg N/ fed ranged from 53.00 (Rsh-18) to 86.92g (Rsh-53).

Table 2. Combined analysis of variance for six different traits across eight environments (two years and four nitrogen levels).

S.O.V	df	Grain yield /plant (g)	1000 grain weight (g)	Panicle width (cm)	Panicle length (cm)	50 % flowering	Plant height(cm)
Environments (E)	7	918.9**	145.7**	50.23**	354.4**	153.4**	2445.5**
Rep / E	16	3.029	2.555	0.290	0.744	2.658	13.49
Genotypes (G)	24	2540.1**	169.2**	83.57**	141.6**	236.2**	131105**
G x E	168	7.652**	1.862*	0.252**	2.978**	1.673**	24.68**
Error	384	5.241	1.446	0.153	1.934	0.740	10.18

where*and mean significant at 5 and 1% level of probabilities, respectively.**

Table 3. Means of twenty-five grain sorghum genotypes of grain yield, 1000-grain weight and panicle width under four nitrogen levels over two years.

No.	Genotypes	Com. of grain yield/plant (g)				Com. of 1000-grain weight (g)				Com. of panicle width(cm)			
		120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed	120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed	120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed
1	Rsh- 11	79.67	80.33	75.00	72.25	24.00	24.33	22.33	20.17	10.83	10.67	10.00	9.08
2	Rsh-12	92.33	88.67	85.22	81.00	29.50	30.33	27.53	27.33	11.33	10.83	10.08	9.08
3	Rsh - 14	86.67	85.00	82.00	78.00	29.00	29.67	26.50	25.83	10.92	10.67	10.25	8.50
4	Rsh- 15	91.50	90.33	83.00	76.80	31.25	32.50	28.33	27.55	10.33	10.17	9.50	9.00
5	Rsh- 16	76.83	73.66	72.83	68.83	29.42	29.83	28.00	27.17	9.33	9.25	8.67	8.00
6	Rsh- 18	56.83	55.67	53.00	50.33	26.17	25.17	24.17	23.33	7.90	6.95	6.05	5.25
7	Rsh- 19	69.00	70.50	66.83	63.67	28.00	27.00	25.83	24.83	7.50	6.55	6.38	6.08
8	Rsh-20	77.33	76.83	71.50	67.50	31.00	30.50	29.50	27.27	6.17	5.63	5.48	4.92
9	Rsh-22	73.17	72.00	65.08	61.48	32.67	34.00	31.00	29.67	7.00	6.42	5.75	5.62
10	Rsh-23	91.00	92.03	85.93	78.42	26.53	25.50	24.50	22.77	10.25	10.28	9.42	8.43
11	Rsh-26	68.50	67.67	66.16	63.33	26.83	25.83	24.67	22.48	8.05	8.00	7.12	6.90
12	Rsh- 28	74.83	72.41	69.67	66.68	29.17	30.67	26.36	25.03	6.83	6.67	6.08	5.37
13	Rsh-30	73.50	73.00	68.53	66.78	25.25	24.67	23.17	21.88	6.33	6.00	5.42	4.30
14	Sel pop. 7	77.50	76.67	73.17	70.17	29.50	29.17	28.00	27.17	8.08	7.67	7.17	6.42
15	Sel pop. 13	63.00	61.17	60.00	57.83	27.90	27.67	26.67	24.95	8.42	7.58	6.08	5.57
16	Adv-39	68.00	67.17	66.00	63.50	30.67	31.50	28.40	26.92	7.75	7.17	6.58	5.17
17	Adv- 40	71.67	70.33	69.17	66.13	32.33	32.50	30.83	28.73	7.25	6.50	5.83	5.28
18	Adv- 44	90.50	88.83	84.17	77.17	30.83	31.50	29.83	29.17	11.75	11.58	10.83	9.83
19	Rsh- 53	91.17	88.93	86.92	81.38	32.00	32.42	29.50	28.50	10.50	10.25	9.52	8.83
20	Rsh- 60	68.00	64.50	62.40	59.16	27.38	28.07	26.73	25.43	9.63	9.72	8.98	8.58
21	Adv- 47	59.83	59.33	57.83	56.33	27.48	28.27	26.92	25.92	5.92	5.67	5.50	4.83
22	Rsh- 69	68.50	66.16	64.53	61.87	29.05	26.81	24.88	25.26	6.25	6.57	5.33	5.08
23	Rsh- 70	61.17	61.00	54.98	52.60	28.17	27.33	26.83	25.50	7.05	6.88	6.60	6.00
24	Adv- 48	60.33	57.48	54.72	52.83	28.58	28.17	26.50	25.28	6.45	6.58	5.92	5.58
25	Dorado	68.67	67.67	61.28	55.76	30.55	32.75	28.73	26.40	6.92	6.60	6.58	5.87
	L.S.D 0.05	2.79	2.74	2.27	2.50	1.64	1.45	1.51	1.54	0.91	0.89	0.80	0.69

