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Assess Correlation and Regression between Effective Traits on Corn Seed yield Affected Different Level of Irrigation and Micro Nutrient

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RESEARCH ARTICLE

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ABSTRACT

BACKGROUND: Presence of sufficient amounts of nutrients in plant organs results in better grain filling and increased grain weight.

OBJECTIVES: This study was conducted to evaluation effect of different levels of irrigation and iron and zinc chelates on correlation between quantitative and qualitative traits of corn crop under warm and dry climate condition.

METHODS: This research was carried out via Split plot experiment based on randomized complete blocks design with three replications along 2018-19 year. The treatments included water stress (60, 90 and 120 mm evaporation from class a evaporation pan) as a main plot and iron and zinc chelates (non-spraying, foliar spray of 2 per thousand and 5 per thousand) belonged to subplot.

RESULT: Result of analysis of variance revealed effect of different level of irrigation regimes and spraying zinc and iron on all studied traits was significant at 1% probability level (instead Seed protein content, was significant at 5% probability level). Also interaction effect of treatment on all studied traits was significant at 1% probability level (instead 1000-seed weight, Seed protein content, Seed zinc content and Seed iron content was not significant). Simple correlation coefficients between traits these coefficients were estimated according to Pearson coefficient. Result showed the most positive and significant correlation between biologic yield ($r=0.98^{**}$), 1000-seed weight ($r=0.83^{**}$), number of seed per row ($r=0.70^{**}$) and seed yield was observed. Also the traits of number of seed per ear ($r=0.59^{*}$), seed protein percent ($r=-0.52^{*}$) had significant correlation with the seed yield at 5 percent probability level.

CONCLUSION: Generally traits such as of biologic yield, 1000-seed weight, number of seed per row had the most positive-direct effects on Corn seed yield can be proposal to plant breeder to more studied process such as stepwise regression and path analysis.

