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Evaluation the Correlation between Different Traits and Plant Performance in the Spring Safflower Varieties

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Abstract:

Safflower (*Carthamus tinctorius L*) is a native of Iran oil seed. This crop is compatible with the environmental conditions in the country as well; this is especially true in areas exposed to non-biological stresses such as drought and salinity. The study of abiotic stress in plants has advanced considerably in recent years. However, the majority of studies testing the response of plants to changes in environmental conditions have focused on a single stress treatment applied to plants under controlled conditions. In contrast, in the field, a number of different stresses can occur simultaneously. These may include conditions such as drought, extreme temperature or high salinity and may alter plant metabolism in a novel manner that may be different from that caused by each of the different stresses applied individually1,2. Drought and heat shock represent an excellent example of two different stresses that occur in the field simultaneously, especially in semi-arid or drought-stricken areas1-4. Although drought stress and heat shock have been extensively studied5-7, relatively little is known about how their combination impact plants. We identified sucrose accumulation as a possible defense mechanism of plants against this stress combination. Our long-term objective is to develop different plants and crops with enhanced tolerance to a combination of drought stress and heat shock. A combination of drought stress and heat shock is common to many semi-arid or drought-stricken regions of Nevada. Developing plants and crops with enhanced tolerance to this stress combination will contribute significantly to Nevada agriculture and economy and directly address one of the major NAES research priorities. The results of causality analysis for correlation coefficients between the grain yields with the regression model traits showed that either three moisture regimes, the grain yield per bush is most influenced by the number of grain per boll and the number of boll per bush. But these direct effects are reduced by their negative and indirect effects. The 1000 grain weight has positive and relatively high effects on grain yield per bush in both stress and stress free environments, but because of important indirect and negative affection by the number of boll per bush, the number of grain per boll and the days to %100 flowering, it showed positive and relatively low correlation with the grain yield per bush. In general, the results indicate that the number of grain per boll and the number of boll per bush can be used as two appropriate selection indexes in safflower breeding programs in order to improved grain yield. Meanwhile it seems that the varieties with more 1000 grain weight produce more grain yield in both conditions.

Keywords: causality analysis, correlation, safflower.

1.0 Introduction:

Safflower (*Carthamus tinctorius L*) is one of the oil plants native to Iran. Safflower oil has a significant quality, The experiment was designed in Randomized Block Design with three replications. Positive and significant relationships were found among seed yield and plant height, number of branches, number of pods per plant, biological yield, harvest index and number of seeds per plant. Negative and non-significant relationship was determined between seed yield and 1000-seed weight. According to path coefficient analysis, there were strong direct effects of the biological yield, harvest index and number of seeds per plant on the seed yield, p.c : 0.783 and p.c:

0.441, respectively. Ehdaei and Noormohammadi (1963) mentioned the positive and significant correlation between yield and traits, forage yield, seed yield, morphological traits, such as 1000-grain weight, number of seeds per boll, percent oil and plant height. Rao et al (1977) reported that traits like the number of boll per bush and seed performance in plant correlate to each other so much and between the yield components, the number of boll per bush impressed seed performance. Solanaki and Paliwal (1979) mentioned the significant and positive correlation between grain yield and grain traits such as number of seeds per boll, boll number per plant and 1000-grain weight. Patil (1985) was confirmed a significant positive correlation between 1000-grain yield and weight. Kumer et al (1982) reported that plant height, boll size and seed number per boll have significant and positive correlation with grain and oil yield, they announced this fact after checking safflower figures and the usage of causality analysis. Godrati (1976) with path analysis revealed that traits such as the number of bolls per plant and seed weight per boll were most important factors affecting crop yield by a correlation coefficient of 0/96 %. The aim of this study was to determine the relationship between under evaluated traits and also the one between cause and effect studied traits in 26 spring safflower varieties by causality analysis.

2.0 Materials and Methods:

This research was conducted in East Azerbaijan agriculture research centre located 20 km of Tabriz - Azarshahr road. In this study, 26 spring safflower cultivars as subplots B of drought resistance in three different levels of irrigation were investigated in a split-plot form study with completely random block designs.