Finally, under level 60 Kg N/ fed the mean ranged from 50.33 (Rsh-18) to 81.38g (Rsh-53) to While the combined average across the two years in 1000 – grain weight under 120 Kg N/fed ranged from 24.00 (Rsh-11) to 32.33g (Adv-40), under 100 Kg N/fed ranged from 24.33 (Rsh-11) to 34.00g (Rsh-22), In level 80 Kg N/ fed the

average ranged from 22.33 (Rsh-11) to 31.00g (Rsh-22) and under 60 Kg N/fed ranged from 20.17 (Rsh-11) to 29.67g (Rsh-22). For panicle width the combined average across the two years under 120 Kg N / fed ranged from 5.92 (Adv-47) to 11.75 cm (Adv-44), while under 100 Kg N/fed ranged from 5.63 (Rsh-20) to 11.58cm (Adv-44). In the level 80 Kg N / fed the average ranged from 5.33 (Rsh-69) to 10.25cm (Rsh-14) and in 60 Kg N/ fed ranged from 4.30 (Rsh-30) to 9.83cm (Adv-44). Regarding panicle length (Table 4) the combined average across the two years ranged from 24.91 (Rsh-22) to 35.55 cm (Adv-44) under 120 Kg N/ fed. While under100 Kg N / fed ranged from 24.08 (Rsh-22) to 33.53cm (Rsh-20). Under level 80 Kg N/ fed ranged from 22.33 (Adv-48) to 31.57 cm (Rsh-20) and in 60 Kg N/ fed ranged from 19.90 (Sel pop-7) to 29.78cm (Rsh-20). For days to 50% flowering the combined average across the two years ranged from 63.83 (Rsh-16) to 75.17days (Adv-47) under 120 Kg N/ fed. While under 100 Kg N/fed ranged from 65.00 (Rsh-16 and Sel pop-13) to 76.17days (Adv-47), in 80 Kg N/fed ranged from 66.00 (Adv-40) to 77.17days (Adv-47). Similarly, under 60 Kg N/ fed the combined average across the two years ranged from 68.00 (Adv- 40) to 79.17days (Adv-47). The combined average across the two years for plant height under 120 , 100, 80, 60 Kg N /fed ranged from 109.83, 109.67, 108.17, 103.83cm ,respectively (Rsh-53) to 189.83,189.50, 180.67, 178.00 cm, respectively (Rsh-12). The data regarding to means of eight environments for studied traits across genotypes are represented in (Table 5). The range of individual trait for plant height (139.3 - 154.4 cm in T_4Y_2 and T_1Y_2 ,respectively), for number of days to 50% flowering (69.51-73.55 day in $T_1Y_1$and T_4Y_2, respectively), for 1000-grain weight (26.04 g to 29.28 g in T_2Y_2 and T_4Y_2 , respectively) grain yield/plant (65.62 - 74.56 g in T_4Y_2 and T_1Y_1, respectively), for Panicle length (23.95 - 29.56 cm in T_4Y_2 and T_1Y_2, respectively) and Panicle width (6.447- 8.881 cm in T_4Y_2, T_1Y_1, respectively). Also, the results showed that the lowest mean values for all traits except days to 50% flowering were obtained under low nitrogen level 60 Kg N/ fed in both seasons while the reverse was obtained under high nitrogen level 120 Kg N / fed in the two growing seasons

Table 4. Means of twenty- five grain sorghum genotypes of panicle length, 50% flowering and plant height under four nitrogen levels over two years.

