UNDER PEER REVIEW

Correlation and path coefficients Analysis between Morphological Characteristics and Conservable grain Yield under conditions of different planting method of sweet corn and super sweet (*Zea Mays* L. var. Saccharata) varieties

Abstract

In order to investigate the effects of different planting method on morphological characteristics of sweet corn and super sweet varieties, an experiment was conducted at the Khorasan Razavi Agricultural Research and Natural Resources Center, Mashhad, Iran during 2012. In this research treatment experiments consisted of three planting method (one and two raised bed and furrow planting) and three varieties sweet corn (Chase, Temptation, KSC403su) and one super sweet corn (Challenger) were cultivated factorial design based on randomized complete block design with three replication. The Pearson's simple correlation and stepwise regression analysis were used to determine the effective attributes on regression model. In addition, Path coefficient analysis was used to assess the direct and indirect effects of morphological traits on conservable grain yield. The result of variance analysis demonstrated that different planting methods had significant effects on morphological traits such as plant height, ear height, ear leaf area, relative growth rate, 1000- grain weight, ear diameter, number of ear per plant, grain depth, conservable grain yield and plant harvest index at a 0/01 level of probability. Result of variance analysis (ANOVA) indicated significant differences between traits such as the number of ear per plant, ear diameter, grain percentage, ear cob percentage, 1000-grain weight, conservable grain yield, and Plant harvest index. The results that obtained from the correlation coefficient analysis identified the high and significant correlation (0/01) between conservable grain yield and all traits except plant height, ear height, relative growth rate, ear diameter and the number of ear per plant. The result of stepwise method of regression analysis and path coefficient indicated that conservable grain yield was affected by three traits of 1000-grain weight, ear diameter, number of ear per plant. Furthermore, these three traits manifested the high and significant regression coefficient on conservable grain yield respectively and could justify the effect of these traits on conservable grain yield variations being about more than 74 percent. The effect of other traits was relatively insignificant. Results of path coefficient analysis indicated that the direct effects of all traits on conservable grain yield were positive. Therefore, Traits such as 1000-grain weight, ear diameter and the number of ear per plant had the highest direct

UNDER PEER REVIEW

effect on conservable grain yield respectively. According to this study, selecting the plants which had traits of more than 1000-grain weight, more ear diameter and number of ear per plant, were appropriate for improving the conservable grain yield.

Key words: planting method, conservable grain yield, Path coefficient, Stepwise method, correlation coefficient analysis

INTRODUCTION

Sweet corn crop is produced with high nutritional value and the tendency for producing of fresh or conserve form of it, has been increased (Ti-Da *et al*., 2006). In addition, nowadays sweet corn (*Zea mays L. var Saccharata*) is one of the popular vegetables which Americans tends to use it and the tendency for using it has been increased among Asians and Europeans, too (Abendroth and Freehill, 2006). As a result of increasing demand and the importance of sweet corn, the areas of land being under cultivation of sweet corn has been increased. In coordination with the growth speed of industrial agriculture in the world, the cultivation of this plant has been increased in Iran, because of possessing the qualities such as the high production potentiality, adaptation compatibility, high compatibility with different climates and vast cultivation area in tropical and subtropical climates. Considering the existing time gap after cessation of winter's rain & snowfall to the next planting in autumn, selecting the suitable plants, which require short–term cultivation (80-90days) have priority to others which leads to the optimal use of two stocks of land and time. According to the conducted studies, the planting method of two rows raised bed had superiority to the planting method of one rows raised bed in Iran (Bazrafshan *et al*., 2006). Most of researchers found that the two rows raised bed planting method with constant density had more effect than one row raised bed planting method on yield (Amiri *et al*., 2009). Suitable cropping pattern via appropriate distribution of light in plant canopy was going to the increase in amount of energy. For instance, when the spacing between rows decreased and the spacing between plants increased, constant density of yield would increase because of the increase in getting more light (Prine, 1969). Sprague and Dudley (1998) reported that grain yield in two-row raised bed planting method was more than the single-row planting method. The results of experiment showed that grain yield had significant positive correlation with some traits such as the number of grain per ear, 1000-grain weight, ear weight and ear height (Khatun *et al*., 1999). Result obtaining from the research of Nasrolah Alhossini indicated that on one hand, there was a positive and significant correlation between two variables of conservable grain yield and harvest index, ASI under saline conditions. On the other hand, there was a significant negative correlation between grain yield and traits of the number of ear per plant,

