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PRODUCTIVITY AND ASSOCIATION OF TWO CANOLA VARIETIES UNDER SOME DRIPP IRRIGATION LEVELS.

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ABSTRACT

Two field experiments were conducted in a new desert reclaimed area, on canola (*Brassica napus L.*), under a drip irrigation system, during 1997 / 1998 and 1998/1999 seasons, to study the effect of three irrigation levels, Viz. 280.02 (I_1), 560.04(I_2) and 1120.08(I_3) m^3/fed., on yield and some yield attributes of AD 201 (V_1) and B.P.S. Tower (V_2) varieties. A split plot design with three replicates was used, where irrigation levels occupied the main plots, while the sub-plots were devoted to the two varieties. Water use efficiency (W.U.E) was calculated for all combination treatments. Correlation, stepwise and path coefficients analysis were performed.

The obtained results, in both seasons, revealed that significant increases due to irrigation varying from I_1 to I_2 were seen with all traits, Then after the increases were insignificant, except with respect seed yield/fed., where the highest value were detected on I_2 (427.0 Kg/fed.) and I_3 (510.0 Kg/fed.) in the first and second seasons, respectively. The two varieties did not significantly vary to each other with respect to seed yield/fed. and some other traits, while AD 201 surpassed B.P.S. Tower with all traits. Interaction effect was insignificant with all respects except number of silique/plant in the second season. The combinations (I_2 X V_1) and (I_3 X V_1) gave the pronounced seed yield / fed. in the first season, i.e. 534.0 Kg/fed. and 616.0 kg/fed. in the second season. Water use efficiency was greater in the second season. The combination of (I_2 X V_1) produced the highest W.U.E. values, Viz. 0.65 and 0.68 Kg/m^3 in the first and the second seasons, respectively.

All traits were positively and significantly correlated to each other. Stepwise analysis indicated that number of silique/plant and 1000 seed weight were the most traits in the predictions equation. Path coefficient analysis declared that the previous two traits directly, indirectly and totally relative contribution were 53.39, 16.25 and 69.64 % for number of silique per plant and 2.75 , 0.51 and 3.26 % for 1000 seed weight , respectively .

INTRODUCTION

In the world, canola (*Brassica napus L.*) ranks the second position after soybean either for cultivated area (24.85 million hectare) or seed yield (37.46 million ton), Production Estimates and Crop Asessment Division, FAS, USDA, (1993).

Egypt know rapeseed in the last three decades, where the crop still in the research phase. Studies, with this respect, stated that such crop may be a promising one, depending upon some advantages, however such crop is of short duration, a winter crop, of high capability to grow in poor soils and of relative higher productivity. Thereafter, many thought that canola may be a considerable constructive oil crop for filling the wide gap (90 %) between the local production and consumption from edible oil.

Because of the critical role of water for life, studies on irrigation would always be welcomed. Canola yield seemed to increase by irrigation at least one or two times, as compared to unirrigation, Ghosh et al (1994). Mahal et al (1994) added that maximum seed yield required at least two irrigations, first at 3-4 weeks and second 9-10 weeks after sowing. Generally, the reduction in seed yield of canola due to watering stress could usually be attributed to the corresponding reductions in most of growth features and yield components, including number of branches/plant, (Sharama 1994), 1000 seed weight, (Singh et al 1994) and seed yield / plant and / fed. , (El Bagge 2001). On the other hand, no significant effect due to irrigation was detected on seed yield / fed., (El Bagge 2001).

Canola is considered as a rich oil crop with many genotypes. Several canola varieties were deeply studied in Egypt, where only spring group was considered. Abd El-Hafeez et al (1990) reported that AD 201 cv. overyielded the other tested varieties. El Bagge (2001) classified canola varieties, according to their root length, into short and long types. The most common varieties in Egypt, viz. AD 201 and B.P.S. Tower are belonging to the two types, respectively.