Twenty six safflower varieties have been used are: BONAB L, MIANEH L1, MARAND L1, MIANEH L2, MARANDL2, MARAND L3, LANGARMAHAN L, ZARGHAN L2, ZARGHAN L3, ZARGHAN L4, KERMAN 1, ZARAND, KERMAN 2, ZARAND, KORDESTAN 2, ESFAHAN L, BROOJERD L, NISHABOOR L, N974051, V -51-242, N51016, NEBRASKA 825, a-1, TOMJIC, N.5, 6151, D51-361 and 24-1.

Each experiment was repeated with three main plots and 26 sub-plots within the main plot of 2*3 m occurred. The evaluated traits in this study were: number of days from sowing to germination, sowing to stem growth, sowing to 50% budding, sowing to 50% flowering, sowing to 100% flowering, bush height, boll number per plant, seed number per plant, 1000-grain weight, plant performance and oil content. The relationship between traits was reviewed by GMP software. These correlations were calculated separately for three irrigation levels. The causality analysis of grain yield with yield components and the other traits was conducted with MSTAT-C software for each irrigation level.

3.0 Results and Discussion:

The results are in table1. The number of grain per boll, the number of boll per bush, 1000 grain weight and oil percentage had the most positive and significant correlation with plant yield. Ehdaei and Noormohammadi (1963) mentioned the positive and significant correlation with 1000 grain weight, the number of grain per boll and oil percentage with the grain yield. Also Cosentino et al (1697) and Prasad et al (1993) and Rao. V., M.clarified a positive and significant correlation between the numbers of grain per boll, the number of boll per bush and 1000 grain weight with the grain yield. The bush height and the number of the days to germination had no significant correlation with plant yield. But Ehdaei and Noormohammadi (1963) mentioned a positive and significant correlation between bush heights with grain yield. There is a positive and significant correlation between the numbers of the boll per bush with the oil percentage. Han et al (9) mentioned a positive and significant correlation between the oil percentage and the number of bolls per bush. But Alba and Greco (1977) announced no correlation between the oil percentages with the number of bolls per bush. Omidi Tabrizi (1970) reported a positive and significant correlation between the numbers of the bolls per bush with the oil percentage.

There was a negative and significant correlation between the oil percentages with the traits like the number of the days to %50 budding, the number of the days from planting to shoot appearance and the number of the days to %50 flowering. But there was no correlation between the oil percentages with the traits like the bush height, the number of the grain per boll, 1000 grain weight, the number of the days to germination and the number of the days to %100 flowering. Bratulean (1991) and Weiss (2000) reported a positive and significant correlation between oil percentages with 1000 grain weight. Whereas Patil (1985) mentioned a negative and significant correlation between oil percentages with 1000 grain weight. Considering table 1, the

traits like the number of the days to %50 flowering, the number of the days to %100 flowering, the number of the days to %50 budding, the number of the days to shoot appearance and the of bolls per bush showed a positive and significant correlation with the bush height. There was a negative and significant correlation between the bush height with the traits like 1000 grain weight and the number of the days to germination but no significant correlation between the numbers of grains per boll with the bush height.

The number of the grain per boll with the number of bolls per bush had negative and significant correlation and with 1000 grain weight per grain had a weak and negative correlation. The bush height had a positive and significant correlation with the number of bolls per bush but the number of the boll per bush had a negative and significant correlation with the number of the grain per boll. This negative correlation prevents from the height positive influence on the yield. Since the bush height considers as an indirect grain yield components, it seems that long genotypes have no problem for manual harvesting. But the severe winds limit the long crops planting; we should consider the crops with suitable height. Meanwhile these crops are not appropriate for mechanical plant and harvest (Weiss, 2000).

3.1 Path Analysis:

There are the cause and effect relationships between safflower different traits and the plant yield. The most direct effect on the plant yield was seen by the number of the grain per boll and the least one was by the bush height. In addition to the number of the grain per boll, other traits like the number of boll per bush and 1000 grain weight had more direct influence on the plant yield. But the number of the days to %50 flowering had direct and negative effect on the plant yield. There is a negative and significant correlation between the numbers of the days to %50 flowering with the plant yield. So we can say that negative and indirect effects by these traits had been done on the yield. The most indirect and negative effect of the bush height is by the number of the days to %50 flowering. The bush height had direct effect on the grain yield and the oil(1974). Malleshappa et. al (1989) announced the direct effect of the plant height on the yield. The correlation between 1000 grain weights and the plant yield is positive and %1 significant. Ehdaei and Noormohammadi (1963) investigated the yield and yield components of two safflower varieties and saw a positive and significant correlation between the grain yields with 1000 grain weights.