UNDER PEER REVIEW

ear cob diameter (Nasrolah Alhossini *et al*., 2011). Results of most researches have manifested that there is a significant positive correlation between grain yield and the plant height, ear height, ear diameter, ear cob diameter, number of rows per grain, number of grain per ear, 1000-grain weight (Nemati *et al*., 2009; Khatun *et al*., 1999; Viola *et al*., 2003). Therefore, these traits have considerable importance for the increase in grain yield on maize hybrids (Nemati *et al*., 2009). The results of field experiments have determined that the relationship between yield and 300-grain weight, number of row per grain, number of grain per row, ear diameter, and number of ear per plant can use as an important yield components for the breeders (Nemati *et al*., 2009). This finding has confirmed the result of (Amiri *et al*., 2009 and Agrama 1996). Also, other researches indicates that traits such as the number of row per grain, number of grain per ear and 1000- grain weight have a positive direct effect on grain yield (Khazaei *et al*.,2010 ;Viola *et al*., 2003). Evaluating of simple correlations between grain yield and yield components has shown the significant and positive result (Ahmed *et al*., 2001). The result of regression analysis indicated the significant positive direct and indirect effects on traits such as the ear length, number of grain per row, number of row per grain and 1000-grain weight in comparison with other yield component traits (Deovi *et al*., 2001). For selecting high-yield varieties, it was necessary to determine the role of effective traits on yield and for understanding of their relationships path coefficient analysis was used (Torres *et al*., 2004; salleem *et al*., 2007). Traits correlations with yield due to the direct effect of one trait or indirect effects of others could be determined by path coefficient analysis. Investigated traits in correlation analysis had different effects on yield and it was identified as the most important factor for improving the yield which could be examined by regression analysis and it was used for identifying the factors leading to the highest direct or indirect effect on yield (Sadek *et al*, 2006 ; Bahoush and Abbasdokht, 2008). it is noticeable that evaluating of direct and indirect effects of traits by using of the path coefficient analysis provides more accurate and more acceptable results in this field. Just using of Correlation and regression analysis cannot provide the selection of suitable indices estimating of regression coefficients among agronomic traits led to the development of appropriate information in order to modify plants. Identifying and understanding of relationship between traits, especially the effect of each trait on yield was the first step for selecting the best plant breeding components (Bahoush and Abbasdokht, 2008). Therefore, identification and suitable selection of high yield plants and planting methods required correlation analysis. Determination of components with highest direct effect on conservable grain yield was the most important factor in improving the grain yield in management programming .Planning of

UNDER PEER REVIEW

more successful breeding programs and more desired varieties could be achieved by using these relationships (Ashofteh beiragi *et al*, 2011).

MATERIAL AND METHODS

The present study was conducted to evaluate the effects of different planting method on morphological characteristics of sweet corn and super sweet (*Zea Mays* L. var. Saccharata) varieties and estimating the simple correlations and direct and indirect effects of different treatments on conservable grain yield. The field experiment was at the Khorasan Razavi Agricultural Research and Natural Resources center, (Latitude: 36˚ 13́ N., Longitude: 59˚ 40́E., and 985 meters above sea level) in Mashhad, Iran during the 2012.Treatment experiment consisted of three planting method (one and two row raised bed and furrow planting) and the varieties consisted of three sweet corn varieties (Chase, Temptation, KSC403su) and a super sweet corn(Challenger),which was conducted in factorial design based on a complete randomized block design (RCBD) with three replication. Seeds were sown on June 20th. The soil texture at experimental area was silt loam (PH= 8 and EC= 1/67 mmho/cm).In this research each experimental plots consisted of 4 lines with 4/5 meters length, 75 and 20 cm spacing between rows, respectively. The plant density was adjusted as 66000 plants/ha. Three seeds per hill were planted, which were thinned to one plant per hill at 4-6 leaf stage. According to Water and Soil Researches Institute, fertilizer consisted of 200 kg/ha Ammonium phosphate ($NH_4H_2PO_4$), 200 kg/ha K_2SO_4, 300 kg/ha urea (CH_4N_2O) was applied to each experiment and this was followed by 200 kg/ha N as urea at the six leaf stage. During the growth period, some of the morphological traits such as plant height, ear height, and ear leave area were considered. Data recorded on 10 randomly selected plants from each plot, yield components and conservable grain yield (kg ha^{-1}) calculated from the entire plot. Also, the relative growth rate (RGR) based on the formula which was suggested by (Nevada and Cross, 1990) calculated as follow:

