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Assess Correlation between Traits Affected Different level of Nitrogen Fertilizer (Urea Source) and Interval between Irrigation Round of Sorghum

Bahareh Jahangiri[1,2], Mojtaba Alavifazel[2]*, Mohamad Reza Dadnia[2]

1- MSc. Graduated, Department of Agronomy, Khuzestan Science and Research Branch, Islamic Azad University, Ahvaz, Iran.

2- Department of Agronomy, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.

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ABSTRACT

BACKGROUND: Knowing about grain yield issue and its components plays an important role for being successful in evaluative programs. Success in breeding and having fruitful varieties of agricultural products with a higher quality depends on knowledge about genetic grain yield controlling and its relation with seed yield components, also to phonologic traits and forage quality.

OBJECTIVES: This study was conducted to predict the most effective traits on sorghum seed yield according correlation between characteristics in response to apply different interval irrigation round and urea fertilizer.

METHODS: To investigation the effect of different level of Nitrogen fertilizer and irrigation method on crop production of Sorghum (Speed feed cultivar) a farm research was arranged via split plot experiment based on the randomized complete block design with three replications in 2012. Main plots were included apply three levels of interval between irrigation (I_1: 8 day; I_2: 12 day; I_3: 16 day) and the sub plots consisted three level of urea fertilizer (N_1: 200, N_2: 300, N_3: 400 kg.ha^{-1}).

RESULT: According result of analysis of variance effect of different level of irrigation regime, urea fertilizer and interaction effect of treatments on all measured traits (instead harvest index) was significant. Simple correlation coefficients between traits were estimated according to Pearson coefficient. The most positive and significant correlation was observed in total dry weight (r=0.91**), fresh forage yield (r=0.85**) and number of seed per panicle (r=0.79**). The traits of Panicle length (0.69*), 1000-seed weight (r=0.67*), number of racemes in panicle (0.64*) number of fertile tiller (r=0.61*) and seed protein content (0.51*) had correlation with the seed yield was significant at 5% probability level.

CONCLUSION: According to the results of this research, traits of total dry weight, fresh forage yield and number of seed per panicle, had the most positive-direct effects on Sorghum seed yield can be proposal to plant breeder to more studied process such as stepwise regression and path analysis.

KEYWORDS: *Crop production, Dry weight, Nutrition, Relation between traits, Yield.*

