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Research Article

Salt Stress Tolerance of Spring Canola (*Brassica napus* L.) Cultivars

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Abstract

In order to evaluate the effect of salinity stress (three treatments including control, 6% and 20% sodium chloride) on yield and components of seed yield of spring canola (Sarigol, Delgan, Zaffar, Zarfam, RGS003), a factorial experiment based on Randomized Complete Block Design with three replications was conducted. Main effects of cultivar, salinity stress and interaction of salinity stress × cultivar in all evaluated traits were significant at 0.01 P-values. In all cultivars, the highest values of yield and its components were observed under non stress condition. Grain yield significantly decreased with increasing salinity levels. Dahlan cultivar (19.3 gr grain yield) had the highest seed yield under control conditions. Stepwise multiple linear regression analysis showed that grain weight per pod and number of pods per plant had the highest effect on grain yield and explained 95% of grain yield variations. Factor analysis showed that four factors explained 80.81% of total variations. The first factor explained 36.07% of total variance and was named as an effective factor in vegetation growth. The second factor explained 16.28% of the variation and was identified as the grain yield and its components factor. The third and fourth factors explained 14.8% and 9.66% of total changes respectively, and were named as root dry weight and one thousand seed weight factors respectively. In this research, Sarigolcultivar was introduced as tolerant cultivar due to the highest grain yield under salinity stress conditions.

INTRODUCTION

Canola (*Brassica napus* L.) is one of the world's major oil seed in recent decades which it's under cultivation field in Iran is 75431 hectares [1]. This plant has become an important crop in rotation with wheat that it's under cultivation area is steadily on the rise. However, due to agricultural constraints, it has not yet found its actual status [2]. One of the main limitations is the abiotic stress such as salinity and drought stresses [3].

Salinity stress is one of the most important abiotic stress and its impact on crop production increased researches on salt tolerance with the aim to improve the tolerance of plants. Salinity is the presence of excessive soluble salts and minerals in water and soil leading to accumulation of salt in the root and plants face problem in the absorption of enough water from the soil. Salt stress is first perceived by the root system and impairs plant growth both in the short term, by inducing osmotic stress caused by reduced water availability, and in the long term, by salt-induced ion toxicity due to nutrient imbalance in the cytosol [4].

Increase salt concentration in the soil was prevented water absorption by the root, which was found a severe drought, withering dark spots on the leaves and thick cuticles during different stages of plant growth and also found a decrease in the yield [5,6]. Due to the inappropriate use of natural resources and technology in agricultural production particularly in relation to irrigation water, a significant portion of arid agricultural land areas face salinity problems [7].Therefore, the selection of tolerant cultivars to salinity stress seems to be necessary. Brassicaceae from salt tolerance at germination stage point of view locate among the *Poaceae* (resistant) and *leguminous* (most sensitive) family [8]. Several studies were examined the effect of salinity stress at different growth stages of canola. Zamani et al. [9], studied the effect of salinity stress on four varieties of winter canola, they found that salinity stress was significantly reduced grain yield, grain weight, the number of seeds per pod, number of pods per plant, leaf area and plant height. Sakr et al. [10], reported that most of the growth parameters including weight of dry matter, the number of seeds per pod and the total yield significantly decreased with increasing the levels of salt. Azimi Gandomani et al. [11], have evaluated the effect of salinity on physiological characteristics of eight varieties of spring canola and reported that, biological yield, grain yield and oil content decreased with increasing salinity.