$$RGR = \frac{0.75 \times \text{leaf width} \times \text{leaf lenght} \times \text{number of total leaf}}{number\ of\ date\ silking}$$

At the time of harvesting sweet corn which was the beginning of grain dough stage (65-70 percentage), first, in each plot two lateral rows and half a meter removed from the beginning and end as the removal after effects. Then, the rest of plants were counted and weighed; finally, the grains were harvested by hand. Then, traits such as the ear diameter, number of ear per plant, grain depth, grain percentage, and ear cob percentage of 10 ear in each plot

UNDER PEER REVIEW

were observed and recorded randomly. In this study, In order to determine conservable grain yield, ear grain of each cob were separated and weighed. In addition, trait of 1000-grian weight was calculated based on 70% moisture. Trait of plant harvest index obtained from the calculation of the proportion of grain yield to the biological yield. In Statistical analysis, variance analysis of data was estimated based on the complete randomized block design. Then, the correlation coefficients between studied traits were estimated. Although the correlation coefficients between traits gave useful information to the researcher, the separation of simple correlation coefficients in detail and their direct and indirect effects via path analysis provided information that is more accurate. In this way, it could help the researcher to access the proper information and selecting the traits, which were useful for achieving desired goals. (Khavari Khorasani *et al.*, 1997) For this purpose, conservable grain yield was considered as dependant variable and the Stepwise regression analysis was used to identify the traits effects on conservable grain yield. Then, the direct and indirect effects of traits on conservable grain yield were calculated via path analysis (Dewy and Lu, 1959). In this research, data related to the traits measurements, was entered to Excel software and gathered information was analyzed by MSTAT-C software. Mean were compared using Duncan's multiple range tests at a 0.05 level of probability and F values were significant (steel and Torrie, 1984). For calculating the simple correlation coefficient between all variables, the stepwise regression and the Calculation of path- coefficient were done with SAS (ver.9.2) software's.

RESULTS AND DISCUSSIONS

Results of variance analysis between studied variables revealed that plant height, ear height, ear leaf area, relative growth rate, ear diameter, number of ear per plant, 1000 grain weight, grain depth, conservable grain yield and plant harvest index at a 1% level of probability were affected by different planting methods. In addition, another part of analysis showed the traits such as the grain percentage and ear cob percentage did not have significant differences (Table 1). This study revealed the significant differences among traits of number of ear per plant, grain depth, cob ear percentage, and grain percentage at a 5% level of probability. Traits of 1000-grain weight and conservable grain yield had a significant effect at a 1% level of probability (Table1). The significant differences among treatments were seen as the indicative of being enough diversity between studied variables. Therefore, the selection of varieties and suitable planting methods in terms of yield and yield components would be possible. Other studies indicated the high and significant diversity in corn varieties in traits of plant height, ear cob length, flag leave area, number of grain per ear, biological yield and