Interactions among irrigation and varieties were insignificant, (Pannu et al 1997), mean while significancy among them varied according to studied traits, (El Bagge 2001).

Correlation was studied on canola traits, where most studies showed positive correlations among tested traits, of them Kandil et al (1994) who found such relations between number of silique and each 1000 seed weight and seed yield / plant.

The present study was planned to investigate the performance of two canola varieties under dripp watering, in a new reclaimed area, to suggest the optimal combination treatment for application in such area.

MATERIAL AND METHODS

Two field experiments were carried out during 1997/1998 and 1998/1999 seasons, to study the effect of dripped irrigation level on canola, in a private farm, which is located in Regwa Company Area, Kilometer 62, Desert Road, Cairo-Alexandria. Mechanical analysis of the soil, at 0-30 cm.depth, over the two seasons, showed that the soil was loamy sand, containing 13.1 % clay, 13.1 % silt and 73.8 % sand. The prevailing climatic factors are summarized in Table 1.

In both seasons, calcium super phosphate (15.5 % P_2O_5) at the rate of 100.0 Kg / fed. and equal rate of potassium sulphate (50.0 % K_2O), were added during seed bed preparation. Nitrogen at 48.0 Kg / fed. as ammonium sulphate was added at four equal rates; the first was just before sowing irrigation, the remainder were added as fertigation during the first, second and third irrigation, respectively. Seeding was in the middle of November. Seeds were drilled in hills 30 cm apart, at a rate of 3.0 Kg / fed. Thinning was carried after complete germination and before first irrigation, to secure four plants / hill.

Table 1: The average daily values of air temperature (C^0) and rainfall (mm and m^3 / fed.) at Nobaria area, during the two seasons.

Season	Month	Air Temp.C^0	Rainfall	
			(mm)	(m^3/fed.)
1997/1998	November	19.30	0.66	2.77
	December	15.89	12.72	53.42
	January	14.71	27.84	116.93
	February	14.77	21.12	88.70
	Marsh	15.29	18.18	76.36
Total		-	80.52	338.18
Mean		-	16.10	67.64
1998/1999	November	19.30	4.62	19.40
	December	15.92	12.24	51.41
	January	16.81	25.92	108.86
	February	16.88	2.28	9.58
	Marsh	17.44	14.16	59.47
Total		-	59.22	248.72
Mean		-	11.84	49.74

Each irrigation (I) was carried out for 90 minutes, through a drip irrigation system, where drippers of GR type were used. Such dripper discharges 2.0 , 4.0 and 8.0 L./hr. Number of the drippers / fed. was 15556. Such number was calculated by the following equations:

Nod = Fe.ar ÷ Rap X Dap

Nod = Number of drippers / fed.

Fe.ar = Feddan Area = 4200.78 m^2

Rap = Rows apart = 90 cm

Dap = Drippers apart = 30 cm

The previous drippers discharge about 31.11, 62.22 and 124.44 m^3 / fed. per one hour. Consequently, for every irrigation (1.30 hr.) the previous amounts would be herein 46.67, 93.34, 186.68 m^3 / fed., respectively. Amount of delivered water (m^3 / fed) was calculated by the summation of irrigation [time frequency (fre.), quantity] and rainfall in both seasons in table 2.

Two German canola varieties, viz . AD 201 (V_1) and B.P.S. Tower (V_2) were used. The first variety is the older in Egypt well adapted and of short root (4.14mm). The second highly yields and of long root (5.74 mm), El Bagge (2001). Thereafter, five independent treatments, viz. (I_1): 280.02 m^3/fed., (I_2): 560.04 m^3/fed., (I_3) : 1120.08 m^3/fed., (V_1) : AD 201 and (V_2) : B.P.S. Tower as well as their six combinations were used. All other agriculture practices as well as other fittings and rules in dripping systems were carried out as usual.

A split plot design with three replications was used. The main plots were devoted to the three irrigation treatments. the sub-ones were occupied by the two tested varieties. Plot area was 40.5 m^2 (45.0 m. long X 0.9 m apart).

