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Path Coefficient Analysis and Correlation for some Yield and its Attributes in Rice (*Oryza sativa* L.)

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ABSTRACT

Yield and its components traits of rice varieties were studied to estimate the relationship between grain yield and its components. Sixty rice genotypes were used in this research. A field experiment was conducted in a randomized complete block design with three replications at Sakha Agricultural Research Station, Kafr elsheikh, Egypt during 2017 and 2018 seasons. The results revealed that the Giza 178, GZ 9399-4-1-1-3-2-2 and Giza 177 exhibited the highest values of no.of filled grains panicle^{-1} and grain yield t/ha. The mean square analysis for the rice genotypes was highly significant for all studied traits, indicating that the differences among the rice genotypes and their traits. Chlorophyll content, flag leaf area, number of panicles plant^{-1}, panicle length and number of filled grains panicle^{-1} showed positive direct effect on grain yield, while, rest of traits showed negative effect on grain yield. This indicates that more number of filled grains panicle^{-1} is a highly reliable component of grain yield. Another important character with direct effect on grain yield is number of panicles plant^{-1} and flag leaf area which showed positive direct effect on grain yield. Hence, number of panicles and filled grains panicle^{-1} should be given a prior attention in rice improvement program because of their major influence on yield. Highly significant and positive correlations were found between grain yield and each of no.of panicles plant^{-1}, panicle length, no.of filled grains panicle^{-1} and 1000-grain weight.

Keywords: Path coefficient analysis, Rice grain yield, correlation, yield components rice

INTRODUCTION

Grain yield is one of a quantative complex trait in rice, several agronomic and morpho-physiological traits affected on grain yield. Yield and its components traits are correlated with each other and exhibited a close relationship and highly affected by environmental factors (Prasad *et al*., 2001). To Maximizing the grain yield in rice can be achieved according to the degree of associated of plant traits as well as on its importance and nature of variation among them (Zahid *et al*., 2006). Identifying the correlation coefficient will help the rice breeder in the selection where the path coefficient analysis including direct and indirect matrix in addition to correlation is a more meaningful way to improving the selection in plant breeding (Mohsin *et al*., 2009). Path coefficient analysis is a statistical tool to improve grain yield in crops developed by (Wright 1921). The importance of path analysis is that partitioning of the correlation coefficient into its components; the first component is path coefficient that measures the direct effect of a predictor variable upon its response variable, the second component being the indirect effect of a predictor variable on the response variable through other predictor variables (Dewey and Lu 1959). In crops, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Samonte *et al*., 1998 and Ezeaku and Mohammed 2006). Several scientists in different crops were studied the correlation coefficient into its components of direct and indirect (Surek and Beser 2003). The rice breeders used the path coefficient analysis to estimate the traits that are desirable in the selection to improve the grain yield (Milligan *et al*., 1990).

The present investigation aimed to study of the direct and indirect contribution of the plant characteristics to grain yield through path analysis and correlation coefficient

MATERIALS AND METHODS

This research work was carried out at the experimental farm of Sakha Agricultural Research Station, kafr elsheikh, Egypt during 2017 and 2018 rice seasons. Sixty rice genotypes having a wide range of variability among them in their morphological and agronomical traits were evaluated. Randomized complete block design with three replications was used in the both seasons. All rice genotypes were subjected to water deficit for 10 days to test their performance under water shortage. The plant characteristics, i.e., chlorophyll content, leaf rolling, leaf drying score, canopy temperature, plant height, no.of panicles plant^{-1}, panicle length, no.of filled grains panicle^{-1} and grain yield t/ha., were measured according to (IRRI, 2012). Analysis of variance was conducted for each season according to (Snedecor and Cochran 1967). Error variances from separate analysis of the data were tested for homogeneity using Bartletts test (Bartllett, 1937). Data over the two seasons were analyzed according to. Phenotypic (PCV) and genotypic (GCV) coefficient of variability were estimated according to the method of (Borton 1952). The expected genetic advance from selection (g) for the studied plant characteristics as well as the phenotypic correlation between any pairs of traits was calculated according to (Johnson *et al*., 1955). Path analysis was calculated according to (Dewey and Lu 1959).

