RESPONSE OF CANOLA (*Brassica napus,* L.) TO HARVEST DATE, NITROGEN RATES AND PLANT POPULATION DENISTY

BY

Nasser Kh. B. El-Gizawy

Dept., of Agron., Faculty of Agric., Moshtohor, Zagazig Univ., (Banha Branch)

ABSTRACT

Two field experiments were carried out at the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Kalubia Governorate, Zagazig University, (Banha Branch), during 2001/ 2002 and 2002 / 2003 seasons to study the effect of three harvest date (150, 160 and 170 DAS), four N rates (0, 50 ,100 and 150 kg/fed.)and three plant spacing (20, 30 and 40 cm) on growth, yield and its attributes and seed quality of canola cv. Pactol. The soil of the experimental field was clay textured with pH value of 8.01 , 19.8 ppm available N , 2.00 % organic matter content and 3.80 % $CaCO_3$. The results showed that growth and yield components did not differ significantly due to different harvesting dates. While, delayed harvest significantly reduced seed yield due to shattering of seeds. Application of 150 kg N/fed produced the highest values of growth characters and yield attributes which resulted in the highest seed yield. Growth , yield and its components significantly increased by increasing plant spacing from 20 to 40 cm between plants. All theeffect of theinteraction between the experimental factor were not significant on all studied characters in both seasons with one exception for the interaction between harvest date and nitrogen rates.

Key words : canola, *Brassica napus*, L , harvest date , N rates and plant spacing.

INTRODUCTION

Canola (*Brassica napus*, L.) is a name applied to edible oilseed rape. It is considered as one of the most important oil crops in the world because its seeds contain about 40 % oil and 23 % protein. The oil is high in mono-and polyunsaturated fatty acids (Oleic , linoleic and linolenic). This oil could be used as an edible oil for human consumption. In Egypt , the production of oil crops is insufficient since, cropping structure does not allow enough space for oil crops. Production of oil in Egypt can be increased by expanding the area under oil seed crops and maximizing their yield per unit area. The acreage could be increased by cultivating new oil seed crops such as Canola in the old and new reclaim soils .

Cultural practices (i.e. harvest date, nitrogen fertilization , plant population, etc..) that may affect Canola growth and production under local conditions are important fields for investigation .

Timely harvest of canola is critical to prevent shattering. Shattering can account for significant crop losses, therefore harvesting must not be delayed. Pods and seeds color is more important than overall color of the filed in

determining plant maturity. **Oplinger *et al*. (1989)** reported that harvesting too early may result in low yield and poor seed quality, whereas harvesting too late may result in shattering and reduced seed yield. **Sabry and Larry (2001**) found that Canola can be harvested 2 weeks before reaching harvest maturity without affecting yield. Generally, by harvesting at the optimum time for yield and seed quality producers will receive the greatest production net return.

Nitrogen nutrition of this crop is important to its productivity ,optimum requirement of this major nutrient is relatively high and has been shown to vary from soil to soil. Results of many investigation have shown that both growth and yield of Canola are enhanced significantly by high doses of nitrogen fertilizer. **Nemat Noureldin, *et al*. (1993)** adding the nitrogen levels of 90, 120 and 150 kg N/fed and found that increasing the doses of N fertilizer from 90 to 120 either to 150 kg N/fed increased seed, biological and straw yields for canola cultivars. **Hasssan and El- Hakeem (1996)** indicated that applying 60 and 90 kg N/fed increased seed yield/fed by 27.8 , 50.5 % as compared with 30 kg N fed. Similar results were obtained by **Rajendra and Shaktawat (1992).**

Plant density has been observed to have a great effect on growth , development, seed yield and components of seed yield in canola.. The literature indicated that plant density is very important in canola production. **Abla Ashoub *et al.* (1988)** reported that seed and oil yields/fed were significantly increased by increasing the plant spacing from 20 to 40 cm within rows **Chauhan *et al*. (1993)** using 3 row spacing 20 , 30 and 40 cm and found that row spacing of 30 cm gave more seed and stover yields than the other treatments. On the other hand, **Sharma and Thakur (1993**) reported that row spacing did not influence on plant height, seed yield and its attributes This study was undertaken to investigate the effect of harvest date, N rates and plants spacing on growth and yield of Canola.