Studied characters

Eighteen guarded plants were randomly taken from each plot at harvest,

to study the following traits:

1- Plant height, cm (Pl.H.).
2- Number of branches / plant, (Br. / Pl).
3- Number of silique / plant, (Sil. /Pl).
4- 1000-Seed weight, gr. (S.W.).
5- Seed yield (gr) / plant, (S.Y.Pl.).
6- Seed yield (Kg) / fed, (S.Y. / fed.).

Water use efficiency (W.U.E.)

Water use efficiency was calculated for the six combination treatments, using (A.D.W.). Consequently, Vietes (1965) equation was used for estimating (W.U.E) as follows:

W.U.E = S.Y. (Kg) / fed.÷ A.D.W. (m^3/fed.).

Statistical analysis

Analysis of variance

At the end of both seasons, means of the traits studied were subjected to analysis of variance, where they were compared by L.S.D. method at 0.05 level of significance, according to Sendecor and Cochran (1981).

Correlation, stepwise and path coefficient analysis

The average over the two seasons was computed for each record pair. thereafter, 18 means of each trait was used for analyzing simple correlation coefficient. Thereafter, stepwise mathematical linear model for multiple regression analysis, was carried out as described by Gomez and Gomez (1983).

It was assumed that the total variation of seed yield / fed. was completely determined by the variation in the other studied traits.

Path coefficient analysis was done later according to Dewey and Lu (1959) only for the most contributors to seed yield / fed. previously shown in stepwise analysis.

RESULTS AND DISCUSSION

1- Performance of seed yield and it's components:

Table 3 gives the means of the studied traits as affected by irrigation levels, canola varieties and their combinations in the two studied seasons.

1-a : Irrigation effect

Table 3 shows, in both seasons, that effect of varying irrigation levels was significant with all studied respects. It was observed that all traits, except seed yield / fed., gradually increased as irrigation increased, where such increases were significant only when increasing irrigation quantity from 280.02 to 560.04 m^3/fed. Such results assured the unquestionable role of water in growth and yield of plants. On the other hand, data clearly indicated that saving watering from 1120.08 to 560.04 m^3/fed. did not reflect any significant reduction in any of the studied yield attributes. The greatest products of plant height, number of branches / plant, number of silique / plant, 1000 seed weight and seed yield / plant were 175.3 cm., 7.42 , 244.4 , 4.38

gr. and 18.53 gr. in the first season and 177.6 cm., 7.17 , 241.3 , 4.25 gr. and 12.70 gr. in the second season, respectively. Generally, it seemed that additional watering increased plant elongation through more cell division, enlargement and expansion. It appeared that the promoting effect of enough water on plant height was automatically reflected to the number of branches / plant. Those results are in harmony with those were obtained by El Bagge (2001). Number of silique / plant increments stopped at 560.04 m^3 / fed., indicating that such trait may mainly require to the early enough watering , which push canola towards flowering and fruiting instead of vegetative growth which would be highly continued under higher irrigation. El Bagge (2001) concluded the same. Enough watering up to 560.04 m^3/fed. allowed good seed filling, (4.42 and 4.25 gr., in the two respective seasons), through higher solving and translocation of solid substances to seed during formation of such seeds. The results herein are in disagreement with those were reported by Sharama (1994) and El Bagge (2001), they found no limits on watering for increasing 1000 seeds weight.