Combined analysis of variance was used (after performing homogeneity test) to estimate the genotypic variance (2 g), environmental variance (2 e), genotypic x environmental variance (2 gy), phenotypic variance (2 ph), genotypic (GCV), phenotypic (PCV) coefficient of variation components.

RESULTS AND DISCUSSION

Mean performance:

Data in Table 1 indicated that the rice genotypes WAB880-1-38-P2-HB, WAB964-B-3A1-2 and GZ10332-19-2-2-2 recorded the highest values of chlorophyll content in their flag leaf (47.43, 47.10 and 47.07 SPAD, respectively), While, the rice genotypes IR77734-93-2-3-2,Sena and IR84233-30-2-2 exhibited the lowest values (28.80, 28.87 and 29.52, SPAD, respectively. For drought susceptibility, leaf rolling and drying, the rice genotypes IR77734-93-2-3-2 and IR84233-30-2-2 recorded the highest values while, Giza 178 and GZ9399 recorded the lowest values, indicating that these genotypes are more tolerant to drought.

For days to 50% heading, the rice varieties WAB880-1-38-P2-HB and WAB181-18 exhibited earliness of 67.33 and 69.00 days. On the other hand, the IR79505-51-2-2-2 and AFR 453 were late 124.5 and 127.00 days, the reaming genotypes were intermediate among them. Regarding to flag leaf area, IR79505-51-2-2-2, Kitumbo and GZ9577-4-1-1 had the highest values of flag leaf with 47.66, 46.68 and 46.58 cm^2, respectively, while, Sena rice variety recoded the lowest one 17.17 cm^2. IR79268-44-2-1-3, Sena, IR80732-34-2-1-2 and IR78554-145-1-3-2 exhibited the highest values of leaf temperature (32.03, 30.90, 30.75 and 30.67 ◦c, respectively), while, GZ9626-2-1-3-2-3 and GZ 9524-9-2-1-1-1 showed the lowest values (21.68 and 21.98 ◦c).

Table 1. Mean performance of sixty rice genotypes for some of agronomic traits and yield and its components, data was combined over two years.