No.	Genotype	)cm(Com. of panicle length				Days to 50% Flowering				) cm (Com. of plant/ height			
		120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed	120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed	120 kg N/fed	100 kg N/fed	80 kg N/fed	60 kg N/fed
1	Rsh- 11	32.42	31.33	29.92	27.20	69.67	70.50	71.67	74.17	183.67	183.17	174.67	164.50
2	Rsh-12	31.17	29.45	27.38	25.35	69.67	70.67	71.67	73.00	189.33	189.50	180.67	178.00
3	Rsh - 14	31.13	30.87	27.63	25.22	72.17	72.50	73.33	74.50	174.00	172.00	160.17	153.33
4	Rsh- 15	32.33	29.93	26.25	24.05	71.83	72.83	73.50	75.17	164.33	161.83	159.33	155.00
5	Rsh- 16	27.92	28.42	26.92	24.50	63.83	65.00	66.83	68.67	165.83	162.83	153.67	150.17
6	Rsh- 18	28.00	27.20	26.13	22.52	65.83	67.33	68.33	69.83	175.83	168.50	157.50	154.00
7	Rsh- 19	28.17	27.15	25.75	22.87	70.17	71.50	72.67	74.17	174.83	168.83	165.33	158.33
8	Rsh-20	34.92	33.53	31.57	29.78	70.83	71.83	72.33	74.50	155.17	154.17	150.33	147.17
9	Rsh-22	24.91	24.08	23.80	23.11	71.67	72.67	73.67	74.67	165.83	162.17	156.50	152.67
10	Rsh-23	31.58	30.25	28.33	27.17	67.83	69.33	70.50	71.83	148.17	146.00	145.83	142.50
11	Rsh-26	29.08	27.65	26.16	24.68	72.00	72.67	73.33	75.33	143.17	138.82	136.50	136.17
12	Rsh- 28	28.42	27.92	26.15	22.82	70.67	71.83	72.50	74.17	189.83	185.83	170.33	164.83
13	Rsh-30	26.83	27.63	25.33	22.15	66.17	68.00	69.17	71.17	188.83	185.67	180.50	172.67
14	Sel pop. 7	27.17	24.45	22.57	19.90	65.33	66.17	68.00	69.50	159.50	157.33	151.67	147.50
15	Sel pop. 13	27.67	25.78	23.63	20.65	64.33	65.00	65.83	68.33	172.50	163.83	159.67	154.50
16	Adv-39	27.17	26.42	25.50	24.33	64.83	66.33	66.83	68.83	135.67	130.50	124.67	121.33
17	Adv- 40	27.67	25.92	25.20	22.35	64.67	65.17	66.00	68.00	131.17	124.67	121.50	117.17
18	Adv- 44	35.55	32.25	29.00	27.00	70.17	71.17	72.00	73.17	132.00	125.00	118.33	112.83
19	Rsh- 53	34.17	32.75	29.13	26.17	71.17	72.17	73.50	74.50	109.83	109.67	108.17	103.83
20	Rsh- 60	30.58	32.07	29.12	26.78	73.50	74.83	75.33	76.50	124.33	121.17	116.50	111.00
21	Adv- 47	29.75	27.77	25.22	24.95	75.17	76.17	77.17	79.17	129.50	122.50	118.00	112.67
22	Rsh- 69	28.75	26.47	26.00	23.17	70.33	71.67	72.83	75.00	119.17	116.67	113.83	112.00
23	Rsh- 70	26.88	25.07	24.33	23.20	71.50	72.50	73.83	75.17	127.85	124.35	121.30	118.65
24	Adv- 48	26.37	25.00	22.33	19.98	74.50	75.67	76.50	77.50	126.20	121.35	119.35	118.15
25	Dorado	29.00	29.25	26.25	24.07	71.00	70.83	73.17	74.00	152.83	145.17	135.10	131.70
	L.S.D 0.05	1.63	1.66	1.44	1.50	1.32	1.44	1.42	1.50	4.38	3.50	3.43	2.85

Table 5. Means of eight environments (two years and four nitrogen levels) for six studied traits across genotypes.