Sharifi [12], showed that canola root length, germination, shoot length and seedling weight significantly become affected under the influence of different concentrations of sodium chloride and observed highest percentage reduction of traits at a concentration of 17 ds/m. Tajali et al. [13], in a study examined the effects of sodium chloride treatments (0, 3, 6, 9 and 12 ds/m) on five cultivars of canola (Opera, Okapi, Madonna, Pioneer and

Kobra) and showed that the effect of salinity stress on canola yield is significant. Alborzi Hagigi et al. [14], showed that by increasing salinity, the number of leaves, plant height, plant dry weight, leaf area index and potassium concentrations were significantly decreased. Shokri [15], examined the response of canola cultivars to salt stress and showed that grain yield in Crete cultivar, days to 50% flowering, plant height, number of pods on the main stem, pod length, seed yield per plant, seeds per pod, harvest index, seed weight, number of pods per branch, number of lateral branches were reduced by salinity stress. Yousefi et al. [16], examined the effects of salinity(control and salinity of 150 mM NaCl) on two cultivars of canola (Shirali and Hayoula 401) and showed that the salinity stress significantly reduced seed yield, biological yield, harvest index, plant height, number of branches and relative water content but the SPAD number and the relative permeability of the membrane increased.

For a deeper understanding of the relationships among traits, multivariate statistical methods can be used. Factor analysis is an affective statistical method which reduces the large number of variables into smaller groups of variables (called factors) as well as the primary variable interpretation. This method is effective for understanding the relationships and structure of crop yield components and morphological traits. In this regard, several researchers have used the factor analysis to examine relationships between variables in canola [17,18]. This study was conducted to evaluate the effect of salinity on yield and yield components of canola and identify the best cultivar of five studied varieties and to investigate relationships among traits using multivariate statistical methods such as regression analysis and principal component analysis.

MATERIALS AND METHODS

An experiment was conducted based on randomized complete block design with 3 replications in 2016 at the Agriculture Research Station of University of Tabriz. Plant materials included five varieties of canola: Sarigol, Delgan, Zaffar, Zarfam, and RGS003 and three salt concentrations of sodium chloride (control, 6% and 20%).These cultivars are commercial and currently cultivated in Iran. The seeds were cultivated in the plastic pots with a diameter and height of 30 cm in the greenhouse condition (thermo-period 22\15 °C day\night, relative humidity 50\60% day\night).Soil used in this study was loamy and during vegetation period, irrigation was done weekly using distilled water.

Depth of planting seeds was 1-1.5 cm. In order to prevent the accumulation of salt in pots, four holes with a diameter of one centimeter in the bottom of the pot for drainage was built and the bottom of each pot was dumped with gravel to a height of 5 cm. Ten seeds were planted in each pot. After the establishment of the plantlets, three plants in each pot retained and the others were eliminated. The salt solutions prepared with distilled water. Salt treatment applied at the flowering stage (55-65 days after planting depending on the cultivar) through irrigation. At the end of the growth period (Seed physiological maturity), of which approximately 50% of the pods per plant were greenish-brown, (after 85-95 days of planting depending on the cultivar) the number of pods per plant and seeds per pod per plant were measured. Also, plant height, the number of branches, seed weight per pod, fresh weight, root dry weight, yield per plant (yield of single plant), plant dry weight, grain weight, and number of leaves were measured. Mean comparison was performed with Duncan's test least significant range (LSR) at the 0, 05 level of significance. Factor analysis was conducted based on principal component analysis and Varimax rotating method. Multiple regression analysis was done based on step wise process. Data analysis was carried out with MSTATC and SPSS ver.18 software.

RESULTS AND DISCUSSION

Analysis of variance and comparison of means

The results of analysis of variance showed that the effects of cultivar, salinity stress and salinity stress × cultivar interaction in the probability of 1% in all traits were significant (Table 1). Therefore, the variation among cultivars may be suitable for the selection of cultivars. Since the interaction of salinity × cultivar was significant in all traits, the mean comparison was done for this effect (Table 2). The highest plant dry weight relates to the Zaffar in control (without salinity stress) and the lowest was for Delgan with 20% salinity stress (Figure 1). In the Delgan cultivar with increasing salinity the plant dry weight decreased. In accordance with the result of this study, Sakr et al. [10,11,16], reported that in canola cultivars dry matter weight significantly decreased with increasing levels of salt. The largest number of pods per plant was observed in Delgan, Zaffar and RGS003 cultivars, at control condition, while the number of pods per plant was reduced under two levels of salinity stress while the largest number of pods was found at 20% salt level in Sarigol and Zarfam. As this is important to show these are resistant to salt stress (Table1, Figure 2). This result was similar to Zamani et al. [9], Shokri [15], and Tajali et al. [13], that reported the reduction of the number of pods per plant in the canola under salinity stress.

