International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:12, No:10, 2018

The Study of Rapeseed Characteristics by Factor Analysis under Normal and Drought Stress Conditions

Ali Bakhtiari Gharibdosti, Mohammad Hosein Bijeh Keshavarzi, Samira Alijani

***Abstract*—**To understand internal characteristics relationships and determine factors which explain under consideration characteristics in rapeseed varieties, 10 rapeseed genotypes were implemented in complete accidental plot with three-time repetitions under drought stress in 2009-2010 in research field of agriculture college, Islamic Azad University, Karaj branch. In this research, 11 characteristics include of characteristics related to growth, production and functions stages was considered. Variance analysis results showed that there is a significant difference among rapeseed varieties characteristics. By calculating simple correlation coefficient under both conditions, normal and drought stress indicate that seed function characteristics in plant and pod number have positive and significant correlation in 1% probable level with seed function and selection on the base of these characteristics was effective for improving this function. Under normal and drought stress, analyzing the main factors showed that numbers of factors which have more than one amount, had five factors under normal conditions which were 82.72% of total variance totally, but under drought stress four factors diagnosed which were 76.78% of total variance. By considering total results of this research and by assessing effective characteristics for factor analysis and selecting different components of these characteristics, they can be used for modifying works to select applicable and tolerant genotypes in drought stress conditions.

***Keywords*—**Correlation, drought stress, factor analysis, rapeseed.

I. Introduction

ON the base of researches, among the different factors which make stress such as disease, pest, weed, drought, salinity, temperature, dryness lonely leads to 45% reduction in production [1]. According to canola importance for supplying oil and protein, recognizing characteristics which have close relationship with seed yield and by improving them, seed yield will increase, has important for modifying plants. Seed yield is one of the important aims in canola agronomy, and this characteristic is affected by plant numbers per surface unit, pod number per plant, and seed numbers per pod and seed weight [2]. The findings of Qifuma et al. [3] on canola showed that water shortage in flowering stage and seed filling had negative impact on seed yield. Chrismas [4] suggested that seed yield is affected by factor such as plant number per surface unit, pod number per plant, seed number per pod and seed weight. Ozer [5] reported a positive and significant coefficient among seed yield and pod number per plant and 1000 seeds weight. Chamapolivier and Merrin [6] suggested that pod number and seed number per plant is affected by drought stress.

Factor analysis technique is beneficial for deep under stinting of multivariable data. Analyzing the main factors is one of the principal calculations among multivariable analyzing and is a method that reduces data and their interpretations, by this method a small set of variables are determined by the way that includes a wide part of main fluctuating variables. As a result, this method omits the effect of a variable on other variables relations and minimized characteristics coverage [7]. Implementing this experiment in different irrigation conditions may lead to change in variables growing. The goal of this research is considering morphological and quantitative characteristics relations and recognizing the most important and effective characteristics on seed yield and determining role and their relative amount under normal and drought stress conditions.

II. Method and Materials

This research had been done in 2009-2010 in agriculture field of agriculture college, Islamic Azad University, Karaj Branch. In this research, 10 Canola genotypes were assessed under normal and drought stress in complete accidental plot with three times repetitions. Karaj zone with average rainfall 250 mm and 15 °C temperature has been located in 51° eastern geographical longitude and 35 and 49 min northern geographical latitude.

Each experimental plot included four rows with 2 m length, and they had 50 cm distance with each other. Irrigation had been done control in care stage to do stress. At the first, more seeds were cultivated, but at the four or five leaves stage, they were harvested till reach to favor concentration. Measuring some characteristics such as plant height and days counting till 50% of flowering had been done before harvesting and after omitting margins; harvestings were done from two middle rows and under considered characteristics were measured carefully.

In this research, 11 characteristics were considered which were related to growth, production, and function stages. They were included: seed yield per plot, day's number till 50% flowering, plant height, pod number per main stream, pod height, seed yield per plant, seed number per pod, harvest

Ali Bakhtiari Gharibdosti is with the Department of Agronomy and Plant Breeding, Karaj Branch, Islamic Azad University, Karaj, Iran (e-mail: alireza4711@yahoo.com).

Mohammad Hosein Bijeh Keshavarzi is with the Young Researchers and Elites Club, North Tehran Branch, Islamic Azad University, Tehran, Iran (phone: + 989128496086, e-mail: keshavarzi64.mh@gmail.com).