Environment	Grain yield /plant(g)	1000 grain weight(g)	Panicle width(cm)	Panicle length(cm)	50% flowering	Plant height(cm)
T_1 Y_1 120	74.56	29.00	8.881	29.45	69.51	152.8
T_2 Y_1 100	73.32	28.97	8.099	28.30	70.24	149.7
T_3 Y_1 80	69.76	27.22	7.532	26.42	70.99	144.1
T_4 Y_1 60	66.37	26.10	6.827	24.37	72.69	139.9
T_1 Y_2 120	74.20	29.27	8.397	29.56	69.84	154.4
T_2 Y_2 100	72.87	29.28	7.827	28.39	70.88	149.6
T_3 Y_2 80	69.44	27.37	7.159	26.35	72.09	143.9
T_4 Y_2 60	65.62	26.04	6.447	23.95	73.55	139.3
Revised L.S.D 0.05	0.603	0.553	0.186	0.299	0.564	1.272

T_1= treatment 120, T_2 = (100), T_3= (80) and T_4= (60). Y_1= 2019, Y_2=2020.

Phenotypic correlations are presented in (Table 6) showed significant or highly significant and positive association of panicle length, panicle width, plant height and 1000-grain weight with grain yield (0.663), (0.738), (0.564) and (0.456) respectively. Panicle width and panicle length showed positive and highly significant or significant correlation with 1000-grain weight (0.511and 0.488, respectively), whereas negative and highly significant association with plant height (-0.503). Highly significant and positive association of panicle length with panicle width (0.609, 0.150) respectively), whereas negative and significant with 50% flowering (-0.088). The pathways through which the four traits operate to produce their genotypic association with grain yield / plant of sorghum reveal direct and indirect contributions (Table 7).

Table 6. Phenotypic correlations between six studied traits.

Trait	Grain yield /plant(g)	1000 grain weight(g)	Panicle width(cm)	Panicle length(cm)	50% flowering	Plant height(cm)
Grain yield /plant(g)	--	0.456*	0.738**	0.663**	-0.157	0.564**
Grain yield /plant(g)		---	0.511**	0.488*	-0.131	-0.503**
Grain yield /plant(g)			---	0.609**	-0.088	0.150
Grain yield /plant(g)				---	-0.062	0.098
Grain yield /plant(g)					---	-0.347
Grain yield /plant(g)						--

Where * and ** mean significant at 5 and 1% level of probabilities, respectively

Table 7. Direct and indirect effects of 1000- grain weight, panicle length, panicle width, and plant height on grain yield / plant.

Path way association	Direct effect(p)	Indirect effects (px)	r
1- 1000 grain weight			
(a). Direct effect (P1Y)	0.760		
(b). Indirect effect via			
Indirect effect via. PW r12 Py2		0.0685	0.456
Indirect effect via. PL r13Py3		0.0590	
Indirect effect via. PH r14Py4		-0.460	
(c). Total effect			
2- Panicle width			
(a). Direct effect (P2Y)	0.134		
(b). Indirect effect via			
Indirect effect via. 1000KW r12Py1		0.388	0.738
Indirect effect via. PL r23Py3		0.074	
Indirect effect via. PH r14Py4		-0.460	
(c). Total effect			
3- Panicle length			
(a). Direct effect (P3Y)	0.121		
(b). Indirect effect via			
Indirect effect via. 1000KW r13Py1		0.371	0.663
Indirect effect via. PW r23Py2		0.082	
Indirect effect via. PH r34Py4		0.090	
(c). Total effect			
4 – Plant height			
(a). Direct effect (P4Y)	0.914		
(b). Indirect effect via			
Indirect effect via. 1000KW r14Py1		-0.382	0.564
Indirect effect via. PW r24Py2		0.0201	
Indirect effect via. PL r34Py4		0.090	
(c). Total effect			
5. Residual effect (P x y)		-0.0002	

P= Path Coefficient; (P x r) = Path coefficient, (r) = CorrelationCoefficient
1000 KW: 1000 kernel weight, PW: panicle width, PL: panicle length, PH: plant height.