MATERIALS AND METHODS

Two field experiments were conducted at the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Kalubia Governorate, Zagazig University, (Benha Branch), during 2001 / 2002 and 2002 / 2003 seasons. The aim was to assess the effect of harvest date , N rates and plant spacing on growth , yield and its attributes and seed quality of canola.

Soil analysis:

The soil was clay having an alkaline reaction. The properties of the experimental soil are listed in Table 1, and the preceding crop was maize in both seasons.

Table 1. Physical and chemical analysis of experimental soil

Soil characteristics	Average of both Seasons
1-**Physical analysis**	
Sand (%)	25.0
Silt (%)	19.9
Clay (%)	55.1
Texture	clay
2- Chemical analysis	
E.C. (dS m^{-1})	2.00
pH(1:2.5 soil water suspension)	8.01
Organic matter (%)	2.00
Available N (ppm)	19.8
$CaCO_3$	3.8

Treatments:

A split–split plot design with three replications was used for each experiment. The main plots was occupied by the three following harvest dates (day after sowing)

A1-150 (DAS)
A2-160 (DAS)
A3-170 (DAS)

The sub plots were allocated to following four nitrogen rates (kg/fed.):

B1-Control (without nitrogen fertilizer)
B2- 50 kg N/ fed
B3- 100 kg N / fed
B4- 150 kg N / fed

Ammonium nitrate ($NH_4 NO_3$-33.5 N%) was used as the nitrogen source in both seasons, which was applied at three equal doses after planting and before the 1st and 2nd irrigation.

The sub sub plots were devoted to the following three plant spacing within rows (cm):

C1-20 cm (making a plant density of 60000 plants / fed.)
C2-30 cm (making a plant density of 40000 plants / fed.)
C3-40 cm (making a plant density of 30000 plants / fed.)

Each sub-sub plot with a size of 10.5 m^2 and consisted of 5 canola ridges 3 m in length and 70 cm apart (1/400 fed).

Canola seeds cv. Pactol supplied from (Oil Crop Res. Section , ARC) were planted on 14th Nov. in 2001 / 2002 and 11th Nov. in 2002 / 2003 . Before the first irrigation i.e. after 21 days from sowing the plants were thinned to two plants/hill at distance of 20 , 30 and 40 cm apart. The normal cultural treatments of growing canola plants were practiced.

Data recorded at harvest:

At harvest, 10 plants from 3 inner rows of every treatment in 3 replications were chosen to determine the following data:

I- growth characters:

1- plant height (cm)
2- Number of branches / plant

II-Yield and its attributes

1- Number of pods / plant
2- Number of seeds / pod
3-Weight of 1000 – seeds (g)
4-Seed yield (kg/fed.) , which was determined on whole sub-sub plot basis.
5-Oil yield (kg/fed.) , estimated by multiply oil % x seed yield
6-Protein yield (kg / fed.) , estimated by multiply protein % x seed yield.

III-Chemical analyses

Three samples of canola were randomly collected from each treatment . Then all samples were cleaned , dried at 60 C^{o} for 24 h and analyzed for oil content (on a dry weight basis) using Soxhlet apparatus and petroleum ether as a solvent. Seed nitrogen content was measured by an automated colorimetric method following Kjeldahl digestion (**Varley, 1966**) and the protein content was calculated using the factor 6.25.

Statistical analysis:

Data were analyzed with analysis of variance (ANOVA) procedures using the MSTAT-C Statistical Software package (**Michigan State University, 1983**). Where the F- test showed significant differences among means Least Significant Differences (LSD) test was performed at the 0.05 level of probability to separate means.

RESULTS AND DISCUSSION

I-Growth and yield attributes:

1-Effect of harvest date:

Final plant height, number of branches / plant, number of seeds / pod and 1000 – seed weight were not significantly affected by harvest date in both seasons of experimentation (Table 2). However, number of mature pods / plant at 1^{st} season was gradually increased by delayed harvest date at 170 days after sowing. This result is expected since growth characters and yield components reach their maximum values at physiological maturity which was reached befor all harvesting treatment.

An exceptional cas was observed with number of mature pods / plant in the firet season, where delaying harvesting increased this number. The cause of this result may be due to the presence of unmatured pods at the early harvesting dates.