UNDER PEER REVIEW

grain yield (Saleem *et al.*, 2007). Result of interaction between varieties × planting method indicated there were significant differences among traits of the number of ear per plant, grain depth, grain percentage, ear cob percentage, 1000-grain weight and conservable grain yield at a 1% level of probability and it was only significant in plant harvest index at a 5% level of probability (Table 1). The results of mean comparison indicated that different planting methods had varied effects on each studied variables in such a way that the effect of two raised bed method on plant height, ear leaf area, relative growth rate, ear diameter and conservable grain yield was at the highest amount. As a result of increase in traits via two-raised bed planting method and spatial arrangement, more desired plants distribution and closeness to the square form was achievable. In addition, it caused less competition between plants and the highest plants potentiality which was used for absorbing the light led to increase in yield (Ottman and Welch, 1989). The effects of varieties on traits indicated the significant difference in such a way that the highest amount in traits of grain percentage, 1000-grain weight and the conservable grain yield belonged to Challenger variety among others (Najafi Nejad *et al*., 2009). reported that there were differences among varieties in terms of genetic aspect; therefore, these differences were under influenced of environment while they appeared in phenotypes. Hence, phenotypic differences in some characteristics of varieties in terms of genetic differences are usual and the varieties, which are able to be compatible with local conditions and have had the high yield potentiality, are recommendable to farmers. Interaction effects of planting method × varieties indicated the highest amount of 1000-grain weight in one row raised bed method belonged to Challenger variety being about the average of 128 gram. Also, the highest amount of conservable grain yield in two-row raised bed method belonged to Challenger varieties with average of 25 ton/ha while the interaction effects of one rows raised bed × verities indicated 43 percent which belonged to Cheas variety.

Correlation analysis

Ease in recognition or measuring the trait or traits which were related to the high yield had particular importance in breeding programs in such a way that they should be recognizable in farm directly which led to ease in selection and increase in yield (Zeinali *et al.*,1384). In practice, the most important trait was grain yield in all breeding programs. In addition to low heritability, it was a complex trait, which was affected by range of morphological and physiological mechanisms. Result of Simple correlation coefficients indicated that there was a significant positive correlation between conservable grain yield and traits of grain depth, ear diameter and grain percentage ($r = 0.42^{**}$, $r = 0.53^{**}$ and $r = 0.43^{**}$ respectively). Conservable

UNDER PEER REVIEW

grain yield and ear cob percentage (r = -0.43**) had significant negative correlation (Table 1). It is noticeable the correlations below 50 percentages do not have biological value in breeding programs. Investigation of simple correlation coefficients demonstrated the conservable grain yield had significant correlation with traits of 1000-grain weight (r=0.82**) and plant harvest index (r = 0.77**). The results in this experiment concur with the results of other researchers such as (Rafiei *et al*., 2002 ; Sharma *et al*., 1987). In this experiment, results of simple correlation coefficients demonstrated the significant positive correlation between relative growth rate and plant height, ear height respectively (r = 0.86** and r = 0.93**). Increase in Co2 absorption, producing photo Assimilate and reduction of entering the photosynthetic active radiation to the lower classes of canopy, increase in plant height and corn as two main resources of reserving assimilate seemed logical, because of the increase in leaf's growth rate and the leaf corn area. One of the effective traits on yield was the ear leaf area. It seemed that, increase in this trait led to the reduction of conservable grain yield, which was indicated in form of negative correlation (table 1). In this study, the high correlation between conservable grain yield and ear leaf area indicated that the size of leaf corn should be considered. It seemed the role of photosynthesis on leaves in grain fullness per ear and subsequently on grain yield was determinant. these results were in harmony with those obtained by(Zeynali *et al*., 2006). Also, the high significant positive correlation between conservable grain yield and 1000- grain weight confirmed this (Table 1). It seemed logical that increase in amount of this trait should be considered in selection of high yield varieties. In addition, the highest significant negative correlation was observed between conservable grain yield and ear leaf area, ear cob Percentage being about (r = -0.43**) (Table1). The results of stepwise regression analysis indicated the above trait was the first one which was entered to the model. These results were in agreement with those obtained by Pongsak (1997). The correlation between relative growth rate and traits of ear leaf area, ear diameter had significant effect at a 1% level of probability, amount of 0.63** and 0.95**, respectively.