Genotype	Chlorophyll content (SPAD Unit)	Leaf rolling	Leaf drying	Days to 50% Heading (day)	Flag leaf area (cm2)	Leaf temperature (oC)
IR80732-34-2-1-2	32.00	3.60	3.33	107.00	33.00	30.75
IR84233-30-2-2	29.52	5.00	4.32	110.00	31.52	29.80
IR83526-38-3-3-1	36.40	2.83	1.33	111.00	30.00	31.70
IR79268-44-2-1-3	40.00	3.50	4.31	116.80	32.10	32.03
IR82127-26-2-2-3	31.00	4.80	4.32	109.20	24.10	26.00
IR32809-26-3-3	41.20	3.32	4.33	109.00	22.00	28.00
IR78554-145-1-3-2	29.00	1.33	1.33	102.00	28.33	30.67
Sena	28.87	5.00	4.33	111.00	17.17	30.90
IR77734-93-2-3-2	28.80	3.31	4.00	107.00	27.83	27.10
IR77629-72-2-1-3	35.00	3.33	1.33	106.00	29.40	26.70
IR72049-B-R-22-3-1-1	36.65	4.50	4.00	103.00	30.70	28.10
IR68333-R-R-B--22	35.05	3.33	4.00	104.00	27.80	27.71
IR80098-40-3-1-2	34.75	4.32	4.00	105.00	30.60	26.00
CSR-90IR-2	37.27	6.00	4.00	99.00	36.10	29.10
IR75287-19-3-3-3	40.20	5.30	4.00	104.00	29.80	27.35
Tetracycline	36.12	6.00	4.00	102.00	31.30	27.13
Turiani	35.51	4.50	2.83	97.00	36.00	27.00
Tangulia	37.10	3.50	2.50	104.00	30.43	26.32
Somba	38.02	6.00	2.83	106.00	23.10	27.78
Kasegere	37.02	4.00	2.00	107.00	27.80	29.45
Dunduli	38.76	1.32	1.83	102.30	31.35	28.58
IR60080-46A	38.35	1.33	2.00	95.10	33.73	27.70
Sindano/Lindi	35.83	3.50	2.50	107.67	32.65	26.50
Moshi Wataa	31.43	6.00	3.00	113.00	23.27	29.67
Sukarisukari	43.70	1.30	2.50	118.00	31.93	26.28
Gamti Ndogo	38.82	3.32	2.50	119.50	26.25	26.98
Karafuu	41.93	1.31	2.83	112.50	35.77	24.72
IR72890-81-3-2-2	35.87	1.33	2.50	98.67	31.90	25.92
IR79505-51-2-2-2	37.65	6.00	4.00	124.50	47.60	29.83
IR81336-39-3-3-3	38.77	3.33	2.50	105.50	42.65	26.10
IR80897-20-1-2-2	37.20	6.00	4.00	106.67	26.80	26.10
AFR 453	41.66	1.30	2.50	127.00	27.10	25.95
Meri	37.72	1.33	2.60	106.50	28.73	26.22
AFR 404	34.20	6.00	3.66	88.54	32.00	29.53
Mropa	33.42	5.67	2.50	102.17	22.10	29.72
Supashinyanga	38.87	1.33	2.50	106.33	27.40	26.42
Lunyuki	41.00	1.33	2.02	82.00	32.13	25.35
AFR 4311	41.02	1.33	2.50	78.50	27.65	26.00
Gombe	41.90	3.33	2.83	118.67	27.42	28.72
Kalunde	38.00	1.67	2.50	92.50	25.48	26.40
Kitumbo	39.33	1.33	3.33	83.17	46.58	24.30
NFC-2	33.88	1.66	1.33	97.83	44.27	24.75
GZ10332-19-2-2-2	47.07	1.33	1.32	90.00	44.38	22.37
GZ9328-1-2-1-3	44.55	1.31	1.33	88.10	43.48	23.72
GZ9577-4-1-1	46.00	1.33	1.32	92.00	46.68	24.50
Giza 177	46.83	1.32	1.33	90.00	44.88	22.83
GZ5310-20-3-3	44.55	1.33	1.33	92.33	36.47	25.43
Giza 178	46.53	1.33	1.34	100.80	43.60	22.67
Sakha 105	44.22	1.32	1.33	90.00	33.00	24.30
Sakha 103	38.82	1.33	1.33	89.33	31.32	24.05
GZ 9399-4-1-1-3-2-2	46.43	1.33	1.34	86.50	45.57	22.77
GZ9626-2-1-3-2-3	46.58	1.34	1.33	91.83	45.07	21.68
GZ9524-9-2-1-1-1	46.38	1.33	1.32	89.00	35.33	21.98
WAB 964-B-3A1-2	47.10	1.33	1.31	74.17	42.73	22.27
WAB 450-12-2-BL1-DV1	41.30	1.20	1.30	75.83	44.57	24.13
WAB 181-18	43.05	1.00	1.00	69.00	42.72	25.03
WAB 775-21-5-2-HB	43.72	1.20	1.20	109.33	33.72	24.51
WAB 880-1-38-15-P2-HB	47.43	1.00	1.40	67.33	46.38	24.32
WAB 569-35-1-1-1-HB	45.50	1.20	1.20	92.67	42.47	24.00
WAB 189-B-B-B-B-HB	43.30	1.30	1.30	73.17	42.62	23.08
LSD at 0.05	1.35	1.30	1.60	6.80	2.10	0.704

Table 1. Cont.