Samira Alijani is MSc. Student of Food Industries, Islamic Azad University, Damghan Branch, Agriculture Faculty, Iran.

index, 100 seeds weight, pod number per subsidiary steam and subsidiary branch number. Statistical calculations had been done by SAS, SPSS and Excel software.

III. Results

Variance analysis results of under consideration characteristics under normal conditions showed that means square of treatment for seed yield per m^2, seed yield per plant and pod number per subsidiary stem were significant in 5% probable level, and plant height, pod number per main stem and pod height were significant in 1% probable level (Table I).

Variance analysis of under consideration characteristics under drought stress conditions showed that means square of treatment for seed yield per m^2, seed yield per plant, harvest index and 100 seeds weight were significant in 5% probable level, and for plant height, pod number per main stem and seed number per pod were significant in 1% probable level.

For day's number till 50% flowering, pod height, pod number per subsidiary stem and subsidiary stem number hadn't any significant differences (Table II). Overall, there were high varieties among genotypes from under consideration characteristics aspects.

Under normal irrigation conditions, it was observed that the most seed yield amounts were related to Likord, Hyola 308, Zarfam and Ocapi varieties which were 875.7, 820.1, 712.7, 664.8 gr per m^2 respectively.

The most means of seed yield per plot under drought stress were related to Likord, Sarigol and RGS003 varieties which were 201.2, 242.65, 287.88 gr per m^2 respectively.

In this study, correlation coefficient results under normal condition were shown (Table III) that seed yield has positive and significant coefficient with seed yield per plant (r = 0.98) and pod number per subsidiary stem (r = 0.41) in 1% probable level.

Coefficient results under drought stress (Table IV) showed that seed yield had positive and significant coefficient with seed yield per plant (r = 0.75), plant height (r = 0.74), pod number per subsidiary stem (r = 0.47), seed number per pod (r = 0.46) and harvest index (r = 0.41) in 1% probable level. There was a negative coefficient among seed yield and 100 seeds weight (r = -0.30) also. Results of this investigation were accordance to Taylor and Smith [8], Campbell and Kondara [9] findings.

TABLE I.A
Variance Analysis (Mean Squares) of Under Consideration Characteristics in 10 Rapseseed Genoyypes Under Normal Condition

S.O.V	df	seed yield per m^2 (kg)	day's number till 50% flowering	plant height (cm)	pod number per main steam	pod height (cm)
Block	2	88157.03 ^{ns}	276.13 ^{ns}	1113.16 **	548.99 **	0.424 *
Genotype	9	169845.38 *	180.13 ^{ns}	460.14 **	352.818 **	0.636 **
Error	18	66102.03	143.13	117.108	107.96	0.144
C.V (%)		21.45	7.97	11.01	15.31	6.01

TABLE I.B
Variance Analysis (Mean Squares) of Under Consideration Characteristics in 10 Rapseseed Genoyypes Under Normal Condition

seed yield per plant (g)	seed number per pod	harvest index	100 seeds weight (g)	pod number per subsidiary stem	subsidiary stem number
51.95 ^{ns}	65.104 **	0.001 ^{ns}	0.022 *	6594.16 *	0.487 ^{ns}
128.51*	13.81 ^{ns}	0.003 ^{ns}	0.003 ^{ns}	4662.89 *	0.831 ^{ns}
44.88	8.858	0.005	0.006	1875.143	1.106
7.32	10.99	25.95	19.03	16.15	9.21

Note: *and ** indicate significant difference at 5% and 1% probability level, respectively. ns is not significant.

TABLE II.A
Variance Analysis (Mean Squares) of under Consideration Characteristics in 10 Rapseseed Genoyypes under Drought Stress

S.O.V	df	seed yield per m^2 (kg)	day's number till 50% flowering	plant height (cm)	pod number per main steam	pod height (cm)
Block	2	2280.12^{ns}	134.43ns	245.41^{ns}	479.53**	0.18 ^{ns}
Genotype	9	12490.92*	126.67^{ns}	646.25**	180.22**	0.23 ^{ns}
Error	18	4764.01	82.35	151.51	42.76	0.14
C.V (%)		19.24	6.23	17.06	17.32	6.68