Regression analysis

Considering the conservable grain yield as dependant variable at a 0/05 level of probability, the results that obtained from stepwise regression analysis indicated that conservable grain yield was affected by three traits including the 1000-grain weight, ear diameter and ear number per plant. In addition, investigation of the correlation coefficient between conservable grain yield and traits of ear diameter , number of ear per plant showed that these two variables had the highest correlation (r = 0.82**) (Table 4). Therefore, at first step, the high correlation between these two traits led to the inclusion of the 1000-grain weight in

UNDER PEER REVIEW

model, which could justify 0.67 percent solely, and the largest share in conservable grain yield. Considering the numerical amount of adjusted coefficient, three traits above had the high cumulative effect on conservable grain yield and totally could justify more than 74 percent of conservable grain yield variation (Table 5). Out of three traits, which were entered to the model, the highest model of regression equation coefficient was related to the trait being the number of ears per plant. It seemed that the results obtaining from this study were affected by genetic and environmental factors in site testing. In order to improve the conservable grain yield, these traits were useful.

Path coefficient analysis

Evaluating of path coefficient analysis of each studied trait manifested the trait of the1000-grain weight (0.846), ear diameter (0.248) and number of ear per plant (0.225) had just positive indirect effects on conservable grain yield (Figure1). The result of indirect effects indicated that ear diameter had positive indirect effects on conservable grain yield which could be justify via the (0.028) weight of 1000- grain. Thus, it can be said the number of ear per plant had indirect and negative effects on conservable grain yield through traits of ear diameter (-0.0921) and 1000grain weight (-0.0521) (Table 7). According to These results, it can be expressed the 1000-grain weight can be known as the most important trait and because of having the most positive and direct effect on conservable grain yield and can be used as the criteria which is appropriate for choosing between the varieties of high yield sweet corn. According to the negative direct effects, it can be expressed the selection of those varieties which have less number of ear, can be increased through the heightening of the ear diameter which leads to the weights of over than 1000-grain and finally it will lead to the increase in conservable grain yield. Considering the formation of all effective traits on yield during the growth period and their effects on each other and finally on grain yield, it should be noted that providing the suitable conditions for growth and selection of suitable planting methods can be the one way for improving the conservable grain yield. These results are consistent with results of similar researches.

Conclusion

According to the result of the study, different planting methods have indicated significant effect on morphophisological characteristics of all the studied traits. In evaluating the results among varieties, significant differences have been observed on traits such as the number of ear per plant, grain depth, grain percentage, ear cob percentage, 1000-grain weight, and conservable grain yield and plant harvest index. In this experiment, evaluating of correlation coefficients on the studied traits also indicates there is a particularly significant correlation

UNDER PEER REVIEW

between conservable grain yield and all traits except plant height, ear height, and relative growth rate of ear leaf, ear diameter, and number of ear per plant at 1% level of probability. Results of stepwise regression analysis indicate that conservable grain yield is affected by the three traits of the 1000-grain weight, ear diameter, and number of ear per plant. Therefore, the three traits above have had high and significant regression coefficient on conservable grain yield, which can totally justify more than 74% of the conservable grain yield variation. The effect of the other studied traits is relatively insignificant. Considering the result of path analysis, direct effects of all traits on conservable grain yield are positive. Consequently, traits such as 1000- grain weight, ear diameter, and number of ear per plant have respectively the highest positive and direct effect on conservable grain yield. Generally, results of the study emphasize the point that, Selecting plants which have weighed over than 1000-grains and have more ear diameter in proportion to the number of ear per plant, are appropriate for improving the conservable grain yield. Therefore, in order to achieve more desired results leading to prediction of future condition confidently, such an experiment must be done in extend scope and covers all probable aspects.