Genotype/ Trait	Plant height (cm)	No. of panicles /hill	Panicle length (cm)	No. of filled grains /panicle	Grain yield (t/ha.)
IR80732-34-2-1-2	107..60	13.00	21.50	107.00	8.33
IR84233-30-2-2	103.20	9.32	22.10	83.00	5.47
IR83526-38-3-3-1	103.00	7.20	20.00	100.00	6.43
IR79268-44-2-1-3	93.80	7.00	23.00	84.10	4.28
IR82127-26-2-2-3	92.00	9.00	19.50	66.90	2.45
IR32809-26-3-3	104.00	11.33	22.10	82.30	4.66
IR78554-145-1-3-2	110.52	8.50	22.30	64.00	4.59
Sena	97.00	9.00	18.00	108.00	5.24
IR77734-93-2-3-2	81.50	9.00	18.38	50.00	2.50
IR77629-72-2-1-3	112.54	11.00	23.98	128.50	7.64
IR72049-B-R-22-3-1-1	82.10	8.30	24.03	112.60	4.55
IR68333-R-R-B--22	84.50	8.80	20.90	75.00	3.67
IR80098-40-3-1-2	103.10	10.33	23.00	96.80	5.24
CSR-90IR-2	104.10	8.50	22.60	55.90	2.33
IR75287-19-3-3-3	98.75	10.33	21.00	65.00	2.98
Tetracycline	90.00	8.97	19.00	70.00	4.19
Turiani	95.10	6..68	22.83	88.50	5.24
Tangulia	95.50	6.67	17.83	47.80	2.38
Somba	95.00	7.00	21.65	68.00	4.64
Kasegere	95.40	8.50	20.78	80.00	4.02
Dunduli	94.20	8.10	17.98	60.17	2.36
IR60080-46A	96.50	9.000	20.53	75.67	5.24
Sindano/Lindi	99.00	8.70	22.58	45.00	2.38
Moshi Wataa	106.00	8.70	23.58	69.00	5.02
Sukarisukari	89.00	9.00	17.58	55.00	2.50
Gamti Ndogo	97.00	8.60	20.18	69.33	3.57
Karafuu	107.00	11.00	23.68	72.00	3.76
IR72890-81-3-2-2	94.17	8.00	20.40	44.67	3.69
IR79505-51-2-2-2	90.53	8.67	22.33	56.83	3.74
IR81336-39-3-3-3	109.12	8.33	23.10	82.67	3.71
IR80897-20-1-2-2	100.07	8.30	19.90	47.17	4.40
AFR 453	104.60	8.40	26.20	82.83	4.24
Meri	100.90	8.67	21.50	70.67	4.02
AFR 404	96.50	8.83	22.18	69.50	3.59
Mropa	102.80	8.00	20.85	68.33	3.12
Supashinyanga	98.00	8.67	25.25	74.83	3.28
Lunyuki	117.08	8.37	20.58	106.33	6.66
AFR 4311	97.62	8.13	22.78	52.67	3.05
Gombe	99.73	8.80	16.22	57.50	2.38
Kalunde	98.17	8.70	19.27	68.33	3.07
Kitumbo	123.00	14.00	23.85	115.67	9.28
NFC-2	124.10	10.53	20.65	115.83	6.19
GZ10332-19-2-2-2	103.67	10.45	22.77	111.67	8.16
GZ9328-1-2-1-3	101.83	16.00	23.25	137.17	7.38
GZ9577-4-1-1	99.97	15.00	23.27	141.17	7.09
Giza 177	102.53	16.33	23.95	151.83	9.90
GZ5310-20-3-3	95.40	15.10	21.60	115.33	6.21
Giza 178	105.08	22.67	23.93	155.17	11.66
Sakha 105	104.00	17.17	24.60	136.33	7.69
Sakha 103	100.77	15.17	22.13	104.17	6.45
GZ 9399-4-1-1-3-2-2	103.33	20.53	24.85	156.00	10.78
GZ9626-2-1-3-2-3	105.00	15.63	23.65	136.50	5.85
GZ9524-9-2-1-1-1	106.10	15.50	21.00	122.50	5.55
WAB 964-B-3A1-2	98.00	11.20	18.98	97.50	4.99
WAB 450-12-2-BL1-DV1	106.00	10.63	22.02	135.33	6.31
WAB 181-18	108.00	12.00	23.00	157.50	6.73
WAB 775-21-5-2-HB	97.00	12.30	21.83	113.33	4.99
WAB 880-1-38-15-P2-HB	106.00	10.63	25.00	144.50	5.36
WAB 569-35-1-1-1-HB	102.10	10.80	26.12	112.50	5.74
WAB 189-B-B-B-B-HB	103.00	11.00	22.27	130.00	6.02
LSD at 0.05	4.10	2.80	1.20	9.6	1.35