According to Liu et al. [19], probably a decrease in the number of pods caused by an increase in the abscisic acid hormone, so the high level of this hormone can cause the death of the pollen, resulting in decreasing the number of inoculum flowers and the number of pods. In all studied cultivars, the highest grain yield was observed in control and by increasing salinity significantly decreased grain yield and the highest and the lowest seed yield was found in Delgan and Zarfam, respectively (Table 2). This result is consistent with the results of other researchers [9-11,13-16], based on grain yield reduction is consistent due to salinity. Dehshiri [20], reported that salinity stress was reduced the number of pods per stem and the number of seeds per pods, which led to a decrease in grain yield. One reason for this reduction can be due to reduction in the number of branches and therefore reduction of pods per lateral branches and subsequently reduced as the grain yield. When plants are exposed to salinity stress, due to osmotic reduction effect undergo a physiological drought and the roots under these conditions can increase the amount of abscisic acid which the hormone is transferred to shoot through the transpiration stream. This hormone in shoot decreased stomatal conductance and transpiration is reduced to comply with it and finally because of the emissions of CO_2, photosynthesis, growth and finally the grain yield decreases [21]. Accelerate growth of apical offshoot and a reduction in the total number of seeds, reduced pollen viability, the reduction in pollen germination, fertilization and seed filling, are the effect of salinity on the reproductive growth stages. The highest seed weight of

Table 1: Analysis of Variance for studied traits in canola cultivars.

Source of variation	Degree of freedom	Mean of squares										
		Shoot height	Number of pod per plant	Number of seeds per pod	Seed weight per pod	One thousand seed weight	Biomass dry weight (gr)	Yield per plant (gr)	Number of dead leaves after salinity stress	Fresh leave weight	Root dry weight	Number of lateral branches
p-value		0.001	0.004	0.005	0.009	0.006	0.003	0.008	0.002	0.007	0.0098	0.001
Replication	2	**0.057	**15.2	*0.429	0.017	0.295	14.506	0.673	**0.657	**1.093	**0.673	**0.383
cultivar	4	**8.412	**3549.8	**7.442	**0.010	**0.343	**69.14	**1.149	**0.18	**1.609	**0.368	**0.837
Salinity stress	2	**1.615	**245	**0.301	**0.032	**1.2	**10.697	**1.519	**0.276	0.044	0.046	**2.287
cultivar × Salinity	8	**2.415	**371.75	**2.239	**0.003	**0.797	**39.708	**0.221	**0.212	**0.595	**0.258	**10.19
Error	28	0.1	0.2	0.26	0.0003	0.38	0.6	0.25	0.7	0.38	0.38	0.12
CV (%)		0.45	1.16	3.14	50.94	27.16	11.92	45.46	14.16	40.82	65.58	3.21

Table 2: Mean comparison of salinity stress × cultivar interaction effect in studied traits.