1) There was a positive and significant correlation between the number of boll with the plant yield and the most correlation of studied traits with the plant yield was related to the number of the grains per boll. Also this trait affected the plant yield by the number of the bolls per bush (Solanaki and Paliwal, 1979; Baradaran, 1974; Godrati, 1976). Sivasubramanian (1986) mentioned the positive and direct influence of the number of the bolls per bush on the plant yield. The corrected explanation coefficient of causality analysis was 0/90 about the studied traits. In other words in addition to considered variables, some other factors affect the performance. In general this study indicates that there were similar relationships and the way affection in both stress and non-stress conditions. The causality analysis and simple correlation coefficients, improved number of grains per boll and the number of the bolls per bush can improve the plant yield in both environmental conditions.

Fig. Experimental Species and field studies

Table1: Simple correlation coefficients of 26 spring safflower in different irrigation levels.

Traits	%100F	%50F	%50SF	DBG	DPBS	1000KW	NLP	NST	Height	Oil.P	Yield
%100F	1/000										
%50F	0/9503**	1/000									
%50SF	0/8017**	0/8361**	1/000								
DBG	-0/2688**	-0/2250**	-0/2143**	1/000							
DPBS	0/7505**	0/7615**	0/7433**	-0/3616**	1/000						
1000KW	-0/5079	-0/5552	-0/4510	0/2639**	-0/3500	1/000					

	**	**	**		**						
NLP	0/2652 **	0/2819 **	0/1437 +	0/0051	0/0694	-0/2337 **	1/000				
NST	-0/0441	-0/0624	0/0110	-0/0082	-0/0097	-0/1490 +	-/4865**	1/000			
Height	0/6401 **	0/6889 **	0/6119 **	-0/2460 **	0/4431 **	-0/5257 **	0/3876 **	0/0413	1/000		
Oil.P	-0/1099	-0/1785 *	-0/2829 **	0/0982	-0/1953 *	0/0682	0/3105 **	-0/1074	-0/0985	1/000	
Yield	-0/1368 +	-0/1952 *	-0/2150 **	0/1108	-0/2117 **	0/2979 **	0/3205 **	0/4058 **	0/0682	0/2540 **	1/000

+ ,* and **: significant in %10, %5, and % 1 respectively; DBG: the number of the day to germination; DPBS: the number of the day to shoot supernatant; 50%SF: day to %50 budding; 50%F: day to %50 flowering; 100%F: day to %100 flowering; Height: the bush height; NLP: number of bolls per bush; NST: number of grain per boll 1000KW: 1000 grain weight; Yield: bush performance

Table2: Path analysis of Independent traits with plant yield in 26 varieties

The simple correlation between independent traits with plant yield	Indirect effect from							
	Height	**N.S.T**	**N.L.P**	**1000Kw**	**%50F**	**%100F**	**Direct effect**	**Trait**
-0/137+	0/5036	-0/04116	0/24431	-0/32220	-0/33188	-	0/26373**	%100F
-0/195*	0/05422	-0/05800	0/25998	-0/35201	-	0/25054	-0/24935**	%50F
0/298**	-0/04155	-0/13939	-0/21573	-	0/19389	-0/13397	0/63426**	1000Kw
0/321**	0/03053	-0/45558	-	-0/14842	-0/09852	0/06989	0/92193**	N.L.P
0/406**	0/00323	-	-0/44898	-0/09450	0/02166	-0/01160	0/93549**	N.S.T
0/068	-	0/03836	0/35771	-0/33489	-0/24070	0/16879	0/078690*	Height

+ ,* and **: significant in %10, %5, and % 1 respectively; 50%F: day to %50 flowering ; 100%F: day to %100 flowering; Height: the bush height ; 1000KW: 1000 grain weight ; NST: number of grain per boll; NLP: number of bolls per bush

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