EFFECT OF IRRIGATION REGIME ON SOME RAPE VARIETIES

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Abstract

Two field experiments were carried out at Mallawi Agric. Res. Station for the two successive Years 1989 and 1990 to study the effect of water regime on plant height, seed yield , oil percentage, consumptive use and water use efficiecy of different rape varieties. The results revealed that :

Plant height, seed yield Kg / fed and oil percentage were significantly affected by availble soil moisture depletion (ASMD) levels, the highest mean values were obtained with irrigation after 40% depletion in available soil moisture, followed by 60% then 80%.

The same characteristics were not significantly affected by the different varieties, except the number of pods and seed yield which were affected by the same factor . The rape variety (V_2) " Semue 201/81 G_1" is the best cultivated variety in this experiment. It gave the highest values for plant growth and seed yield.

Consumptive use was increased by decreasing soil moisture stress. The highest mean values were obtained at treatment 40 % (ASMD), while the lowest mean values were obtained at 80 % (ASMD).

The highest water use efficiency for seed production was obtained for variety " Semue 201/80 G_1 " , when irrigated at 60% (ASMD).

The highest water use efficiency for seed production was obtained for variety " Semue 201/80 G_1", when irrigated at 60% (ASMD) in the two successive years.

INTRODUCTION

Rape is one of oil winter crops, while most of oil crops cultivated in Egypt are summer crops . Rape seed contains more than 40 % of an excellent edible semi-dry oil , it grows well in the newly reclaimed area (Ibrahim *et al.* 1988). A lot of rape varieties have been imported and cultivated in Egypt, but it is not known which variety gives high productivity of seed and oil under Egyptian conditions.Consequently, irrigation management of such newly introduced crops is a very important aspect. For this reason, it is necessary to determine the optimum water requirement in order to reach the best irrigation schedules for maximum crop production for these imported rape varieties under local conditions.

Clarke and Simpson (1978) and Ibrahim *et al.* (1988) reported that yield component and consequently , seed yield (g) / plant, number of seeds / pod and 1000 seed weight had increased by increasing irrigation. Decau *et al.* (1973) , Krogman and Hobbs (1975) and Ibrahim *et al.* (1988) found that oil content of rape seed had increased by irrigation. Ibrahim *et al.* (1988) also reported on the average of " WCU" of rape variety " Semue 201/81 G_1", it was 1678 and 2072 m^3 in the years 1985 , 1986 in Mallawi and El-Fayum, respectivily.

The present work was carried out to study the effect of soil moisture depletion levels on plant growth , seed yield , oil content, consumptive use (WCU) and water use efficiency (WUE) of three rape varieties.

MATERIALS AND METHODS

Two field experiments were carried out in the two successive years 1989 and 1990 at Mallawi Agricultural Research Station. Three moisture levels were tested in each experiment . Randomized complete plot design was used with four replications for each treatment . The three rape varieties used in this study were V_1 Semue 65/78, (V_2) Semue 201/81 G_1, and (V_3) RT 82 ". The irrigation treatments were based on the available soil moisture depletion (ASMD) as follows : a) Irrigation when 40 % of the available moisture was depleted, b) Irrigation when 60 % of the availale moisture was depleted , and c) Irrigation when 80 % of the available moisture was depleted.

The soil was clay loam , and its chemical analysis, mechanical analysis, and moisture characteristics were determined according to Dackson (1985) , Wright (1934) and Richards (1974) . These data are shown in Table 1.

Table 1. Some physical and chemical properties of the soil experiment.

Depth cm	T.S.S %	PH	Sand %	Silt %	Clay %	Textural class	Bulk density	Field capac -ity%	Wilting %	Avail-able water
0-20	0.16	7.80	28.40	29.30	42.30	clay Loam	1.25	44.20	21.50	22.70
20-40	0.16	7.70	28.55	30.35	41.05	clay Loam	1.30	40.05	20.10	19.95
40-60	0.15	7.65	28.90	30.60	40.10	clay Loam	1.32	36.75	18.65	18.10

Planting dates were on 4 December 1989 and 1990 . After germination the seedlings were thinned . The spacing between plants was 5 cm and between the rows 30 cm. 15 kg P_2O_5 /fed (Superphosphate) was applied to each experiment in the two years before sowing , N fertilizer (Urea) was added in three equal doses. the 1st dose (20 Kg N/fed) at planting , while the 2nd and the 3rd doses were applied before the first and second irrigations, respectivily.

Soil samples were periodically taken at different intervals to determine the proper time of irrigation . The soil samples were taken at three soil depths 0-20 , 20-40 and 40-60 cm . Irrigation water was applied by raising the soil moisture to its field capacity when it reached the desired avilable soil moisture depletion (ASMD) level.

The first irrigation took place 21 days after sowing using equal amounts of water for each plot, after which the three irrigation regimes under test were practiced. Irrigation was practiced when plants consumed approximately 40 , 60 and 80 % of the available soil moisture within the root zone.