KEYWORDS: *Crop production, Iron, Maize, Protein, Water deficit.*

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1. BACKGROUND

Production of maize for forage or seed requires a lot of water. However in last decades breeders focused on introducing drought tolerant crops (Tabatabaei and Shaleri, 2015) but plant nutrition got a special consideration in water deficit situation (Norastehnia and Farjadi, 2016). Between plant nutrition elements, potassium has a special value in biotic and abiotic stresses like drought stress. Maize is the one of the important field crops in creating human food security (Afarinesh, 2015; Shiri *et al*., 2015). Crop production during the spring and summer months in the semiarid Mediterranean-type environments mainly relies on irrigation (Sepaskhah and Khajehabdollahi, 2005). One of limitation factor in agricultural plants production in dry areas in the water tension at growth step negative effect of water tension on corn growth depends on the time of tension occurrence, the intensity, plant growth and genotype step (English and James, 1990). Deficit irrigation strategies were equally effective in saving irrigation water. Alternate furrow irrigation practice for rapeseed provides water use efficiency benefit compared to full irrigation. The value of benefits from water saving should be balanced with the value of yield reductions and the cost of implementing alternative irrigation system compared to conventional systems (Bahrani and Pourreza, 2016). Multivariate analyses are useful for characterization, evaluation and classification of plant genetic resources when a number of accessions are to be assessed for several characters of agronomic, morphological and physiological importance. Different types of multivariate analysis such as regression analysis, path analysis, principal component analysis (PCA) can be used to identify groups of genotypes that have beneficial traits for breeding and instructing the patterns of variation in genotype accession, to recognize relationships among accessions and possible gaps. Correlation coefficients describe the mutual relationships between different pairs of characters without providing the nature of cause and effect relationship of each character (Sharifi *et al*., 2020). Yield improvement is a major breeding objective of most crop improvement programs (Ghobary and Abd-Allah, 2010). More than two billion people in Asia, Africa, and Latin America suffer from severe malnutrition and iron (Fe) and zinc (Zn) deficiencies (Grujcic *et al*., 2018; Gupta *et al*., 2008). Zinc is an essential low-use element involved in the activity of various enzymes. Carbonic anhydrase, which catalyzes the reversible conversion of carbon dioxide and water into carbonic acid, contains zinc and requires zinc for its activity (Weisany *et al*., 2012). Zinc plays a role in protein metabolism, gene expression, structural and functional integrity of biological membranes and photosynthetic carbon metabolism. Zinc interferes in regulating the opening of the stomata due to its role in maintaining the integrity of the membrane. In zinc deficiency, the K+ content of stomatal guard cells decreases (Tester and Davenport, 2003). Zinc is necessary in the biosynthesis of growth regulators like indoleacetic acid and carbohydrates that improve yield and yield components. It may be due to their importance in accumulation of assimilates in grains in the final stages of plant growth, and as a result, production of larger and heavier grains. Reduced number of grains per plant under nutrient deficiency indicates the negative effects of absence of the aforementioned micronutrients, consequently preventing the reproductive organs from preparing for grain production (Bybordi and Mamedov, 2010). Zinc deficiency in cases caused by the limitations of the subsoil, dryness of the surface soil and diseases cannot be completely and definitively resolved through the consumption of fertilizers containing zinc. Therefore, the use of effective genotypes for the absorption of zinc can be an effective and sustainable solution for the production of more crops in conditions of zinc deficiency (Sadeghzadeh, 2013). Zinc deficiency exists in a large part of the hot and cold regions soils in the world, and it is considered one of the most important deficiencies of micronutrients in the world (Mostafavi Rad *et al*., 2018). Zinc sulfate is used in strips in the soil at the same time as cultivation. In addition, if needed, this fertilizer can be used as a foliar spray (3-5 per thousand) in 2-3 times with intervals of 15 days. Since soil application of zinc has multi-year residual effects, it is recommended to use this fertilizer as soil (Malakouti, 2005). Iron deficiency occurs in different plants depending on several soil, environmental and genetic factors and causes a significant decrease in yield and product quality (Goos and Johnson, 2001). Naeve (2006) stated that foliar feeding of iron is a suitable method to eliminate iron deficiency, but this method is only effective for plants with mild yellowing symptoms (Chlorosis) or in a short period of time. Spraying of iron solution and a combination of iron and zinc increased the concentration of iron in black cumin (*Nigella sativa*) leaves (Mousa *et al*., 2004). Foliar spraying of zinc and iron increased yield and absorption of nutrients in peanut compared to control, and the combined application of iron and zinc had a greater effect (Attia, 2004).

2. OBJECTIVES

This study was conducted to evaluation effect of different levels of irrigation and iron and zinc chelates on correlation between quantitative and qualitative traits of corn crop under warm and dry climate condition.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was done via Split plot experiment based on randomized complete blocks design with three replications along 2018-19 year. Place of research was located in Hamideyeh city at longitude 48°10'E and latitude 31°33'N in Khuzestan province (Southwest of Iran). The treatments included water stress (60, 90 and 120 mm evaporation from class a evaporation pan) as a main plot and iron and zinc chelates (non-spraying, foliar spray of 2 per thousand and 5 per thousand) belonged to subplot. This experiment had 27 plots. Each plot consisted of 6 lines with a distance of 75 cm and 5 meters length.

The distance between the shrubs on every row was 17 cm.

3.2. Farm Management

Base fertilizers (150 $kg.ha^{-1}$ Nitrogen from urea, 90 $kg.ha^{-1}$ Triple superphosphate and 150 $kg.ha^{-1}$ Sulphate potassium) were added to the soil based on soil tests and the recommendations of the Iranian Soil and Water Research Institute at the planting stage. But need to mention half amount of Urea fertilizer was added to soil at stem elongating stage. The light-disk harrow was used to mix the soil and the fertilizer after soil fertilization. The furrower was used to make furrows at a distance of 75 cm. The first irrigation was done one day after planting and until the stage of four to five leaves according to the region's custom. Subsequent irrigations were done according to the amount of evaporation from the evaporation pan. Iron and zinc chelate solution was sprayed in the listed amounts in the early morning when the weather was cool (around 7 to 8 am) at the eight-leaf stage in one time. Iron and zinc liquid fertilizer contains iron chelate (5.3%), zinc chelate (1.2%), amino acids, fulvic acid and humic acid (5%). Zinc and iron chelate fertilizer is completely stable in a wide range of acidity and is used to compensate for zinc and iron deficiency in all crops. This fertilizer was prepared and used from Zarafshan Poison and Fertilizer Company. Weed control was done by manual weeding and no chemical pesticides were used during the growth period. Physical and chemical properties of studied soil were mentioned in table 1.