Cultivar	Salinity stress	Plant dry weight (gr)	Number of pod per plant	Yield per plant (gr)	One thousand seed weight(gr)	Number of seed per pod	Seed weight per pod	Number of lateral branches	Plant height (cm)	Root dry weight (gr)	Fresh leave weight (gr)	Number of dead leaves after stress
Sarigol	control	^{d}8.78	^{b}55	^{b}2.18	^{bc}3.94	^{g}9.98	^{cd}0.04	^{b}16.94	^{e}79	^{bc}1.28	^{bc}1.73	^{d}4.95
	6%	^{j}4.96	^{a}75	^{c}1.44	^{h}0.90	^{c}20.92	^{e}0.02	^{f}8.98	^{h}63	^{cde}0.65	^{cd}1.31	^{d}5.94
	20%	^{h}6.5	^{a}75	^{c}1.21	^{efgh}1.12	^{d}16.89	^{d}0.03	^{d}10.98	^{f}77	^{bcd}1.08	^{de}0.73	^{d}4.94
Delgan	control	^{l}2.76	^{d}40	^{a}3.19	^{def}2.28	^{a}35	^{a}0.08	^{c}13.97	^{j}55	^{de}0.45	^{ef}0.29	^{d}4.96
	6%	^{m}2.45	^{f}37	^{bc}1.84	^{fgh}1.55	^{a}31.99	^{bc}0.05	^{d}10.98	^{k}48.66	^{e}0.35	^{fg}0.22	^{d}4.97
	20%	^{o}1.17	^{h}27	^{d}0.8	^{efgh}1.72	^{d}16.97	^{d}0.03	^{f}8.97	^{l}45	^{e}0.32	^{g}0.04	^{d}4.94
Zaffar	control	^{a}14.83	^{c}45	^{bc}1.78	^{cd}2.82	^{ef}13.99	^{cd}0.04	^{g}7.9	^{a}113	^{a}2.58	^{a}3.69	^{d}4.94
	6%	^{k}3.41	^{d}40	^{d}0.77	^{defg}1.89	^{g}9.88	^{e}0.02	^{g}7.89	^{i}60	^{de}0.51	^{ef}0.45	^{d}4.96
	20%	^{f}8.15	^{g}35	^{g}0.23	^{fgh}1.45	^{h}7.98	^{f}0.01	^{h}5.97	^{b}95	^{b}1.39	^{bc}2.13	^{a}9.87
RGS003	control	^{n}2.16	^{b}55	^{a}0.53	^{b}4.59	^{f}12.89	^{b}0.06	^{f}8.98	^{h}63	^{cde}0.65	^{cd}1.38	^{c}5.95
	6%	^{g}7.31	^{e}38	^{de}0.73	^{gh}1.18	^{de}15.98	^{e}0.02	^{c}13.96	^{h}63	^{bcd}0.98	^{bc}2.08	^{b}6.89
	20%	^{e}8.29	^{i}17	^{ef}0.50	^{gh}1.17	^{b}24.9	^{d}0.03	^{e}9.98	^{m}44	^{bcd}1.04	^{bc}1.67	^{c}5.94
Zarfam	control	^{i}5.78	^{f}9	^{fg}0.36	^{de}2.63	^{def}14.99	^{cd}0.04	^{a}21.99	^{g}64	^{de}0.54	^{de}0.74	^{d}4.92
	6%	^{c}9.57	^{k}14	^{f}0.42	^{a}5.34	^{i}3.97	^{d}0.03	^{h}5.97	^{d}81	^{ab}1.74	^{b}2.51	^{b}6.96
	20%	^{b}11.45	^{j}15	^{h}0.1	^{fgh}1.45	^{i}3.21	^{f}0.01	^{g}7.98	^{c}91	^{de}0.54	^{a}3.75	^{b}6.98

Sarigol, Delgan, Zaffar and RGS003 was found under the control treatment; however in Zarfam cultivar was found fewer than 6% salinity stress (Table 2).

Maas and Grieve [22], reported that salinity stress affects the yield components, depending on the different phonological stage of the plant. Grain weight has also been reported by Zamani et al. [9], Shokri [15], and Tajali et al. [13], in the control condition in canola. In the present study, the highest seed weight of Zarfam was found at 6% salt, which may be due reducing the number of seeds per pod induced by salinity stress. The other causes of seeds weight loos due to salt stress, can be caused by the remobilization of photosynthetic of seed and also reduce the effects of stress on current photosynthesis which finally decrease transferred photosynthetic materials to grains, as a result, seeds become small and wrinkled [23].