Seed yield / plant was gradually increased by any additional watering, in reverse to the findings previously reported on 1000 seed weight. This means that such trait may be affected by some contributors rather than the effect of 1000 seeds weight. It seemed that the positive effects of watering on the above mentioned traits were in turn seed yield / plant. The present results confirmed those of Mahal et al (1994) and El Bagge (2001)

Seed yield / fed. gathered all the positive effects previously mentioned on studied contributors. However, seed yield / fed. was the highest , i.e. 427.0 Kg/fed. when irrigation was at 560.04 m^3 / fed. in the first season. Meanwhile, the corresponding highest seed yield in the second season, i.e. 510.0 Kg/fed. was produced through watering at 1120.08 m^3/fed. The reduction in seed yield / fed. as irrigation was increased from 560.04 to 1120.08 m^3/fed. in the first season may be attributed to the corresponding reduction in 1000 seed weight from 4.42 to 4.38 gr. The expression of the previous figures in percentages show that the superior treatment in the first season, i.e. 560.04 m^3 /fed. overyielded those of 280.02 and 1120.08 m^3/fed. by about 153.42 and 18.45 % , respectively. In the second season, the treatment 1120.08 m^3/fed. surpassed those of 280.02 and 560.04 m^3/fed. by about 130.77 and 10.34% , respectively. Many authors found similar results, of them El Bagge (2001).

1-b : Variety effect

Table 3 shows that the differences between the tested two varieties were insignificant in both seasons, only with respect to plant height and seed yield/fed. as well as in the second season with both number of silique / plant and 1000 seed weight. Such results revealed that the previous four traits may be highly correlated and three yield contributors of them may be main contributors for seed yield / fed.

On the other hand, it was seen that AD 201 variety surpassed B.P.S. Tower with all aspects. Such superiority may be attributed to the enough applied delivered water in the present study, (table 2), which allowed AD 201 variety good growth features and high yield, in spite of it's short root, i.e. 4.14

mm , which did not find strong difficult to absorb water under such conditions. In other words, under semi drought and drought conditions, long root varieties as B.P.S. Tower (5.74 mm) may exceed short root ones as AD 201 variety. It may be more understanding through noticing the lower differences between AD 201 and B.P.S. Tower under low irrigation (280.02 m^3/fed.) as compared to the corresponding differences under the medium irrigation (560.04 m^3/fed.) or high (1120.08 m^3/fed.) one. The well adaptation AD. 201 than B.P.S. Tower under Egyptian conditions gives other reason for such superiority. Ghosh et al (1994) stated that canola could be grown under limited water with only one or two irrigation. Wrights et al (1995) generalized that there are significant differences in seed yield potential among canola genotypes. Pannu et al (1997) and El Bagge (2001) found similar results.

1-c: Interaction effect

Analysis of variance showed no significant differences with all respects except in the second season on number of silique / plant, where three groups were observed. Within each group no significant differences was detected, (Table 3). The first group included I_1XV_1, I_1XV_2 and I_2XV_1 the second only I_2XV_2 and the third included I_3XV_2 and I_3XV_1. The later group significantly surpassed the second one which did the same over the first group. In general, the present results declare that canola varieties did not significantly vary through varying irrigation. In the other words, the tested two varieties could be grown under a wide range of irrigation. These results are in accordance with those of Pannu et al (1997), meanwhile El Bagge (2001) found somewhat different results although the significance between the six combination treatments is absent in most cases, no difficult to decide herein that the combination [I_2 (560.04m^3/fed.) X V_1 (AD 201)] gave the highest seed yield / fed. in the first season, i.e. 534.0 Kg and the higher yield in the second season, i.e. 508.0 Kg. Therefore, such treatment may be recommended.

Mostly, it was observed that seed yield / fed. in the second season surpassed all the corresponding products with respect to irrigation, varieties and their combination treatments. Such results may be explained as the second season was warmer as compared to the first one, (table 1), especially during January and February (flowering period) as well as in March (pudding period). It's a matter of fact that high temperature accelerates growth. Salwa E. Soliman (1979) on wheat as well as Soliman Mona and Salwa E. Soliman (2002) on faba bean come to the same conclusion.

2-b: Water use efficiency W.U.E.

Table 4 gives the calculated W.U.E. values (Kg / m^3) for the six combination treatments in the two studied seasons.

Table 4: Water use efficiency (kg/m^3) for the six combination treatments in the two seasons.