At harvest time, a sample of 10 plants randomly chosen was used to determine average plant height, number of branches, number of pods, and seed yield/ feddan was calculated based on seed yield/plot, by using the methods described by AOCS (1975), seed oil content was estimated as an average of three samples representing seed yield/plot.

All data except those of water relations were subjected to statistical analysis according to the procedures described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Plant growth

Mean values of plant height (cm), number of branches and number of pods/ plant for the different rape varieties as affected by different levels of available soil moisture depletion (ASMD) are given in Table 2 (a, b and c).

The present data revealed that the plant growth of the three rape varieties was depressed by increasing ASMD % levels. Plants irrigated at 40% ASMD were taller and had more branches, and more pods/ plant, followed by plants irrigated at 60 % then 80 % ASMD.

Statistical analysis of the data revealed that soil moisture levels had a significant effect on plant growth of the different rape varieties, the number of branches and number of pods / plant in the 1st season 1989 , but no significant effect in the 2nd season 1990 was shown, although the difference between the mean values was clear.

These results were in agreement with those obtained by krogman and Hobbs (1975) and Clark and Sempson (1978).

The data also showed that there was no interaction between ASMD and varie-

Table 2. Effect of irrigation treatments on plant growth of rape varieties in 1989 and 1990 seasons.

A. Plant height (cm) :

Varieties	ASMD %							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	165	144	120	143	131	127	112	123
V_2	198	168	129	165	141	130	126	132
V_3	160	141	128	143	126	118	107	117
Mean	174	151	126	150	133	125	115	124

L. S. D. at 0.05

Irrigation	: 21	: 15
Varieties	: 18	: - -
Interaction (I x V)	: 32	: - -

b. Branches number / plant

Varieties	ASMD %							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	5.0	3.7	3.7	4.1	4.7	3.4	3.4	3.8
V_2	5.3	4.7	4.3	4.8	4.9	3.5	3.3	3.9
V_3	5.1	3.9	3.1	3.9	4.3	3.3	3.1	3.6
Mean	5.1	4.1	3.7	4.3	4.6	3.4	3.3	3.8

L. S. D. at 0.05

Irrigation		: 1.1	: 0.97
Varieties		: 0.75	: - -
Interaction	(I X V)	: - -	: - -

C. Number of pods / plant :

Varieties	ASMD %							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	132	119	111	121	185	155	98	146
V_2	238	186	142	189	217	191	119	176
V_3	202	143	121	155	159	131	124	138
Mean	191	149	125	155	187	159	114	153

L. S. D. at 0.05

Irrigation		: 49	: 44
Varieties		: 37	: 31
Interaction	(I x V)	: 98	: 85

ties for plant height and branches number/plant in the two seasons excecpt of the number of pods / plant which was affected by the same factor. The variety V_2 Semue 201/81 G_1 had the highest values of plant growth characters at 40 % ASMD, followed by 60 then 80 % ASMD.

Seed yield

Average seed yield of different varieties Kg/fed as influenced by soil moisture levels (ASMD) are presented in Table 3.

Seed yield was greatly affected by soil moisture levels in the two seasons. Analysis of variance revealed significant difference due to irrigation at different ASMD % levels. The mean values of different treatments in all varieties in the two

seasons tended to decrease when the available soil moisture depletion before irrigation increased. These results are in agreement with those of Krogman and Hobbs (1975), Clark and Simpson (1978) and Ibrahim *et al.* (1988).

The data showed that seed yield was greatly affected by soil moisture levels (ASMD%) with the different rape varieties in the two seasons. V_2 gave the highest values of seed yield , and V_1 gave the lowest, while V_3 had values between V_1 and V_2.

With respect to the interaction between irrigation and varieties, the data revealed that there was significant effect between ASMD and differernt rape varieties in seed yield . It can be concluded that, the variety V_2 when irrigated at 40 % ASMD was the best treatment producing seed yield of 1250 and 975 Kg/fed. in the two successive seasons 1989 and 1990, respectively.

Table 3. Effect of irrigation treatments on seed yield of rape varieties in 1989 and 1990 seasons.

Varieties	ASMD%							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	925	775	550	783	775	675	550	667
V_2	1250	1050	950	1083	975	850	700	842
V_3	950	775	750	825	850	680	585	705
Mean	1042	867	783	897	867	735	612	738

L. S. D. at 0.05

Irrigation		: 150	: 120
Varieties	(I x V)	: 135	: 105
Interaction		: 285	: 210

Seed oil content

Data presented in Table 4 show the effect of soil moisture depletion levels on the oil content of the three rape varieties in the two growing seasons 1989 and 1990.

Seed oil percentage was significantly affected by soil moisture levels. 40 % ASMD gave the highest seed oil % followed by 60 % then 80 % in the different rape varieties. These results were in agreement with those obtained by Krogman and Hobbs (1975) and Ibrahim *et al.* (1988).

Table 4. Effect of irrigation treatments on percentage of seed oil content in the three rape varieties during 1989 and 1990 seasons.