Table 1. Physicochemical properties of the soil at experiment location

Soil depth (cm)	Soil texture	Clay	Silt	Sand	pH	EC ($dS.m^{-1}$)	P (ppm)	Z (ppm)	Fe (ppm)
0-30	Clay loam	42	37	21	7.2	4.8	9.4	0.63	1.9

3.3. Measured Traits

The final harvest area of each plot was 1.5 m^2. Seed yield, its components and the qualitative traits were estimated after the physiological maturity stage. After separating seed from selected plants and weighing them, seed yield was calculated based on 14% moisture. In order to estimate 100 seed weigh, 10 samples of seed containing 10 seed were separated and the means was calculated. At first total nitrogen was determined by Kjeldahl method and then multiplied by a factor of 5.7 and the seed protein percentage were calculated (Keeney and Nelson, 1982). To measure the amount of iron and zinc elements, first, the sample was placed in a furnace at a temperature of 550 degrees Celsius for 6 to 12 hours until they turned into ash. Then the sample was taken out, a few drops of distilled water were added to it and it was placed at 70 degrees Celsius for one hour. After that, the sample was made up to volume in a 50 cc flask with distilled water and using an atomic absorption device (Perkin 400) and installing a special lamp for each element, the amount of absorption in the wavelengths of 3.24 nm iron and 9.21 nm It was read.

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via SAS (Ver.8) software and Duncan multiple range test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. *Analysis of variance*

Result of analysis of variance revealed effect of different level of irrigation regimes and spraying zinc and iron on all studied traits was significant at 1% probability level (instead Seed protein content, was significant at 5% probability level). Also according result of analysis of variance interaction effect of treatment on all studied traits was significant at 1% probability level (instead 1000-seed weight, seed protein content, Seed zinc content and Seed iron content was not significant) (Table 2).

Table 2. Mean square of traits under irrigation regime and spraying zinc and iron

S.O.V.	Number of seed per row	Number of seed per ear	1000-seed weight	Seed yield
Irrigation regimes (I)	**	**	**	**
spraying zinc and iron **(ZI)**	**	**	**	**
(I × ZI)	**	**	ns	**

*, ** and ns are significant at 5% and 1% probability level and non-significant, respectively.

Table 2. Continued

S.O.V.	Biological yield	Seed protein content	Seed zinc content	Seed iron content
Irrigation regimes (I)	**	*	**	**
spraying zinc and iron **(ZI)**	**	*	**	**
(I × ZI)	**	ns	ns	ns

*, ** and ns are significant at 5% and 1% probability level and non-significant, respectively.

4.2. *Correlation between traits*

Simple correlation coefficients between traits these coefficients were estimated according to Pearson coefficient (Table 3). Result showed the most positive and significant correlation between biologic yield ($r=0.99^{**}$), 1000-seed weight ($r=0.83^{**}$), number of seed per row ($r=0.70^{**}$) and seed yield was observed. Also the traits of number of seed per ear ($r= 0.59^{*}$), seed protein percent ($r=-0.52^{*}$) had significant correlation with the seed yield at 5 percent probability level (Table 3). Al-Salim *et al*. (2017) reported all studied traits except grain weight were highly significantly correlated with grain yield and about 35% of variation in grain yield could be explained by the level of nitrogen fertilizer. Also the traits of plant height and dry and green fodder weight were the major contributors towards grain yield since these traits explained (57%, 52% and 50%) respectively of the variation of grain yield. Soltani Howyzeh *et al*. (2018) by compare seventhin spring canola reported the correlation coefficients among the seed yield and 1000-seed weight, number of seed per pod, harvest index and days to maturity were positive and significant. Results of stepwise regression analysis revealed that 1000-seed weight, number of pods per plant and days to maturity had significantly effects on seed yield.