***Corresponding Author:** Mojtaba Alavifazel ✉ Mojtaba_alavifazel@yahoo.com

1. BACKGROUND

Sorghum is indigenous to Africa, and many of today's varieties originated on that continent. Sorghum was also grown in India before recorded history and in Assyria as early as 700 BC. The crop reached China during the thirteenth century and the Western Hemisphere much later (Undersander *et al.*, 2013). Sorghums in general can be classified into two types: Forage types (mainly for forage or animal feed) and grain types (mainly for human consumption). The forage sorghums are further grouped into four types: (a) hybrid forage sorghum, (b) Sudan grass, (c) sorghum x sudan hybrids (also known as Sudan hybrids), and (d) sweet sorghum. The latter is used mainly for molasses but more recently for biofuel production as well (Newmann *et al*., 2010). Abderrahmane *et al*. (2013) reported that total biomass, number of spikes per plant, number of grains per spike are positively correlated with grain yield. Grain yield per plant was positively correlated with grains per spike, harvest index, spikes per plant, spike length and 1000 grain weight (Majumder *et al.*, 2008). In a study aimed to know relationships between grain yield and yield components in bread wheat under different water availability, Mohammadi *et al*. (2012) reported that grain yield was positively correlated with plant height, spike length, days to physiological maturity, agronomic score and test weight. 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 (Artoz, 2012). Yield is a complex character, which depends upon many independent the contributing characters. Knowledge on type of association between yield and its components themselves greatly help in evaluating the contribution of different components towards yield, information on the nature of association between yield and its components help in simultaneous selection for many characters associated with yield improvements (Kumar *et al*., 2012). Knowing about grain yield issue and its components plays an important role for being successful in evaluative programs. Success in breeding and having fruitful varieties of agricultural products with a higher quality depends on knowledge about genetic grain yield controlling and its relation with grain yield components, also to phenologic traits and forage quality (Jafari, 2001). To determine relationships, correlation analyses are used such that the values of two characters are analyzed on a paired basis, results of which may be either positive or negative. When there is positive association of major yield characters component breeding would be very effective but when these characters are negatively associated, it would be difficult to exercise simultaneous selection for them in developing a variety (Nemati *et al*., 2009). Some statistical methods, such as correlation analysis, indicate partial role of each component of yield in the amount of yield; also, they provide necessary information for choosing indirect traits in superior genotypes to have yield breeding. Correlation between traits for evaluation and planning on breeding programs is useful. In other words, when an evaluation is conducted on a trait, knowing its effects on the other traits is totally important. Also by knowing if correlation exists between important traits, interpretation on previous results would become easier and the basis for effective future plans would be provided. Also correlation between important and non-important traits provides plant breeding experts with a significant assistance in indirect selection of important traits, through non-important traits which their measurement is easier (Artoz, 2012). Correlation coefficient, which is used as a standard of measuring linear relationship between two variables, only has one mathematical interpretation, and does not refer to cause and effect relationships (Abozary Gasaforodi, 2002). In this method, Correlation coefficient which exists between two traits is divided in to components which measure direct and indirect effects. Making use of this method requires the knowledge about cause and effect relations which exist between traits, and assuredly must determine the direction of causes according to previous information and experimental evidences (Garcia del Moral *et al.*, 1999). Understanding of interrelationship between component characters helps in determining which character to select when improvement of the related complex character is desired. The correlation coefficient measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for the improvement in associated complex character yield (Sokoto *et al.*, 2012; Mohammadi *et al.*, 2012). Simple correlation is partitioned into phenotypic (that can be directly observed), genotypic (inherent association between characters) and environmental (environmental deviation together with non additive genetic variation) components (Singh and Chaudhary, 1985). The selection criteria may be yield, or one or more of the yield component characters. However, breeding for high yield crops require information on the nature and magnitude of variation in the available materials, relationship of yield with other agronomic characters and the degree of environmental influence on the expression of these component characters. Since grain yield in sorghum is quantitative in nature and polygenic ally controlled, effective yield improvement and simultaneous improvement in yield components are imperative (Bello and Olaoye, 2009). Grain yield and fodder production in sorghum are complex characters controlled by many genes, therefore their improvement will lead to increased overall productivity in sorghum production (Sadia *et al.*, 2001).

2. OBJECTIVES

The current research was conducted to assessment the most effective traits on sorghum seed yield according the correlation between characteristics in response to application different interval irrigation round and the urea fertilizer treatments.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

To evaluate the effect of different level of Nitrogen fertilizer and irrigation method on crop production of Sorghum (Speed feed cultivar) a farm research was arranged via split plot experiment based on the randomized complete block design with three replications in 2012. Place of research was located in Ahvaz city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). Main plots were included apply three levels of interval between irrigation (I_1: 8 day; I_2: 12 day; I_3: 16 day) and the sub plots consisted three level of urea fertilizer (N_1: 200, N_2: 300, N_3: 400 kg.ha^{-1}). The soil properties of studied field was mentioned in table 1.

Table 1. Physical and chemical properties of studied field

Soil depth (cm)	Sand (%)	Silt (%)	Clay (%)
0-30	12.5	41	46.5
30-60	11.5	40	48.4
Soil depth (cm)	**Soil texture**	**ρb (gr.cm^{-3})**	**K (ppm)**
0-30	Siltyclay	1.34	181
30-60	Siltyclay	1.36	125
Soil depth (cm)	**P (ppm)**	**N (%)**	**pH**
0-30	9.1	0.07	8
30-60	6.8	0.03	7.8
Soil depth (cm)	**O.C (%)**	**EC (ds.m^{-1})**	**TNV (%)**
0-30	0.65	1.6	35
30-60	0.36	1	38