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Table1. Means Square of Analysis Phonology characters, Yield, and Yield component on sweet and super sweet corn

Source of Variances	Df	1	2	3	4	5	6	7	8	9	10	11	12
Replication	2	53^{ns}	135^{ns}	890^{ns}	13.6^{ns}	0.07^{ns}	0.069^{ns}	0.35^{ns}	0.002^{ns}	0.002^{ns}	20^{ns}	0.49^{ns}	107^{ns}
Pm	2	2103^{**}	2697^{**}	64475^{**}	2263^{**}	12.9^{**}	0.34^{**}	5.6^{**}	0.002^{ns}	0.002^{ns}	109.62^{**}	11.409^{**}	238^{**}
V	3	85^{ns}	137^{ns}	8437^{ns}	216^{ns}	0.2^{ns}	0.33^{*}	2.5^{*}	0.004^{*}	0.004^{*}	1154.83^{**}	77.105^{**}	70.7^{ns}
Pm*V	6	128^{ns}	116^{ns}	7906^{ns}	161^{ns}	4.7^{ns}	1.08^{**}	3.06^{**}	0.003^{**}	0.003^{**}	86.56^{**}	3.352^{**}	136^{*}
Error	22	156	244	5387.5	205	2.1	0.8	0.6	0.001	0.001	10.74	0.8	46
CV	35	31.44	8.99	20.37	34.55	3.11	15.75	4.58	4.63	9.61	2.9	4.55	21

(1):Ear Height, (2): Total Plant Height, (3): Leaf Area Index, (4): Leaf Ear Growth ratio, (5): Ear Diameter, (6): Number of Ear/Plant, (7): Grain Depth, (8): Grain%, (9): Cob%, (10): 1000Grain Weight, (11): Conservable grain yield and (12): Plant Harvest Index. Pm: Planting Methods, V: Varity and Pm*V: Interaction Between Planting Methods and Varity. Also C.V : Coefficient of variance. Ns,* and **: Non – significant and significant at 5% and 1% levels of probability, respectively

Table 2.Means Comparison some Morphological Traits, Yield, and Yield component of Sweet and Super sweet Corn.

Trait	Levels	1	2	3	**4**	**5**	**6**	**7**	8	9	**10**	**11**	**12**
Planting Method(M)	**M1**	29.4a	163b	329.7b	34.29b	46.6b	1.4a	17b	0.64a	0.35a	110b	19b	28.19b
	M2	35.1b	168b	307.2b	32.86b	47.4b	1.19b	18.3a	0.66a	0.33a	116a	19b	37.05a
	M3	54.7b	191a	443.9a	57.33a	48.7a	1.08b	17.4b	0.67a	0.32a	112b	20a	31.6ab
Verities(V)	**V1**	36.9a	171.8a	327.9a	35.4a	47.7a	1.2ab	18.3a	0.6ab	0.3ab	118b	19b	34.5a
	V2	41.4a	178.5a	401.3a	45.47a	47.3a	1.3a	17b	0.63b	0.36a	101d	17c	28.2a
	V3	37.4a	170.1a	351.2a	39.64a	47.7a	1.1b	17.4b	0.67a	0.32b	126a	23a	32.9a
	V4	43.3a	176.3a	360.7a	45.45a	47.6a	1.1ab	17.5ab	0.68a	0.31b	105c	17c	33.5a
Planting Method× Verities	**M1 * V1**	26a	158.2a	292a	28.16a	46.2a	1.4b	17.7a-d	0.6ab	0.3bc	107c	20c	22.34e
	M1 * V2	27.1a	167.3a	337.4a	30.72a	47.1a	1.8a	16.7de	0.60c	0.39a	101de	16e	34a-e
	M1 * V3	25.1a	158.9a	334.4a	33.03a	45.7a	1.2bc	15.81e	0.6bc	0.4ab	126a	22b	26cde
	M1 * V4	39.5a	168.7a	354.9a	45.24a	47.5a	1.06c	17.7a-d	0.6ab	0.3bc	105cd	17de	29b-e
	M2 * V1	31.8a	167.2a	264.9a	26.21a	48.1a	1.2bc	18.9ab	0.6bc	0.4ab	127a	18cd	43.58a
	M2 * V2	45.4a	177.9a	429.3a	48.1a	47.9a	1.04c	18.3abc	0.6ab	0.3bc	105cd	16e	27b-e
	M2 * V3	27a	155.8a	245.2a	26.39a	47.5a	1.02c	19.12a	0.69a	0.30c	128a	23b	36.5abc
	M2 * V4	35.7a	171a	289.6a	30.73a	45.9a	1.4b	17cde	0.6ab	0.3bc	103cde	17.1e	40.4ab
	M3 * V1	53a	189.9a	426.9a	51.83a	48.7a	1.0c	18.2a-d	0.69a	0.30c	119b	18cd	37.5acb
	M3 * V2	51.7a	190.3a	437.3a	57.6a	46.9a	1.2bc	15.88e	0.6bc	0.3ab	98e	19c	23de
	M3 * V3	59.4a	195.6a	473.9a	59.5a	49.7a	1.00c	17bcd	0.7a	0.3c	124ab	25a	35a-d
	M3 * V4	54.6a	189.4a	437.6a	60.38a	49.4a	1.04c	18abcd	0.6ab	0.3bc	108c	19c	30a-e