Table 3. The Correlation results of studied traits

Traits	1	2	3	4	5	6	7
1	-						
2	-0.51*	-					
3	0.53*	0.54*	-				
4	0.70**	0.59*	0.83**	-			
5	0.52*	0.72**	0.89**	0.99**	-		
6	0.33^{ns}	0.27^{ns}	-0.62*	-0.52*	0.21^{ns}	-	
7	0.30^{ns}	0.23^{ns}	0.44^{ns}	0.44^{ns}	0.19^{ns}	-0.51*	-
8	0.25^{ns}	0.21^{ns}	0.35^{ns}	0.35^{ns}	0.15^{ns}	-0.52*	-0.48^{ns}

^{ns}, * and **: no significant, significant at 5% and 1% of probability level, respectively.
1: Number of seed per row, **2**: Number of seed per ear, **3**: 1000-seed weight, **4**: Seed yield, **5**: Biological yield, **6**: Seed protein percent, **7**: Seed zinc content, **8**: Seed iron content.

4.3. *Regression model*

In regression analysis, seed yield was a dependent variable, while other traits were considered as independent variables. Quantification of plant traits associated with yield increase is important in crop breeding programs. Regression models can be used for it purpose (Jafarnodeh *et al*., 2017).

Equ. 1. Y = 3901 + 95.2 NSPR + 11.8 NSPE + 17.6 SW + 70.5 BY + 0.49 SPP-6.52 SZC + 8.89 8.02 SIC.

1: Number of seed per row, **2**: Number of seed per ear, **3**: 1000-seed weight, **4**: Seed yield, **5**: Biological yield, **6**: Seed protein percent, **7**: Seed zinc content, **8**: Seed iron content.

Grain yield is considered to be a complicated trait, which can be affected by many factors, and usually as a result of insufficient yield heritability factor, direct -selection yield. is not much effective for it; as a result, for yield breeding we would better use indirect selection (Tiamuku, S. 2019). The increase of biologic yield and its direct relation with seed yield show the relations between photosynthesis efficiency of plant and seed yield, therefore genotypes which have gained more profit of production factor according to growth conditions and they keep more photosynthesis materials in their sinks, have more efficiency. This status was in conformity with the results of some other researchers (Mardin, 2017; Tian, 2017). The significant and positive correlation between biologic yield and seed yield indicate efficiency and kind of photosynthesis materials distribution in different parts of plant, especially in seed (Fig.1). Results of Xianc (2018) verify the mentioned issues.

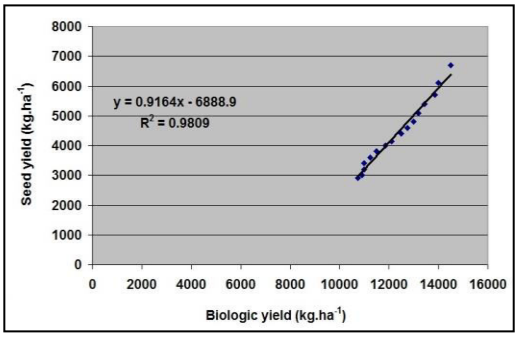

Fig.1. Correlation between seed yield and biologic yield

5. CONCLUSION

Generally according finding of this study, traits such as of biologic yield (r=0.98**), 1000-seed weight (r=0.83**), number of seed per row (r=0.70**) had the most positive-direct effects on Corn seed yield can be proposal to plant breeder to more studied process such as stepwise regression and path analysis.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

CONFLICT OF INTEREST: Authors declared no conflict of interest.

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