Figures response in salinity was different for the number of seeds per pod, as the number of seeds per pod in Delgan and Zaffar cultivars were reduced with increasing level of salinity, while on others, the opposite was observed (Table 2). In accordance with the results of this study, Zamani et al. [9], Tajali et al. [13], and Shokri [15], also reported seeds reduction per pod in canola. Shams Aldin and Farahbakhsh [24], reported significant positive correlation between the length of pods and seeds per pod and stated that one of the reasons for reducing the number of seeds per pod in canola under salinity is the reduction of pod length. Mendham and Salisbury [25], stated that the number of seeds per pod is an average of 30 ovule on flowering time, but the final number is always less than 30 seeds per pot, because factors such as salinity, increased osmotic pressure and other environmental factors are effective in reducing the number of seeds per pod. In

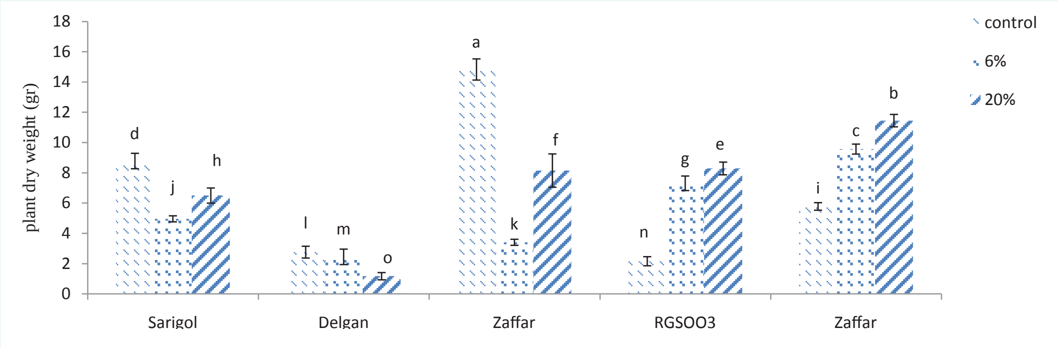

Figure 1 Mean compression of plant dry weight under three salt treatments in canola cultivars.

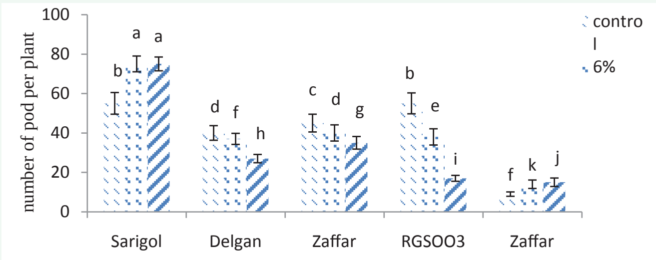

Figure 2 Compression of mean number of pod per plant under three salt treatments in canola cultivars.

Table 3: ANOVA for regression0f grain yield as dependent variable and other traits as independent variables.

Sources of variation	Degree of freedom	Mean of squares
Regression	4	**12.352
Residual	40	0.065
** significant at 0.01 probability level		AdjustedR^2= 0.951 R^2= 0.958

Table 4: Results of stepwise regression for grain yield as dependent variable and other traits as independent variables.

Model	Nonstandard coefficients	Standardized coefficients
(α)Constant	0.858-	
Seed weight per pod (gr) (X_1)	1.45	0.837
Number of pod per plant (X_2)	0.49	0.535
Number of seed per plant (X_3)	0.013-	0.105-
The number of lateral branches (X_4)	0.020-	0.080-

all cultivars the highest seed weight per pod was under control treatment (no salt) and the lowest was found at 20% salt, so, the Delgan under normal conditions had the maximum weight of seed per pod, respectively; but Zaffar and Zarfam cultivars under salt stress 20%, lowest seed weight per pod was found (Table 2).