TABLE II.B
Variance Analysis (Mean Squares) of under Consideration Characteristics in 10 Rapseseed Genoyypes under Drought Stress

seed yield per plant (g)	seed number per pod	harvest index	100 seeds weight (g)	pod number per subsidiary stem	subsidiary stem number
25.92 ^{ns}	2.92 ^{ns}	0.01^{ns}	0.001^{ns}	5916.63 ^{ns}	0.62 ^{ns}
32.57 *	20.51**	0.02 *	0.01*	3686.42 ^{ns}	0.41 ^{ns}
13.09	4.99	0.02	0.004	3324.92	0.44
18.06	8.69	16.19	14.74	13.17	9.76

Note: *and ** indicate significant difference at 5% and 1% probability level, respectively. ns is not significant

TABLE III
CORRELATION COEFFICIENT OF UNDER CONSIDERATION CHARACTERISTICS IN 10 RAPESEED GENOTYPES UNDER NORMAL CONDITION

under consideration characteristics	seed yield per m^2 (kg)	day's number till 50% flowering	plant height (cm)	pod number per main stem	pod height (cm)	seed yield per plant (g)	seed number per pod	harvest index	100 seeds weight (g)	pod number per subsidiary stem
day's number till 50% flowering	-0.05 ^{ns}									
plant height (cm)	0.15 ^{ns}	0.06 ^{ns}								
pod number per main stem	-0.02 ^{ns}	0.32 *	0.50 **							
pod height (cm)	-0.01 ^{ns}	0.01 ^{ns}	-0.02 ^{ns}	-0.19 ^{ns}						
seed yield per plant (g)	0.98 **	-0.07 ^{ns}	0.13 ^{ns}	-0.03 ^{ns}	0.03 ^{ns}					
seed number per pod	0.25 ^{ns}	-0.05 ^{ns}	0.28 ^{ns}	0.04 ^{ns}	0.30 ^{ns}	0.28 ^{ns}				
harvest index	0.21 ^{ns}	-0.46 **	-0.33 *	-0.25 ^{ns}	-0.03 ^{ns}	0.18 ^{ns}	-0.05 ^{ns}			
100 seeds weight (g)	-0.06 ^{ns}	0.01 ^{ns}	-0.43 *	-0.44 *	-0.08 ^{ns}	-0.03 ^{ns}	-0.06 ^{ns}	0.08 ^{ns}		
pod number per subsidiary stem	0.41 *	0.34 *	0.52 **	0.46 *	0.23 ^{ns}	0.38 *	0.05 ^{ns}	-0.18 ^{ns}	-0.36 *	
subsidiary stem number	0.18 ^{ns}	0.36 *	0.46 *	0.29 ^{ns}	0.32 *	0.16 ^{ns}	-0.05 ^{ns}	-0.24 ^{ns}	-0.43 *	0.57 **

Note: *and ** indicate significant difference at 5% and 1% probability level, respectively. ns is not significant.

TABLE IV
CORRELATION COEFFICIENT OF UNDER CONSIDERATION CHARACTERISTICS IN 10 RAPESEED GENOTYPE UNDER DROUGHT STRESS

under consideration characteristics	seed yield per m^2 (kg)	day's number till 50% flowering	plant height (cm)	pod number per main stem	pod height (cm)	seed yield per plant (g)	seed number per pod	harvest index	100 seeds weight (g)	pod number per subsidiary stem
day's number till 50% flowering	0.20 ^{ns}									
plant height (cm)	0.74 **	0.44 ^{ns}								
pod number per main stem	0.19 ^{ns}	0.53 **	0.31*							
pod height (cm)	0.21 ^{ns}	0.14 ^{ns}	0.11 ^{ns}	0.29 ^{ns}						
seed yield per plant (g)	0.75 **	-0.001 ^{ns}	0.83**	0.20 ^{ns}	0.27 ^{ns}					
seed number per pod	0.46 **	0.22 ^{ns}	0.51**	0.28 ^{ns}	0.44 **	0.65 **				
harvest index	0.41 **	-0.24 ^{ns}	0.14 ^{ns}	-0.23 ^{ns}	0.10 ^{ns}	0.37 *	-0.03 ^{ns}			
100 seeds weight (g)	-0.30 ^{ns}	0.05 ^{ns}	0.14 ^{ns}	0.18 ^{ns}	0.14 ^{ns}	0.02 ^{ns}	0.21 ^{ns}	-0.58 **		
pod number per subsidiary stem	0.47 **	0.31 *	0.58 **	0.56 **	0.11 ^{ns}	0.54 **	0.35*	0.04 ^{ns}	-0.03 ^{ns}	
subsidiary stem number	0.11 ^{ns}	0.03 ^{ns}	0.02 ^{ns}	0.10 ^{ns}	0.25 ^{ns}	0.10 ^{ns}	0.019 ^{ns}	0.15 ^{ns}	-0.21^{ns}	0.42**