The path coefficient analysis showed that direct effect of plant height on grain yield was very high and significant (0.914). The indirect effect through panicle width and panicle length (0.0201 and 0.090, respectively) were positive but not so pronounced. Total correlation coefficient (0.564) between grain yield / plant and plant height. However, indirect effects via 1000-grain weight (–0.382). The direct effect of panicle length branches on grain yield / plant was positive (0.121).Wankhede *et al* (1985), Patil and Thombre (1995) and *Tag El-Din et al* (2012) showed positive direct effect of panicle length on grain yield / plant. The indirect effect via 1000-grain weight, panicle width and plant height were positive (0.371, 0.082 and 0.090, respectively). Total correlation coefficient (0.663) between grain yield / plant and panicle length. The direct effect of the panicle width on the grain sorghum yield/plant was positive (0.134) which was mainly due to positive effect of 1000-grain weight and panicle length (0.388 and 0.074). However, indirect effects via plant height (-0.460). Total correlation coefficient (0.738), between panicle width and

grain yield / plant. The direct effect through 1000 grain weight and grain yield / plant (0.760), indirect effect via panicle width and panicle length (0.0685 and 0.0590) was positive but negative with plant height (-0.460). Total correlation coefficient (0.456) between grain yield / plant and 1000 grain weight. Thus, it is revealed from the present study that the traits like 1000-grain weight and plant height had greater importance. Hence, due consideration should be given to these traits, while planning a breeding strategy for increased grain yield/ plant.

From above, can be results concluded that 1000 grain weight, panicle width, panicle length and plant height caused an increase grain yield / plant and vice versa meaning that selection considered any of these traits simultaneously may be effective in improving grain yield per plant. From these results it could be concluded that 1000 kernel weight , panicle width , panicle length and plant height were more important contributions of these component towards grain yield / plant .

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تحليل معامل المرور والارتباط بين المحصول ومساهماته لعدد من التراكيب الوراثية في الذرة الرفيعة

عمرأبو الحسن يونس عبد الرحيم، أمل عبد الرحيم تاج الدين و يوسف محمد يوسف القاضي

قسم الذرة الرفيعة – معهد المحاصيل الحقلية - مركز البحوث الزراعية- الجيزة

أجريت هذه الدراسة لعدد 24 سلالة معيدة للخصوبة في الذرة الرفيعة وصنف الدورادوكمقارن وذلك للمقارنة بينهم في الصفات المحصولية ودراسة العلاقة بين تلك الصفات وارتباطها المباشر بصفة المحصول وذلك بالمزرعة البحثية بشندويل خلال موسمي 2019 و2020م. تم أستخدام أربعة معدلات مختلفة من التسميد النيتروجيني (60 و 80 و 100 و 120كجم نيتروجين للفدان) . وقد أظهرت نتائج التحليل المشترك وجود اختلافات معنوية إلي عالية المعنوية بين البيئات والتراكيب الوراثية وتفاعلها في جميع الصفات المدروسة.كان أفضل التراكيب الوراثية (Rsh-53) لصفة المحصول والتركيب الوراثي (Rsh-22) لصفة وزن الألف حبة والتركيب الوراثي (Adv-44) لصفة عرض القنديل والتركيب الوراثي (Rsh-20) لصفة طول القنديل والتركيب الوراثي(Selpop-13) للتبكير والتركيب الوراثي(Rsh-12) لصفة إرتفاع النبات .كانت القيم العالية متحصل عليها عند التسميد بمعدل 120 وحدة أزوت للفدان لكل الصفات المدروسة ما عدا صفة تزهير 50 % في كلا الموسمين والعكس نحصل علي أقل القيم عند التسميد بمعدل 60 وحدة أزوت للفدان لكل الصفات فى كلا الموسمين . أثبت تحليل الارتباط أن كلا من صفة وزن الألف حبة وطول وعرض القنديل وكذلك إرتفاع النبات لهم أرتباط موجب و معنوي بصفة المحصول. كذلك أوضحت النتائج أن صفة إرتفاع النبات يليها صفة وزن الألف حبة هما الأعلي في تأثيرهما علي صفة المحصول .