Regarding to plant height, GZ 5310-20-3-3 was the shortest plants (95.40cm) while NFC-2 and Kitumbo showed the tallest plants 124.10 and 123.00 cm. Concerning to no.of panicles plant^{-1}, the rice varieties Giza 178 and GZ 9399-4-1-

1-3-2-2 as indica/Japonica gave the highest number of panicles 22.67 and 20.53 while, Turiani and Tangulia rice genotypes showed the lowest values 6.68 and 6.67. For panicle length, AFR 453 and Supashinyanga gave the longest panicles 26.20 and 25.25cm, while Sukarisukari and Tangulia gave the short ones 17.83 and 17.58cm. Giza 178, GZ 9399-4-1-1-3-2-2 and Giza 177 exhibited the highest values of no.of filled grains panicle^{-1} and grain yield t/ ha .while, Sena, IR8097-20-1-2-2 and IR 72890-81-3-2-2 recorded the lowest values of no.of filled grains panicle^{-1} and the rice genotypes, CSR-90IR-2, Tangulia and Sindan/Lindi showed the lowest values of grain yield 2.33 and 2.38 t/ha.

Path coefficient analysis:

Path analysis including direct and indirect effects of different traits was used to investigate the inter-relationships among studied traits. The results showed that the traits, chlorophyll content, flag leaf area, number of panicles plant^{-1}, panicle length and number of filled grains panicle^{-1} showed positive direct effect on grain yield, while, rest of traits showed negative effect on grain yield Table 2. This indicates that more number of filled grains panicle^{-1} is a highly reliable component of grain yield. Another important character with direct effect on grain yield is the number of panicles plant^{-1} and flag leaf area which showed positive direct effect on grain yield. Hence, number of panicles and filled grains panicle^{-1} should be given prior attention in rice improvement program because of their major influence on yield. This findings were in accordance with that of (Gaballah 2016) and (Hammoud *et al* 2012), and (Panwar and Bansal 1989) who found that the number of filled grains per panicle and the number of productive tillers have the highest direct effect on grain yield.

Table 2. Path coefficient analysis direct and indirect effects on grain yield for 60 rice genotypes, and combined data.

	direct	indirect effect											total
		1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	10.00	11.00	12.00	
1.Chlorophyll content	0.06		-0.05	0.11	0.04	0.07	0.02	-0.04	0.12	0.02	0.28	0.00	0.63**
2.Leaf rolling	0.08	-0.03		-0.17	-0.04	-0.06	-0.03	0.04	-0.09	- 0.01	-0.23	0.00	-0.55**
3.Leaf drying	-0.21	-0.03	0.07		-0.05	-0.06	-0.03	0.04	-0.07	- 0.01	-0.27	0.00	-0.63**
4.Days to heading	-0.08	-0.03	0.05	-0.13		-0.07	-0.03	0.02	-0.11	-0.01	-0.33	0.00	- 0.74**
5.Flag leaf area	0.11	0.04	-0.04	0.12	0.05		0.02	-0.05	0.15	0.02	0.32	0.00	0.74**
6.Leaf temperature	-0.05	-0.03	0.05	-0.13	-0.06	-0.06		0.00	-0.08	0.00	-0.25	0.00	-0.60**
7.Plant height	-0.15	0.02	-0.02	0.05	0.01	0.04	0.00		0.12	0.03	0.18	0.00	0.27
8.Panicle number	0.24	0.03	-0.03	0.06	0.04	0.07	0.02	-0.08		0.03	0.35	0.00	0.72**
10.Panicle length	0.05	0.02	-0.02	0.04	0.01	0.05	0.00	-0.08	0.11		0.23	0.00	0.43*
11.Filled grains	0.48	0.03	-0.04	0.12	0.06	0.08	0.02	-0.06	0.17	0.02		0.00-	0.89**

All characters had indirect effect on grain yield through other characters. So, the characters which were showing positive indirect effect on grain yield except leaf rolling, leaf drying, days to complete heading and panicle length should also be improved to enhance an improvement in grain yield. These findings are in accordance to the findings of (Hasan *et al*. 2010) and (Sarker *et al*. 2013).