In studied cultivars, the highest number of lateral branches was found under normal conditions and at different levels of salinity significantly reduced the number of lateral branches which corresponded with the outcome of Shokri [15], and Yousefi et al. [16], investigations. The highest plant height (113 cm) was found in Zaffar cultivar under normal conditions and the minimum height (44 cm) was found inRGS003 cultivar under 20% saline conditions, respectively, in accordance with the results of other researchers [14-16]. Under saline conditions, cell wall properties change and leaf turgor and photosynthesis rates decrease, leading to a reduction in total leaf area. Furthermore, the stem growth (a component of the aerial part) is also normally reduced by high salt concentrations. Decreases in leaf and stem provoke a reduction in all aerial part sizes and in the plant height [4]. Salinity stress also reduced plant height as a result of reported canola. The shoot length was considered as a temporary storage tank is non-structural carbohydrate which by the reduction of plant height, provides smaller amount of carbohydrates, especially under seeds stress conditions during grain filling stage. Salinity stress reduced the division of cells and causes the cell elongation [26], and in this way leads to shorten the height of the plant and reduce plant dry weight. Root dry weight in the Zafar cultivar under normal condition was highest. After applying 20% salinity stress, the highest number of dead leaves (yellow and dried leaves) was observed in Zafar cultivar.

Regression analysis

The results of linear regression between grain yield (as the dependent variable) and measured traits (as the independent variables) (Tables 3,4) showed that there is a significant relationship between grain yield per plant and seed weight per pod, number of pods per plant, number of seeds per pod and number of lateral branches (Equation 1). Adjusted R^2 in this model was 95 percent.

Table 5: ANOVA for regression0f leaf weight as dependent variable and other traits as independent variables

Sources of variation	Degrees of freedom	Mean of squares
Regression	5	**101.160
Residual	39	1.160
** significant at 0.01 probability level		Adjusted R2= 0.922 R2= 0.936

Table 6: Results of stepwise regression for leaf weight as dependent variable and other traits as independent variables

Model	Nonstandard coefficients	Standardized coefficients
(α)Constant	2.713-	
The number of lateral branches(X_1)	1.626	0.566
Yield per plant (gr)(X_2)	0.654	0.403
Plant dry weight (gr) (X_3)	0.86-	0.355-
The weight of one thousand seeds (gr)(X_4)	0.179	0.202
Number of pod per plant(X_5)	0.024-	0.126-

Equation 1: $y= -0.858 + 1.45 X_1 + 0. 49X_2- 0.013X_3 + 0.02 X_4$

Where in;

Grain yield per plant (gr) = y

Seed weight per pod (gr) = x_1

The number of pods per plant = x_2

The number of seeds per pod =x_3

The number of lateral branches =x_4

Equation 1 indicates that by increasing the seed weight per pod and number of pods per plant, grain yield increases. Sheikh et al. [28], showed that in canola cultivars, grain yield changes by the number of main and side branches, seed weight and number of pods per plant was justified. Stepwise regression analysis showed that 98 percent of the variation in grain yield in canola was explained by biological yield, harvest index, number of days from planting to flowering and number of seeds per pod. Fathi et al. [3], also found that the number of seed per pod, number of pods per plant and biological yield indices were the best choice for improving grain yield. In addition, Baradaran et al. [27], as well as the results of this study showed that the number of pods per plant, seeds per pod, seed weight and number of nodes on the stem in canola cultivars explain the 64 percent of the variation in grain yield, respectively. Moradi and Godrati [29], showed that seed yield variations were explained by seed weight and number of seeds per pod and these traits explained 93% of variation in grain yield.

The results of regression between leaf weight (as the dependent variable) and measured traits (as the independent variables) (Tables 5,6) showed that there is a significant relationship between leaf weight and the number of lateral branches, yield per plant, plant dry weight, thousand-seed weight and number of pods (Equation 2). Adjusted R^2 in this model was 92 percent.

Equation 2: $y= -2.713 + 1.626X_1 + 0.654X_2 - 0.86X_3 + 0.179 X_4 - 0.024X_5$

Where in;

Leaf weight = y

The number of lateral branches = X_1

Yield per plant= X_2

Plant dry weight= X_3

One thousand seed weight= X_4

Number of pods per plant= X_5

This relationship indicates that by increasing the number of lateral branches, yield per plant and one thousand seed weight, leaf weight increases.