2-Effect of nitrogen fertilizer rates:

The data presented in Table 2, indicated that growth and yield attributes like plant height , number of branches / plant , number of pods / plant , number

Table 2. Plant height, branches/plant, number of pods/plant, number of seeds/pod and 1000-seed weight as affected by harvest date , N fertilizer rates and plant spacings

Treatment	Plant height (cm)		Branches / plant		Number of pods / plant		Number of seeds /pod		1000 – seed weight (g)	
	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03
*Harvest date (DAS)**										
150	132.5	134.9	10.2	10.5	411.3	515.9	20.9	22.2	3.24	3.43
160	132.0	135.7	10.3	10.4	413.4	517.9	21.1	22.2	3.26	3.45
170	133.2	134.9	10.2	10.6	425.3	535.1	21.0	22.4	3.49	3.22
LSD (*P=0.05*)	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**12.53**	**N.S**	**N.S**	**N.S**	**N.S**
N rates (kg /fed)										
0	107.7	112.2	8.4	9.0	373.9	450.4	18.1	20.5	2.19	2.07
50	125.9	127.9	10.1	10.6	415.1	495.1	20.8	21.4	2.69	2.33
100	140.8	144.1	11.2	10.9	435.5	556.2	22.1	22.4	3.59	3.84
150	155.8	156.3	11.1	11.2	442.2	590.3	23.1	24.5	4.85	5.49
LSD(*P=0.05*)	**5.45**	**4.96**	**0.50**	**0.66**	**14.80**	**14.06**	**1.04**	**0.86**	**0.39**	**0.35**
Plant spacing (cm)										
20	132.6	132.9	9.7	10.1	373.4	490.6	21.0	22.3	3.36	3.28
30	132.9	136.3	10.1	10.5	417.9	516.3	21.1	22.1	3.24	3.48
40	132.1	136.2	10.8	10.9	458.7	562.2	21.1	22.4	3.38	3.55
LSD (*P=0.05*)	**N.S**	**N.S**	**0.43**	**0.38**	**10.27**	**12.08**	**N.S**	**N.S**	**N.S**	**N.S**

(DAS) **Days **A**fter **S**owing*

of seed / pod and 1000-seed weight were influenced significantly due to N fertilizer levels (Table 2). Application of 150 kg N / fed showed the maximum growth and yield attributes in both seasons. Similar results were obtained by **Abla Ashoub *et al*. (1988), Asare and Scarisbrick (1995),Hassan and El-Hakeem (1996), Abd El-Dayem , *et al*. (2000) and Cheema *et al.* (2001)** who showed that nitrogen application increased growth and yield components. On the other hand, **Nemat Noureldin *et al*. (1993**) indicated that 1000-seed weight was not significantly affected by nitrogen application.

Nitrogen is a major component of protein which provides an important structural component of all crops. Increasing N application increase the formation of protein and hence growth. Recent reseach has demonstrated the importance of upper stems and pods as sites of assimilation for the production of seed , since any increse in the size of these two components of growth will tend to increase seed yield. However, excessive N- assimulation can result in over production of protein in oil seed rape, causing a depression of oil contnt **(Scarisbrik and Daniels, 1986 and Marschner, 1995).**

3-Effect of plant spacing:

As shown in Table 2, number of branches / plant and number of pods per plant in both seasons were significantly increased by increasing the spacing between plants. These results are in harmony with those obtained by **Abla Ashoub *et al*. (1988**). However,plant height, number of seeds / pod and 1000-seed weight were not significantly affected in both seasons by increasing the plant spacing from 20 to 40 cm. Many investigators found similar trend, **Abla Ashoub *et al*.(1988**) and **Sharma and Thakur (1993**) found that plant height , number of pods / plant, number of seeds / pod and 1000-seed weight did not differ significantly due to different row spacings.**Momoh and Zhou (2001**) reported that number of effective branches and seed number per pod were significantly decreased when plant denisty was increased.

II-Yield and seed quality:

1-Effect of harvest date:

The results in Table 3, showed that harvest date significantly affected seed yield and seed oil content in both seasons. Delayed harvest time at 170 days after sowing significanlty decreased seed yield of canola. These results may be due to seed shattaring. **Oplinger *et al*. (1989**) recorded that harvest too early may result in low yield and poor seed quality , whereas harvest too late may result in shattering of seed and reduced seed yield.

2-Effect of nitrogen fertilizer rates:

Canola is similar to small grains in its response to fertilizer and levels of soil fertility. Nitrogen is one of the key elements for high canola yields. It is clear from Table 3, that soil nitrogen application at the rate of 150 kg N / fed significantly increased seed yield , protien content , oil and protien yields. The highest seed production was obtained by using 150 kg N / fed either in the first season (791.8 kg / fed) or in the second season (820.7 kg / fed). On the other hand, the higher rates of N fertilizer application reduced the oil content relative to the control treatment in both seasons. Appling 50 , 100 and 150 kg N /fed

Table 3. Seed yield, oil content , protein content, oil and protein yields as affected harvest date , N fertilizer rates and plant spacings.