(1):Ear Height (Cm), (2): Total Plant Height (Cm), (3): Leaf Area Index (Cm^2), (4): Leaf Ear Growth ratio, (5): Ear Diameter (Cm), (6): Number of Ear/Plant, (7): Grain Depth(mm), (8): Grain(%), (9): Cob(%), (10): 1000Grain Weight(gr), (11): Conservable grain yield (Ton/Hec) and (12): Plant Harvest Index(%). **Planting Method** (M1: furrow planting, M2: one raised bed and M3: two raised bed) **Varieties** (V1: Chase, V2: Temptation, V3: Challenger and V4: Ksc403 su). Means, in each column, followed by similar letter are not significantly different at the 5% probability level using Duncan, s multiple range test

UNDER PEER REVIEW

Table3.Correlation coefficients among Morphological Traits, Yield and Yield component of Sweet and Super sweet Corn

	Ear Height	Total Plant Height	Leaf Area Index	Leaf Ear Growth ratio	Ear Diameter	Number of Ear/Plant	Grain Depth	Grain(%),	Cob(%),	1000Grain Weight	Conservable grain yield	Plant Harvest Index
(1)	1.0											
(2)	0.94**	1.0										
(3)	0.87**	0.8**	1.0									
(4)	0.93**	0.86**	0.95**	1.0								
(5)	0.69**	0.63**	0.54**	0.63**	1.0							
(6)	-0.4*	-0.28ns	-0.28ns	-0.38*	-0.4*	1.0						
(7)	-0.02ns	-0.06ns	-0.26ns	-0.18ns	0.33*	-0.21ns	1.0					
(8)	-0.09ns	0.03ns	0.06ns	0.01ns	-0.21ns	0.34*	-0.57**	1.0				
(9)	0.09ns	0.03ns	-0.06ns	-0.01ns	0.21ns	-0.34*	0.57**	-0.98**	1.0			
(10)	-0.06ns	-0.17ns	-0.21ns	-0.16ns	0.11ns	-0.23ns	0.4*	0.4*	-0.4*	1.0		
(11)	0.02ns	-0.03ns	-0.43**	-0.08ns	0.05ns	-0.07ns	0.42**	0.43**	-0.43**	0.82**	1.0	
(12)	-0.16ns	-0.27ns	-0.27ns	-0.27ns	0.06ns	-0.05ns	0.33*	0.16ns	-0.16ns	0.74**	0.77**	1.0

(1): Ear Height, (2): Total Plant Height, (3): Leaf Area Index, (4): Leaf Ear Growth ratio, (5): Ear Diameter, (6): Number of Ear/Plant, (7): Grain Depth, (8): Grain(%), (9): Cob(%),(10): 1000Grain Weight, (11): Conservable grain yield, (12): Plant Harvest Index. Ns,* and **: Non – significant and significant at 5% and 1% levels of probability, respectively

Table4. Analysis of Variance of Stepwise Regression

	Analysis of Variance							
	Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**R^2 - adj**	**R^2 - Partial**	**C(p)**
First Step	Model	1	334.08886	334.088**	70.96**	0.6761	0.6761	34.21
	Error	34	160.06602	4.70782				
	Corrected Total	35	494.15487					
Second Step	Model	2	346.82381	173.411**	38.84**	0.7019	0.0258	30.94
	Error	33	147.33107	4.46458				
	Corrected Total	35	494.15487					
Thirth Step	Model	3	366.83405	122.278**	30.73**	0.7423	0.0405	24.66
	Error	32	127.32082	3.97878				
	Corrected Total	35	494.15487					