Varieties	ASMD							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	44.50	42.40	41.90	42.93	43.20	41.05	41.00	41.75
V_2	43.10	41.75	40.50	41.78	42.70	41.80	41.25	41.92
V_3	44.15	42.20	41.70	42.68	43.55	42.15	41.05	42.25
Mean	43.93	42.12	41.37	42.46	43.15	41.67	41.10	41.97

L. S. D. at 0.05		:	:
Irrigation		: 1.45	: 1.20
Varieties	(I x V)	: - -	: - -
Interaction		: - -	: - -

The data also revealed that there were no significant differences between the different rape varieties in oil content under the differernt levels of ASMD although the difference between the mean values of oil content was clear. The interactions between irrigation regime and different varieties were also insignificant.

Water consumptive use

The sesonal values of WCU under different irrigation regimes are presented in Table 5 .

It is clear that WCU of the different rape varieties increased. The highest values were recorded for the 40 % ASMD treatment followed by 60 % and 80 % . The most Probable explanation for this result is that at 40 % ASMD there was a luxuriant use of water , which ultimately resulted in increasing transpiration. However, losses by surface evaporation are greater at 40 % ASMD than at 80 %.

These results are in agreement with several workers (El-Serogy *et al.*, 1977; El-Wakil *et al.*, 1987 ; Ibrahim *et al.*, 1988).

Water Use Efficiency (WUE) :

As water is the limiting factor in the expansion of cultivated area in Egypt, the primary management objective is the development of water use programme that provides maximum yield per unit of applied water.

Table 5. Effect of irrigation regimes on water consumptive use (WCU) in (m^3 / fed) of different rape varieties in 1989 and 1990 seasons.

Varieties	ASMD%							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	1943	1777	1604	1772	1928	1730	1617	1758
V_2	2037	1848	1642	1842	1976	1743	1502	1740
V_3	1978	1812	1569	1786	1940	1768	1533	1747
Mean	1983	1812	1605	1800	1948	1747	1551	1748

Table 6. Water Use Effeiciency (WUC) Kg seed / m^3 of different rape varieties as affected by irrigation treatments in 1989 and 1990.

Varieties	ASMD							
	1989				1990			
	40	60	80	mean	40	60	80	mean
V_1	0.48	0.44	0.41	0.44	0.40	0.39	0.34	0.38
V_2	0.61	071	0.58	0.63	0.48	0.49	0.47	0.48
V_3	0.48	0.43	0.48	0.46	0.44	0.38	0.38	0.40
Mean	0.52	0.53	0.49	0.51	0.44	0.42	0.40	0.42

A summary of water use effeciency (Kg seed / m^3 of water consumed for the different treatments is presented in Table 6.

In general, water use efficiency had the same trend in the two seasons 1989 and 1990. The 2nd irrigation treatment of 60% ASMD gave the highest WUE values during the two seasons for variety V_2 (Semue 201/ 81 G_1), followed by 40 %, then 80 % ASMD treatments.

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تأثير الرى على بعض أصناف الشلجم

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أجريت الدراسة خلال عامى ١٩٨٩ ، ١٩٩٠ فى مزرعة محطة البحوث الزراعية بملوى وكان الهدف هو دراسة أثر نقص الرطوبة الأرضية على نمو بعض أصناف نبات الشلجم ومحصول البذرة ، والنسبة المئوية للزيت ، والإستهلاك المائى وكفاية استخدام الماء لهذه الأصناف كمحصول زيتى شتوى أدخلت زراعته حديثاً فى مصر.

ولقد بينت الدراسة تأثر النمو ، محصول البذرة ، والنسبة المئوية للزيت معنوياً بنقص الرطوبة الأرضية ، فأعطت المعاملة التى تروى عند فقد ٤٠ ٪ من الماء الميسر أحسن القيم يعقبها المعاملة التى تروى عند فقد ٦٠ ٪ من الماء الميسر ، ثم المعاملة التى تروى عند فقد ٨٠ ٪ من الماء الميسر ، كما ازداد الإستهلاك المائى بزيادة الرطوبة الأرضية فى منطقة الجذور.

لم تتأثر بعض الصفات السابقة معنوياً بإختلاف الأصناف التى تحت الدراسة ، على الرغم أن متوسط القيم تأخذ فى الزيادة بزيادة عدد الريات ، ماعدا عدد الكابسولات لكل نبات ومحصول الحبوب حيث تأثر معنوياً بمعاملات الرى ، وكان أفضل الأصناف المنزرعة فى هذه التجربة صنف " Semue 201 / 81 G1 " حيث أعطى أعلا القيم فى نمو النبات ومحصول الحبوب .

أزداد الأستهلاك المائى بزيادة عدد الريات ، وقد اعطت المعاملة التى تروى عند فقد ٤٠ ٪ من الماء الميسر أعلا القيم بينما أعطت المعاملة التى تروى عند فقد ٨٠ ٪ أقل القيم . وقد أعطى الصنف "Semue 201 / 81 G1 " أعلا كفاءة استعمالية للمياه حينما يروى عند ٦٠ ٪ من الماء الميسر.