Treatments / Seasons	I_1XV_1	I_1XV_2	I_2XV_1	I_2XV_2	I_3XV_1	I_3XV_2
First	0.37	0.26	0.65	0.39	0.30	0.22
Second	0.48	0.46	0.68	0.56	0.47	0.31

Each value in the table is the division result of seed yield / fed. of a treatment ÷ applied delivered water of the same treatment: S.Y./fed. ÷ ADW.

The views on the previous table declare that W.U.E values in the second season were greater than those in the first season, within each treatment combination. These results could be attributed to the high seed yield / fed. values,(table 3) and low applied water.

Delivered water, (table 2), in the second season, as compared to the corresponding values in the first season. Thereafter, in Vietes equation the numerator was always greater, while the denominator was always lower, in the second season as compared to the first one. It was observed that the combination I_2V_1 reflected the highest W.U.E values in the two respective seasons, viz. 0.65 and 0.68 Kg/ m^3.

3-a: Correlation

Table 5 represents the obtained correlation (r) among each trait and all other traits. All (r) values were significant. Such results are of great

Table 5: Simple correlation coefficients between all possible pairs of the studied traits.

Traits	S.Y. / fed. Y	S.Y. / P X_5	1000 S.W X_4	No. of Sil / Pl X_3	No. of Br / Pl X_2
Plant height X_1	0.7940**	0.8565**	0.9387**	0.9091**	0.9392**
No. of Br / Pl X_2	0.8157**	0.9248**	0.9464**	0.9290**	
No. of Sil / Pl X_3	0.8345**	0.8421**	0.8895**		
1000 S.W X_4	0.8248**	0.8907**			
S.Y. / Pl X_5	0.7283**				

importance in agronomy studies. Kandil et al (1994) reported that number of silique / plant was positively and significantly correlated with both 1000 seed weight and seed yield / plant.

3-b: Stepwise analysis

The mathematical linear model for multiple regression analysis was used for testing the importance and relative contribution to the total variation in the dependant variable. It was assumed that the total variation of seed yield / fed. (Y) was completely determined by the variation in the other remainder five traits, viz. plant height (X_1), number of branches / plant (X_2), number of silique / plant (X_3), 1000 seed weight (X_4) and seed yield / plant (X_5). The obtained results are given in Table 6

Table 6: Analysis of the variance of regression

S.O.V	d.f.	S.S.	M.S.	F
Total	11	244489.67		
Regression	2	178241.05	89120.52	12.11*
Residual	9	66248.62	7360.96	

As regression was significant, R^2 between (X_1, X_2, X_3, X_4 and X_5) and Y was calculated as 0.0103, 0.0027, 0.6964, 0.03260 and 0.0175 for X_1, X_2, X_3, X_4, and X_5, respectively. These results declared that the most important traits in regression were number of silique / plant (R^2 = 0.6964) and 1000 seed weight (R^2 =0.03260) consequently, only those two traits were included in the prediction equation which was as follows:

Y = a + b3x3 + b4x4

= 343.28 + 0.9576 x 3 + 128.55 x 4

The above mentioned equation shows that number of silique / plant and 1000 seed weight explain gave only about 72.90 % out of the total variation in seed yield / fed. The direct and indirect effects of those two traits could be known through Path Coefficient Analysis.

3-c: Path coefficient analysis

Path coefficient analysis was carried out according to Dewey and Lu (1959). Relative contributions, directly and indirectly, of the number of silique / plant and 1000 seed weight to seed yield / fed. are given in table 7.

Table 7: Direct and indirect contributions of number of silique / plant and 1000 seed weight to seed yield / fed.

Contribution % Traits	Direct	Indirect	Total
No. of Sil. / Pl	53.39	16.25	69.64
1000 S.W.	2.750	0.51	3.26

Table 7 declares that most of the contribution of number of silique / plant was direct, i.e. 53.39 %. Meanwhile the indirect one was 16.25%. This means that such trait is of great importance in selection studies, however seed yield / fed. may be improved through selection of number of silique / plant .