3.2. Farm Management

The required nitrogen was provided by the urea source. In order to prevent horizontal movement of urea fertilizer during the fertilization, some furrows were made in irrigation streams and the fertilizer was evenly placed in the furrows. Then they were covered by soil and immediately irrigated. While planting at the first stage, urea fertilizer was distributed to the experiment land as the basic fertilizer. Potassium fertilizer was not used due to high level of absorbable potassium. The required amounts of nitrogen fertilizers were identified after the soil analysis and the needed fertilizer for each plot was calculated with regard to the plot size and the levels of studied treatments and 25% of pure nitrogen as the base fertilizer was added to the land before planting and 75% was added at 8-leaf stage. There were 8 plots in each block. The space between each sub plot from the other one was as one non-planting line and the space between every two main plots was as two non-planting lines. There were 6 planting rows in each plot and the space between the rows was 75 cm and over the rows was 12 cm. Cultivar seeds were used. The seeds were planted at the end of July as ridge and furrows at the depth of 3-4 cm. in seed mixing method, after blending the seeds they were dried in shadow and immediately planted. After sowing the seeds, the field was irrigated. During the growth stage, growing operations such as irrigation, thinning and controlling the weeds (at 4-leaf stage) were done.

3.3. Measured Traits

In order to determine the yield and its components two planting lines from each plot and after the removal of marginal effect were carried to the laboratory and were placed in the oven at 75°C for 48 hours and after ensuring that the samples were completely dry, they were weighed and finally the total yield was measured. 1000-seed weight was measured after accurate sifting and cleaning of seeds and drying them in open air. Harvest index (HI) was calculated according to formula of Gardner *et al.* (1985) as follows: **Equ.1.** HI= (Seed yield/Biologic yield) ×100.

To measure the seed nitrogen content and straw nitrogen content the Kjeldahl method was used. So, to calculate the seed protein content the following formula was used (Bremner *et al*., 1983):

Equ.2. Seed protein content (%)= Nitrogen percentage × 5.8. Prussic acid was determined according to the AOAC (1990) methods.

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via Statistical Analysis System (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 regime on seed yield, 1000-Seed weight, Fresh forage yield, number of racemes in panicle, number of seed per panicle, panicle length, plant height and prussic acid content was significant at 5% probability level but on number of plant per m^{-2}, Stem diameter, Seed protein content was significant at 1% probability level and on harvest index was not significant (Table 2). According result of analysis of variance effect of different level of urea fertilizer on seed yield, 1000-Seed weight, fresh forage yield, total dry weight, number of racemes in panicle, number of fertile tiller, number of plant per m^{-2}, panicle length, plant height, stem diameter, prussic acid content and seed protein content was significant at 1% probability level also on number of seed per panicle was significant at 5% probability level but on harvest index was not significant (Table 2). Interaction effect of treatments on all measured traits (Seed protein content at 1% probability level) was significant at 5% probability level but on harvest index was not significant (Table 2).

4.2. Correlation between traits

Knowledge about the relationship among yield components is essential for the formulation of breeding programs aimed at achieving the desired combinations of various components of yield. The estimates of correlation coefficients among different characters indicate the extent and direction of association. The correlation co-efficient provide a reliable measure of association among the characters and help to differentiate vital associations useful in breeding from those of the non-vital ones (Falconer, 1981). Simple correlation coefficients between traits were estimated according to Pearson coefficient (Table 3).

Table 2. Result analysis of variance of measured traits

S.O.V	df	Seed yield	1000-Seed weight	Fresh forage yield	Total dry weight	Harvest index
Replication	2	489^{ns}	3.91^{ns}	24102^{ns}	5971^{ns}	11.82^{ns}
Interval irrigation round (I)	2	54971^{*}	63.85^{*}	169516^{*}	44649^{**}	134.78^{ns}
Error I	4	6012	4.58	23951	4242	79.85
Nitrogen (N)	2	8557^{**}	66.43^{**}	112384^{**}	23712^{**}	23.49^{ns}
I×N	4	3741^{*}	7.68^{*}	48979^{*}	12697^{*}	16.03^{ns}
Error II	12	1143	1.49	14842	3082	14.50
CV (%)	-	6.15	4.32	1.21	2.22	16.38

$^{ns,\ *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 2.