Note: *and ** indicate significant difference at 5% and 1% probability level, respectively. ns is not significant

TABLE V
SPECIAL AMOUNT OF VARIANCE PERCENTAGE AND SPECIAL COEFFICIENTS' VECTORS WHICH IS RELATED TO UNDER CONSIDERATION CHARACTERISTICS IN ANALYZING TO MAIN FACTORS UNDER NORMAL CONDITION

	Factors				
Under consideration characteristics	**1st**	**2nd**	**3rd**	**4th**	**5th**
seed yield per m^2 (kg)	-0.411	0.210	0.028	-0.125	-0.543
day's number till 50% flowering	-0.245	0.246	-0.305	-0.013	0.684
plant height (cm)	-0.421	0.146	0.305	0.214	0.095
pod number per main steam	0.386	0.332	-0.217	-0.198	-0.110
pod height (cm)	0.225	0.396	0.431	0.105	-0.088
seed yield per plant (g)	0.456	0.277	0.062	-0.600	0.092
seed number per pod	0.314	-0.010	-0.013	0.504	0.185
harvest index	0.030	-0.183	0.590	-0.354	0.049
100 seeds weight (g)	-0.138	0.538	0.146	0.074	0.194
pod number per subsidiary steam	-0.040	0.450	-0.332	0.162	-0.228
subsidiary steam number	0.221	0.047	0.432	0.338	-0.267
Special amount	2.681	2.536	1.665	1.205	1.009
Variance percentage	14.44	87.08	46.00	19.58	24.33
cumulative variance percentage	24.37	47.43	62.58	73.54	82.72

To increase seed yield, one should pay attention to some characteristics such as, seed yield per plant and pod number which have high coefficient with seed yield under normal and stress condition. Sadagat et al. [10] suggested that seed yield per plant and bag number per each plant had the most positive effect on rapeseed seed yield.

Factor analysis results on data of 11 under consideration characteristics in 10 genotypes such as characteristics vector, variance ratio and accumulated variance percentage offered in Tables V and VI. Factor analysis under normal irrigation showed that special number of main factors (1-5) were more than 1, and these five factors overall explain by 82.72% of total variance. First factor showed that the most positive impact was related to seed yield per plant and plant height had the most negative impact, so this factor named as seed yield per plant. In second factor, 100 seeds weight had the most positive effect and harvest index had the most negative impact, so this factor named as 100 seeds weight factor. In third factor, the most positive effect was due to harvest index and the most negative effect was related to pod number per subsidiary stem, so it named harvest index factor.

In fourth factor, seed number characteristic per pod had the most positive impact and named as seed number per pod.

In fifth factor days number till 50% flowering had the most positive impact and named as days number till 50% flowering (Table V).

Factor analysis under drought stress showed that special number of main factors (1-4) was more than 1, totally these four factors explained about 76.78% of overall variance. This factor explained 31.73, 19.32, 13.25, and 12.48 of total variance respectively.

First factor showed that the most positive impact was related to 100 seeds weight, and the negative impact was due to seed number per pod. So, it named as 100 seeds weight. In second factor, the most positive impacts were related to pod number per main and subsidiary stem and the most negative impact was related to day's number till 50% flowering, so it named as bag features. The first factor with 31.73 variances and second factor with 19.32% explained 51.05% of data changes totally. In third factors, seed yield per m2 and seed number per pod had the most positive impact and harvest index had the most negative effect, so named as yield factor. In fourth factor, pod number per subsidiary stem had the most positive impact so it named as pod features (Table VI).

Sadequt et al. [10] had similar results as well. Baker [11] suggested that the most important characteristics to select genotypes with high yield were 1000 seeds weight and pod number per subsidiary and main stem. This characteristic was estimated easier than yield and pod number per plant was among the most positive effects and located at 2nd stage after 1000 seeds weight.