Treatment	Seed yield (kg / fed)		Oil content %		Protein content %		Oil yield (kg / fed.)		Protein yield (kg / fed.)	
	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03	2001/02	2002/03
*Harvest date (DAS)**										
150	730.4	759.4	40.4	40.3	21.1	21.3	294.6	306.0	154.7	162.3
160	732.2	752.6	40.9	40.6	20.9	21.8	298.8	305.5	153.7	164.0
170	705.1	741.3	41.7	41.5	21.0	22.1	293.4	307.6	148.7	164.1
LSD *(P=0.05*)	**13.19**	**13.47**	**0.88**	**0.59**	**N.S**	**N.S**	**N.S**	**N.S**	**3.87**	**N.S**
N rates (kg /fed)										
0	634.9	693.8	42.8	41.6	19.7	20.6	271.8	288.4	125.6	142.6
50	714.3	727.8	41.0	41.1	20.7	21.5	292.8	298.9	147.8	156.6
100	749.3	762.0	40.1	40.7	21.5	22.3	301.1	309.8	161.4	169.5
150	791.8	820.7	40.0	40.0	22.1	22.6	316.9	328.2	174.7	185.3
LSD (*P=0.05*)	**13.34**	**20.73**	**1.19**	**0.86**	**0.83**	**1.00**	**10.49**	**12.18**	**6.29**	**8.70**
Plant spacing (cm)										
20	713.9	730.9	40.6	40.7	21.2	22.0	289.4	297.5	150.1	161.4
30	726.5	749.6	41.0	40.9	21.0	21.9	297.4	305.9	153.0	164.4
40	727.3	772.7	41.3	40.9	20.8	21.2	300.1	315.6	154.1	164.6
LSD (*P=0.05*)	**8.37**	**9.42**	**N.S**	**N.S**	**N.S**	**N.S**	**5.29**	**6.44**	**N.S**	**N.S**

(DAS) **Days **A**fter **S**owing*

increased the seed yield over control treatment by 79.4 , 114.4 and 156.9 kg seeds / fed in the 1st season and by 34.0 , 68.2 and 126.9 kg seeds / fed in the 2nd season. Similar results have been repoprted in oilseed rape **(Abla Ashoub *et al*. 1988 ; Hassan and El-Hakeem 1996** and canola **Cheema et al. 2001**)

3-Effect of plant spacing:

It was noticed from Table 3, that seed yield and oil yield significantly increased by increasing the plant spacing from 20 to 30 or 40 cm.The higher oil yield with increasing plants spacing was probably due to higher seed yield. Similar results were obtained by **Hay and Walker (1989**) who found that crops achieve maximum seed yield at a relataively low plant density. However, **Momoh and Zhou (2001**) showed that seed yield of canola significantly increased by increasing plant denisty. **Abla Ashoub *et al* (1988) and Hassan and El- Hakeem (1996)** concluded the same results. On the other side, oil content, protein content and protein yield were not affected by plant spacing in both seasons.

III-Interaction effects:

All the effect of the interaction between the experimental factors were not significant on all studied characters in both seasons, with one exception for the interaction between harvest date and N fertilizer rates on seed yield which showed significant effect in both growing seasons. It could be concluded that the highest average seed yield / fed (831.7 and 848.9 kg / fed) could be produced by adding 150 kg N fed and harvesting at 160 DAS and150 DAS in the 1st and 2nd seasons, respectively.(Table 4 and fig.1&2)

Table 4. The effect of interaction between nitrogen rates and harvesting dates on canola seed yield (kg/fed)