S.O.V	df	No. racemes in panicle	No. fertile tiller	No. plant per m^{-2}	No. seed per panicle	Panicle lenght
Replication	2	1.20^{ns}	0.1^{ns}	5.51^{ns}	12984^{ns}	1.03^{ns}
Interval irrigation round (I)	2	28.81^{*}	1.73^{**}	75.84^{**}	238243^{*}	13.80^{*}
Error I	4	4.80	0.02	0.83	27870	1.74
Nitrogen (N)	2	12.57^{**}	2.23^{**}	61.76^{**}	29270^{*}	21.22^{**}
I×N	4	3.67^{*}	0.19^{*}	13.29^{*}	24438^{*}	2.3^{*}
Error II	12	0.89	0.05	3.92	7406	0.44
CV (%)	-	6.01	9.49	9.43	19.91	4.48

$^{ns,\ *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 2.

S.O.V	df	Plant height	Stem diameter	Prussic acid content	Seed protein content
Replication	2	19.59^{ns}	1.35^{ns}	796.74^{ns}	2.31^{ns}
Interval irrigation round (I)	2	294.65^{*}	27.30^{**}	5475.11^{*}	23.43^{**}
Error I	4	28.14	0.98	473.66	0.91
Nitrogen (N)	2	264.54^{**}	11.18^{**}	5233.56^{**}	8.67^{**}
I×N	4	31.12^{*}	3.23^{**}	1064.97^{*}	2.81^{**}
Error II	12	8.65	0.25	255.58	0.35
CV (%)	-	1.60	3.28	6.16	6.06

$^{ns,\ *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

The most positive and significant correlation was observed in total dry weight (r=0.91**), fresh forage yield (r=0.85**) and number of seed per panicle (r=0.79**) (Fig.1, 2, 3).

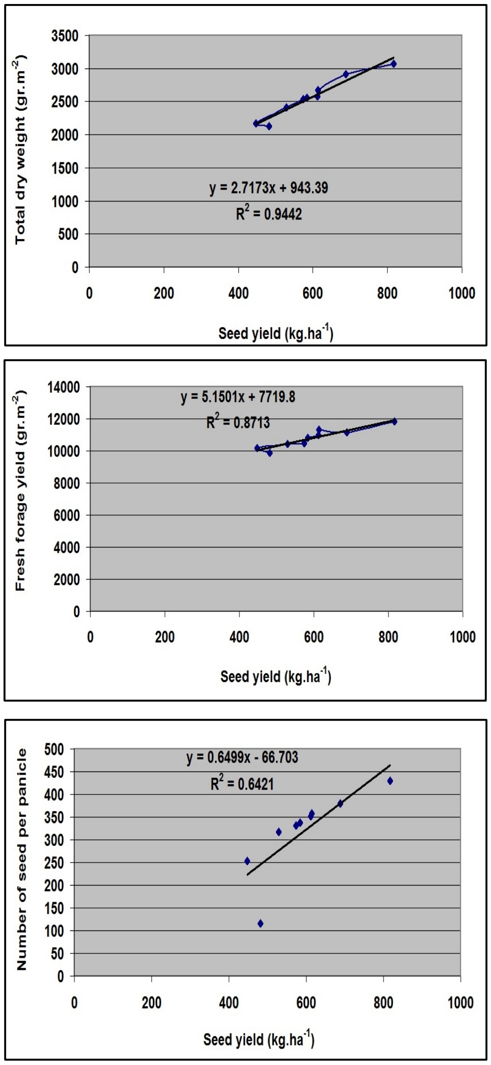

Fig. 1, 2, 3. Correlation relation between seed yield, total dry weight, fresh forage yield and number of seed per panicle.