On the other hand, 1000 seed weight showed relative low contributions, viz. 2.75 % and 0.51 % for direct and indirect, respectively. Shabana et al (1990) and Kandil et al (1994) found similar results.

From all the above mentioned results, the followings may be concluded:

* Significance was completely observed with irrigation treatments, absolutely absent with varieties and completely seen, with minor deviation, with interaction treatments.
* The soundly treatments were I_2 (560.04 m^3 / fed.) V_1 (AD 201) and their combination.
* Correlation between any trait and others was positive and significant .
* The superior combination (I_2XV_1) for seed yield production was also the greatest among W.U.E. values.
* The most important trait for seed yield seemed to number of silique/plant and 1000 seed weight.

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الإنتاجية و الارتباط فى صنفين من الكانولا تحت بعض مستويات الرى بالتنقيط

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**** قسم العلاقات المائية و الرى الحقلى - المركز القومي للبحوث - الجيزة**

أجريت تجربتان حقليتان علي نبات الكانولا تحت نظام الرى بالتنقيط، خلال موسمي ١٩٩٨/١٩٩٧ و ١٩٩٩/١٩٩٨ لدراسة تأثير ثلاثة مستويات للرى و هي ٢٨٠,٠٢ (I_1) و ٥٦٠,٠٤ (I_2) و ١١٢٠,٠٨ (I_3) م^3 / للفدان على نمو و محصول الصنفين AD 201(V_1) وB.P.S. Tower(V_2). و قد استخدم تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات، حيث وزعت معاملات الرى عشوائيا على القطع الرئيسية، فى حين خصصت القطع الشقية للأصناف. وتم دراسة كفاءة استخدام المياه، الارتباط، معادلة التنبؤ و كذا المساهمات النسبية للصفات لمحصول البذور / فدان .

ولقد أوضحت النتائج ما يلى:

تفوقت المعاملة I_2 تفوقا معنويا على I_1 مع جميع الصفات وكانت الزيادة من I_2 الى I_3 غير معنوية إلا مع محصول البذور للفدان حيث لوحظ أعلى محصول فى الموسم الأول و قدره ٤٢٧,٠ كجم / فدان مع I_2- فى حين كان المحصول الأعلى فى الموسم الثانى وقدره ٥١٠,٠ كجم / فدان مع I_3.

لم يختلف الصنفان اختلافا معنويا أحدهما عن الآخر مع صفة محصول البذور للفدان وبعض الصفات الأخرى فى الموسمين ولكن لوحظ تفوق الصنف AD201 على نظيره B.P.S. Tower مع جميع الصفات فى الموسمين و لم يتفاعل الصنفان معنويا مع معدلات الرى. و أعطت المعاملة (I_2XV_1) أعلى محصول بذور للفدان فى الموسم الثانى (٥٣٤,٠ كجم / فدان) فى حين أعطى(I_3XV_1) ٦١٦,٠ كجم/فدان.

بينت الدراسة أن كفاءة استخدام المياه كانت أعلى فى الموسم الثانى قياسا على الموسم الأول- حيث تميز الموسم الثانى بارتفاع المحصول عامة فى حين تميز الموسم الأول بزيادة الأمطار.

و قد أوضحت نتائج تحليل الانحدار المتعددStepwise أن عدد القرون / نبات، و وزن الألف بذرة كانتا الصفتان الأهم فى معادلة التنبوء.

وقد بين تحليل معامل المرور أن عدد القرون / نبات ساهمت بمقدار ٦٩,٦٤% فى تباين محصول البذور/فدان (من بينها ٥٣,٣٩% تأثيرا مباشرا ، ١٦,٢٥% تأثير غير مباشر) فى حين ساهمت وزن الألف بذرة بمقدار ٣,٢٦% (من بينها ٢,٧٥% تأثيرا مباشرا ، ٠,٠٥١% تأثيرا غير مباشر).