Ns,* and **: Non – significant and significant at 5% and 1% levels of probability, respectively

Table5. Summary of Stepwise Regression for independent variable

Number Vars In	Variable Entered	M.S Model	M.S Error	F Value	Partial R-Square	adj R-Square	C(p)
1	1000Grain Weight	334.08	4.70	70.96**	0.6761	0.6761	34.21
2	Ear Diameter	173.4	4.46	38.84**	0.0258	0.7019	30.94
3	Number of Ear/Plant	122.27	3.97	30.73**	0.0405	0.7423	24.66

Ns,* and **: Non – significant and significant at 5% and 1% levels of probability, respectively

Table6.Coefficients of Stepwise Regression equation in conservable grain yield

Variable	First Step	Second Step	Thirth Step
Intercept	8.8030	-7.7908	-20.8798
1000Grain Weight(gr)	0.0864	0.8451	0.0889**
Ear Diameter	-	0.3530	0.5439**
Number of Ear/Plant	-	-	2.8534**

* and **: Regression coefficient in last step was significant at 5% and 1% probability levels respectively

X_1 = 1000Grain Weight, X_2 = Ear Diameter, X_3 = Number of Ear/Plant

$Y= 8.8030 + 0.0864X_1$

$Y= -7.7908 + 0.8451X_1 + 0.3530X_2$

$Y= -20.8798 + 0.0889X_1 + 0.5439X_2 + 2.8534X_3$

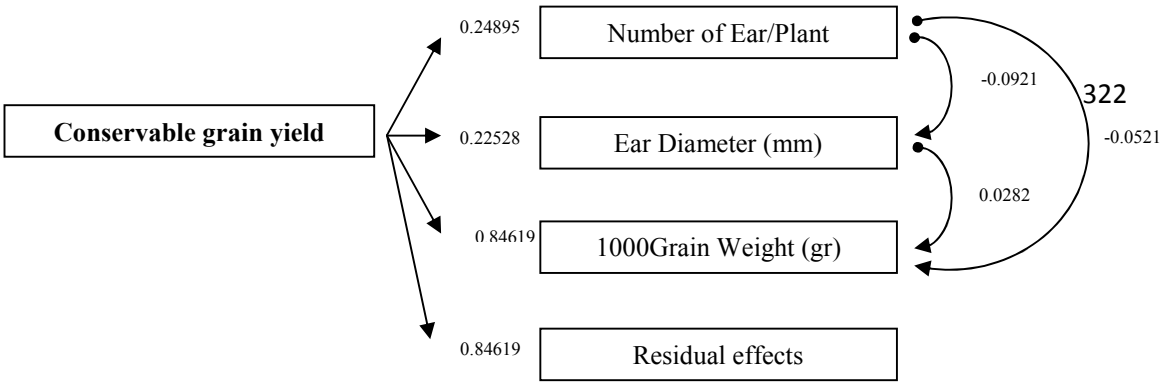
UNDER PEER REVIEW

Table7. Parameter Estimates of Path analysis for conservable grain yield

Variable	DF	Standard Error	T Value	Standardized Estimate	Correlation With Y	Indirect Effect (Y)		
						Ear Diameter	Number of Ear/Plant	1000Grain Weight
Ear Diameter(mm)	1	0.21491	2.53**	0.24895	0.25^{ns}	---	-0.1018	0.0282
Number of Ear/Plant	1	1.27236	2.24*	0.22528	-0.07^{ns}	-0.0921	---	-0.0521
1000Grain Weight(gr)	1	0.00970	9.17**	0.84619	0.82^{**}	0.0958	-0.1958	---

Ns,* and **: Non – significant and significant at 5% and 1% levels of probability, respectively

Figure 1.Path coefficient values estimated for Conservable grain yield of sweet corn



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