The traits of Panicle length (0.69*), 1000-seed weight (r=0.67*), number of racemes in panicle (0.64*) number of fertile tiller (r=0.61*) and seed protein content (0.51*) had correlation with the seed yield was significant at 5% probability level (Table 3). It seems number of seed per panicle earning high correlation coefficient with seed yield, is because it is assimilate supplier for the seeds, therefore, we can consider the positive and significant correlation of number of seed per panicle, with seed yield, a natural thing. As a result, the more this trait is observed, the bigger sink plant would have for metabolic materials (Joka, 2016; Ramos, 2015). 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, and the traits of Plant height and dry and green fodder weight were the major contributors towards grain yield since these traits explained about (57, 52, 50)% respectively of the variation of grain yield, which might be a good traits for breeders to develop high yielding cultivars in sorghum, followed by stem diameter and grain number then leaf area index. The increase of total dry weight and its direct relation with seed yield show the relations between photosynthesis efficiency of plant and seed yield, therefore varieties 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 (Qulipor *et al*., 2004). 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 (Angadi *et al*., 2003). Menapour *et al.* (2006) reported that traits such as number of pods per plant and dry matter yield are effective in seed yield. The main objectives of this research were to analyze the correlation between seed yield and related traits in Rapeseed by applying sequential path analysis and identifying traits, of Cultivars, which may be useful in breeding higher-yielding Cultivars. Correlation between traits for evaluation and planning on breeding programs is useful. In other words, when an evaluation is conducted on a trait, knowing its effects on the other traits is totally important. Also by knowing if correlation exists between important traits, interpretation on previous results would become easier and the basis for effective future plans would be provided. Also correlation between important and non-important traits provides plant breeding experts with a significant assistance in indirect selection of important traits, through non-important traits which their measurement is easier (Rahnama and Bakhshandeh, 2005). In a study by Sarvari and Beheshti (2012), with 13 grain sorghum genotypes in three different moisture conditions, showed the relationship between grain yield and plant characteristics in grain sorghum genotypes.Ghalejoughi *et al.* (2013) studied regression and correlation between grain yield and related traits of corn hybrids, and revealed a positive significant correlation between grain yield and the weight of grain, stem diameter and the total number of grains. The equation of regression of grain yield indicates that the effective roles of vegetative organs growth and biological yield in grain yield within this experiment.

5. CONCLUSION

According to the results of this research, traits of total dry weight, fresh forage yield and number of seed per panicle, had the most positive-direct effects on Sorghum 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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Table 3. Correlation relation between studied traits

Traits	No. seed per panicle	No. fertile tiller	1000-Seed weight	Seed protein content	Seed yield	Biologic yield	Harvest index	Panicle lenght	Plant height	No. racemes in panicle	Fresh forage yield	Total dry weight
No. fertile tiller	0.93^{**}											
1000-Seed weight	0.89^{**}	0.93^{**}										
Seed protein content	0.17^{ns}	0.55^{**}	0.46^{*}									
Seed yield	0.79^{**}	0.61^{*}	0.67^{*}	0.51^{*}								
Biologic yield	0.56^{*}	0.53^{*}	0.21^{ns}	0.51^{*}	0.71^{**}							
Harvest index	0.89^{**}	-0.18^{ns}	0.52^{**}	0.10^{ns}	0.42^{ns}	0.52^{*}						
Panicle length	0.87^{**}	0.28^{ns}	0.75^{**}	0.36^{ns}	0.69^{*}	0.21^{ns}	0.68^{**}					
Plant height	0.45^{ns}	0.61^{**}	0.63^{**}	0.10^{ns}	0.53^{*}	0.46^{*}	-0.53^{**}	0.25^{ns}				
No. racemes in panicle	0.54^{**}	0.69^{**}	0.74^{**}	0.19^{ns}	0.64^{*}	0.66^{*}	0.87^{**}	0.44^{ns}	0.22^{ns}			
Fresh forage yield	0.66^{**}	0.73^{**}	0.11^{ns}	0.57^{**}	0.85^{**}	0.78^{**}	-0.65^{**}	0.47^{ns}	0.59^{**}	0.41^{*}		
Total dry weight	0.56^{**}	0.63^{**}	0.51^{**}	0.47^{*}	0.91^{**}	0.77^{**}	-0.78^{**}	0.45^{ns}	0.23^{ns}	0.29^{ns}	0.97^{**}	
Stem diameter	0.18^{ns}	-0.39^{*}	0.14^{ns}	0.18^{ns}	0.54^{*}	0.81^{**}	-0.47^{**}	0.20^{ns}	-0.15^{ns}	0.17^{ns}	0.58^{**}	0.47^{*}

$^{ns,\ *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

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