Factor analysis

The significance of the Bartlett's test of sphericity indicates that the correlation values of the initial variables were sufficient for factor analysis. Based on the results of the factor analysis (Table 7), primary variables were defined in four factors which explained 80.81 percent of the total variation. Based on the results of factor analysis, the communality of most traits are high that indicates the number of selected factors was appropriate and the selected factors have been able to justify the changes in the traits. The first factor with 36.07 variance had the highest percentage of the total variance. Plant height, fresh leaf weight, root dry weight and plant dry weight had the highest positive coefficients in factor one, so it can be called as growth factor. In second factor that justified 16.28% of the changes, the number of pods per plant, the number of seed per pod, seed weight per pod, grain weight and one thousand grain yield had high positive coefficient. It means that by increasing the number of pods per plant, number of seeds per pod, seed weight per pod, plant yield increases. Therefore, this factor can be called yield factor and its components. The third factor explained 14.80% of the total variation. In this factor, the root dry weight had high positive and was named as root dry weight factor. The fourth factor justifies 9.66 percent of the total variance and in this factor the one thousand grain weight had high positive coefficient while number of pods per plant had high negative coefficient. Therefore, this factor was named as the thousand seed weight. In accordance with the results of this study, Ghaffari Nematabad and Tahmasbpour [17], by using factor analysis reduced 12 traits of canola into 5 factors which explained 81 percent of the total variance.

CONCLUSION

The results showed that salinity stress significantly reduced all traits. Also, the highest effect of salinity on seed yield was under salinity stress of 20%. In all cultivars, the highest grain yield was observed in control group and by increasing salinity stress, grain yield significantly decreased. Delgan and RGS003 cultivars in control condition had the highest and Zarffam had the lowest grain yield in 20% salinity stresses. From the results of the regression analysis in canola varieties, it can be found that for genetic improvement of grain yield, grain weight per pod and

Table 7: Rotated factor loadings, the proportion of variation explained by each factor, Cumulative percentage of variance and Eigenvalues.

Traits	First factor	Second factor	Third factor	Forth factor	communality
Number leaves	0.081	0.209-	0.417	0.169	0.876
Number of dead leaves after stress	0.139	0.024-	0.26	0.259	0.670
Plant height (cm)	0.989	0.126	0.072-	0.293-	0.864
The number of lateral branches	0.096-	0.249	0.077-	0.225	0.495
Number of pod per plant	0.043-	0.698	0.138	0.752-	0.891
Number of seeds per pod	0.168-	0.726	0.261	0.075	0.813
Seed weight per pod (gr)	0.108-	0.696	0.011	0.132	0.842
Fresh leaf weight (gr)	0.796	0.153	0.058	0.081	0.828
Root dry weight (gr)	0.757	0.256	0.649	0.046-	0.786
Yield per plant (gr)	0.109-	0.833	0.629	0.010-	0.773
Plant dry weight (gr)	0.696	0.152	0.046	0.004-	0.812
weight of one thousand seeds (gr)	0.070	0.602	0.296-	0.982	0.567
Eigen values	4.4	1.90	1.70	1.20	
Percent of variance	36.07	16.28	14.80	9.66	
Percent of cumulative variance	36.07	52.35	67.15	80.81	

pod number per plant can be used as indirect selection criteria in breeding programs. Based on the results of the factor analysis, first four factors were explained 80.81 percent of the total variation. Sariogel cultivar with the highest grain yield under salinity stress can be introduced as tolerant cultivar. Number of pod per plant in sariogel and zarffam was higher when treated with 6 and 20 % sodium chloride. Constant advances are being made to identify traits that are associated with salinity tolerance, such as measurements of harvest index and water use efficiency allowing us to get a better understanding of the complex network of traits that contribute to salinity tolerance.

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