Phenotypic correlation

Phenotypic correlation among the studied plant characteristics are shown in Table 3.Highly significant and negative correlation was observed between chlorophyll content and each of leaf rolling, leaf drying score, no.of days to heading and canopy temperature. while, highly significant positive correlation was found between chlorophyll content and flag leaf area, plant height, no.of panicles plant^{-1}, grain yield, panicle length, no.of filled grains panicle $^{-1}$ and 1000-grain weight. Regarding to drought susceptibility, leaf rolling and leaf drying recorded the highly significant and negative correlation with each of chlorophyll content, flag leaf area, plant height, no.of panicles plant^{-1}, grain yield, panicle length, no.of filled grains panicle^{-1} and 1000-grain weight.

For correlation among yield and its components, data in Table 3 revealed highly significant and positive correlation between grain yield and each of no.of panicles plant^{-1}, panicle length, no.of filled grains panicle^{-1} and 1000-grain weight.

Table 3. Upper diagonal phenotypic correlation and lower diagonal genotypic correlation

Trait	Chlorophyll content	Leaf rolling	Leaf drying	Leaf drying	Flag leaf area	Canopy temperature	Plant height	No.of panicles/ plant	Grain yield	Panicle length	Filled grains/ panicle
1.Chlorophyll content	1.00	-0.56**	-0.53**	-0.47*	0.61**	-0.44*	0.27*	0.50**	0.63**	0.41*	0.58**
2.Leaf rolling	0.63-**	1.00	0.79**	0.56**	-0.54**	0.63**	-0.23	-0.36*	-0.55**	-0.21	-0.48*
3.Leaf drying score	-0.63**	0.88**	1.00	0.64**	-0.55**	0.62**	-0.26*	-0.31*	-0.63**	-0.20	-0.56**
4.Days to flowering	-0.60**	0.59**	0.70**	1.00	-0.65**	0.73**	-0.11	-0.47*	-0.74**	-0.17	-0.69**
5.Flag leaf area	0.59**	-0.60**	-0.63**	-0.75**	1.00	-0.51**	0.34*	0.64**	0.74**	0.47*	0.67**
6.Canopy temperature	-0.66**	0.70**	0.70**	0.73**	-0.69**	1.00	0.02	-0.32*	-0.60**	-0.08	-0.51**
7.Plant height	0.11	-0.31*	-0.36*	-0.25*	0.25*	-0.23	1.00	0.53**	0.27*	0.53**	0.37*
8.No.of panicles/plant	0.53**	-0.50**	-0.39*	-0.71**	0.74**	0.65-**	0.56**	1.00	0.72**	0.47*	0.73**
9.Grain yield	0.64**	-0.58***	-0.70**	-0.79**	0.76**	0.70-**	0.26*	0.90**	1.00	0.43*	0.89**
10.Panicle length	0.32*	-0.27*	-0.28*	-0.29*	0.43*	-0.30*	0.41*	0.50**	0.43*	1.00	0.47*
11.Filled grains/panicle	0.57**	-0.52**	-0.63**	-0.76**	0.66**	-0.65**	0.32*	0.89**	0.90**	0.45*	1.00

Genotypic correlation

The genotypic correlation among the studied plant characteristics are presented in Table 3. Data in Table 3 showed negative and highly significant correlation between drought susceptibility (leaf rolling and leaf drying) and flag leaf area, plant height, no.of panicles plant^{-1}, grain yield, panicle length, no.of filled grains panicle $^{-1}$ and 1000-grain weight. While grain yield had a highly significant and positive genotypic correlation with chlorophyll content, flag leaf area and plant height.

For the genotypic correlation among grain yield and its components, data in Table 3 revealed that highly significant and positive genotypic correlation between grain yield and no.of panicles plant^{-1}, panicle length, no.of filled grains panicle^{-1} and 1000-grain weight.