TABLE VI
SPECIAL AMOUNT OF VARIANCE PERCENTAGE AND SPECIAL COEFFICIENTS' VECTORS WHICH IS RELATED TO UNDER CONSIDERATION CHARACTERISTICS IN ANALYZING TO MAIN FACTORS UNDER DROUGHT STRESS

Under consideration characteristics	Factors			
	1st	2nd	3rd	4th
seed yield per m^2 (kg)	0.286	0.226	0.405	-0.402
day's number till 50% flowering	0.392	-0.383	-0.186	-0.088
plant height (cm)	0.311	0.202	0.255	-0.442
pod number per main steam	0.033	0.594	-0.006	0.116
pod height (cm)	0.397	-0.307	-0.349	0.234
seed yield per plant (g)	0.395	0.2269	-0.665	0.221
seed number per pod	-0.302	-0.234	0.375	0.214
harvest index	0.218	0.167	-0.651	-0.013
100 seeds weight (g)	0.402	-0.151	0.359	0.198
pod number per subsidiary steam	0.169	0.220	0.187	0.644
subsidiary steam number	0.145	-0.322	-0.016	-0.125
Special amount	3.49	2.12	1.45	1.37
Variance percentage	31.73	19.32	13.25	12.48
cumulative variance percentage	31.73	51.05	64.30	76.78

Osinska and Laudanski [12] determined that among some features such as seed weight, seed number, pod number are close relations. Results showed that in 11 characteristics, analyzing to five factors under normal condition and analyzing to four factors under drought stress divided by sufficient explanation of total variance. This analysis determined the ratio of each characteristic in each factor and total variety.

Variety in special amount coefficient in factor analysis showed that selecting different compounds of these characteristics can be used to increase yield along with stress tolerance in rapeseed varieties.

REFERENCES

[1] N. L. Mantri, R. Ford, T. E. Coram, and E. C. K. Pang. "Transcriptional profiling of chickpea genes differentially regulated in response to high-salinity, cold and drought". BMC Genomic, 2007, pp. 8: 303.
[2] W. Diepenbrock. Yield analysis of winter oilseed rape (*Brassicanapus* L.): A review Field Crops Research, 2000, 67: 35-49.
[3] SH. Qifuma, R. Niknam, and D. W. Turner. "Resposes of osmotic adjustment and seed yield of *Brassica napus* and *B. juncea* to soil water deficit at different growth stages". Aust. J. Agric. Res., 2006, 57: 221-226.
[4] E. P. Chrismas. "Evaluation of planting date for winter canola production in Indiana. In: Janick (ed), progress in New Crops". Ashs Press, Alexandria, Va. 1992, 278-281.
[5] H. Ozer. "Sowing date and nitrogen rate effects on growth, yield components of two summer rapeseed cultivars". European Journal of Agronomy, 2003, 19(3): 453-463.
[6] L. Chamapolivier, and A. Merrin. "Effects of water stress applied at different growth stage to *Brassica napus* L.var. Oleifera on yield, yield components and seed quality". Eur. J. Agron., 1996, 5: 153-160.
[7] M. Arab Aval, and M. Ebrahimi. "The study of analyzing to main factors on yield and quantitative characteristics of Canola species in different cultivation dates". 7th congress of agronomy and breeding. 2002, P 423.
[8] A. J. Taylor, and C. J. Smith. Comprative physiology of divergent type of winter rapeseed. In: Proceedings of International Canola Conference of Sasckatoon, Canada. 1992.
[9] D. C. Campbell, and Z. P. Kondara. "Relationship among growth patterns, Yield components and yield of rapeseed". Canadian Journal of Plant Science, 1978, 58: 87-93.
[10] H. A. Sadagut, M. H. Nadeem Tahir, and M. T. Hussain. "Physiological aspect of drought tolerance in canola (*Brassica napus*)". International Journal of Agriculture and Biology, 2003, 1560-8530/2003/05-4-611-614.
[11] R. J. Baker. "Breeding methods and selection indices for improved tolerance to biotic and a biotic stresses in cool season food legumes". Euphytica, 1994, 73: 67-72.
[12] A. Osinska, and Z. Laudanski. "Statistical methods in evaluation of soybean collection materials. Part ll. Relationship between chosen characters". Biuletyn instytutu hodowli i aklimatyzacji roslin, 2002, 221: 207-224.