Genetic parameters:

Phenotypic and genotypic coefficients of variability, heritability and genetic advance for each trait are presented in Table 4. The rice genotypes showed a wide range of variation for all studied traits over the two seasons, where mean squares for all traits were highly significant. Thus, selection for these traits among these genotypes would be effective in all cases. Similar results were reported by (Aly *et al.* 1984).The genetic coefficient of variability (G.C.V) for all studied traits ranged between 6.67 and 68.63% over the two seasons. The relatively high genetic coefficient of variability for the studied trait indicated that these traits might be more genotypically predominant and it would be possible to achieve further improvement in them. However, the phenotypic coefficient of variability was higher than the genotypic one in all studied traits, but the most portion of P.C.V was controlled by the genotypic component, less by environmental component, Table 4.

Table 4. Estimates of variance components; genotypic (GCV) and phenotypic (PCV) coefficients of variability for some of agronomic and yield and its components traits.

Trait	Grand mean	Variance components			Genetic variability	
		G	E	P	GCV	PCV
Chlorophyll content	39.22	24.60	0.628	29.81	12.64	13.92
Leaf rolling	2.75	2.38	0.555	5.66	56.09	86.51
Leaf drying	2.52	1.00	0.833	3.753	39.68	76.87
Days to heading	99.27	1090.33	30.00	1138.33	33.26	33.98
Flag leaf area	34.05	281.90	3.93	346.46	49.30	54.66
Leaf temperature	26.38	327.85	0.655	574.66	68.63	90.87
Plant height	100.53	55.19	5.49	121.71	7.38	10.97
No.of panicles/plant	10.44	0.486	0.727	1.583	6.67	12.05
Panicle length	21.74	4.931	0.479	5.64	10.21	10.92
No.of filled grains/panicle	92.04	1092.07	29.42	1139.38	35.90	36.67
Grain yield	2.13	1.194	0.0264	1.232	51.30	52.11

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معامل المرور وتحليل الارتباط لبعض صفات المحصول ومكوناته فى الارز

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درست صفات المحصول لبعض اصناف الارز لتحديد العلاقة بين محصول الحبوب ومكوناته. استخدم ٦٠ صنف من الارز فى هذا البحث. تم استخدام تصميم القطاعات الكاملة العشوائية فى ثلاث مكررات بالمزرعة البحثية لمحطة بحوث سخا موسمي ٢٠١٧و٢٠١٨. اعطت الاصناف جيزة ١٧٨ و جى زد ٩٣٩٩ وجيزة ١٧٧ اعلى قيم لعدد الحبوب الممتلئة بالسنبلة ومحصول الحبوب طن/هكتار وكان تحليل التباين معنوي لكل الصفات المدروسة مما يدل على وجود اختلافات بين اصناف الارز المستخدمة وكذلك صفاتها ويرجع ذلك الى اختلافها في التركيب الوراثي. اظهرت صفات محتوى الكلوروفيل ومساحة ورقة العلم وعدد السنابل/النبات وطول السنبلة وعدد الحبوب الممتلئة بالسنبلة تأثير مباشر وموجب على محصول الحبوب بينما بقية الصفات اظهرت تأثير سالب على محصول الحبوب. يدل هذا على ان أكبر عدد من الحبوب الممتلئة بالسنبلة هو أكبر مكون صادق لمحصول الحبوب تحت ظروف هذه الدراسة، الصفة الاخرى المهمة والتى لها تأثير مباشر على محصول الحبوب هو عدد السنابل بالنبات ومساحة ورقة العلم حيث اظهرا تأثيرا مباشرا وموجبا على محصول الحبوب، وعلى ذلك يجب استخدام عدد السنابل وعدد الحبوب الممتلئة بالسنبلة كأولوية فى برنامج تحسين الارز لأنهما ذات تأثير كبير على محصول الحبوب. وجد ارتباط عالى المعنوية وموجب بين محصول الحبوب وكلا من عدد السنابل/ النبات وطول السنبلة وعدد الحبوب الممتلئة بالسنبلة ووزن الالف حبة. اظهر تحليل معامل المرور مساهمة كل صفة من خلال تحليل معامل الارتباط الى تأثيرات مباشرة وغير مباشرة للصفة.