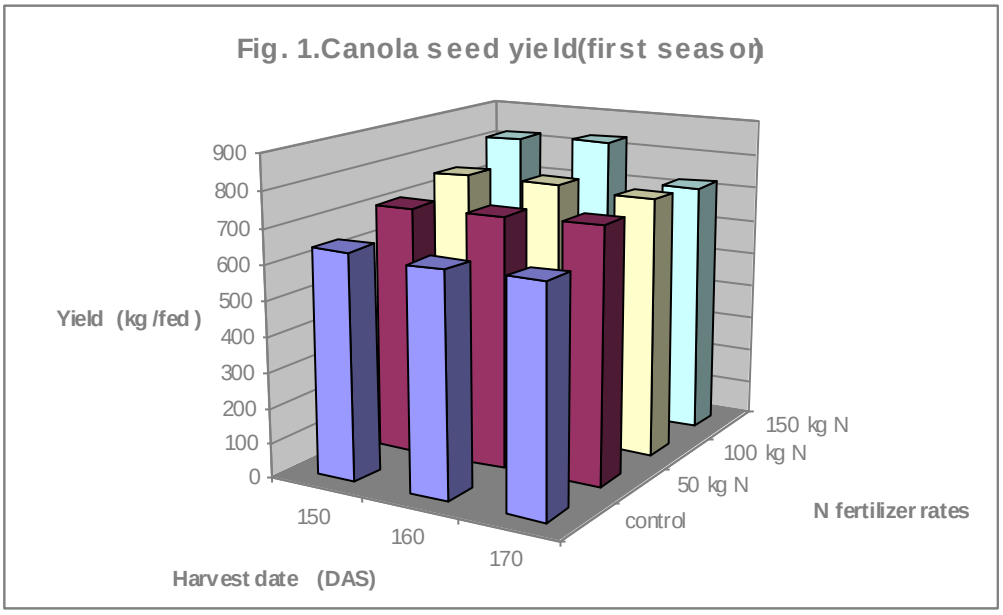
seasons	2001/2002				2002/2003			
Harvest dates	N rates				Nrates			
	control	50 kg/fed	100 kg/fed	150 kg/fed	control	50 kg/fed	100 kg/fed	150 kg/fed
150 DAS	641.1	707.2	753.3	819.8	699.2	725.6	763.8	848.9
160 DAS	629.4	714.4	753.3	831.7	660.6	719.4	791.6	828.9
170 DAS	634.2	721.1	741.1	723.9	721.7	728.3	730.6	784.4

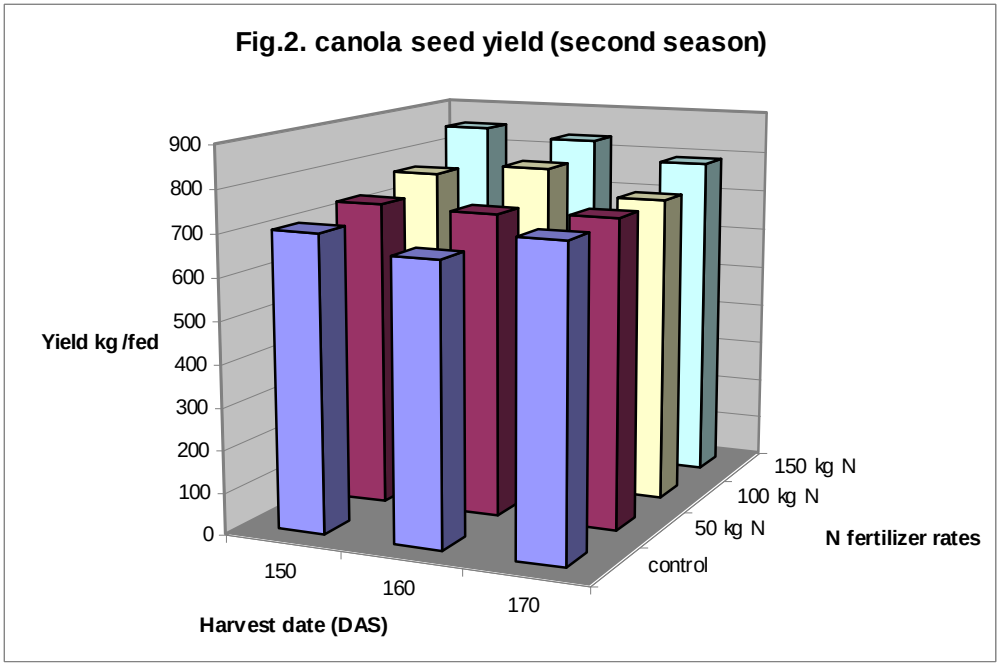
L.S.D 5%= 17.4 L.S.D 5% =27.1

General conclusion

The obtained results showed that planting canola at 30 – 40 cm between hills (on ridges 70 cm apart) and applying N at 150 kg / fed and harvesting after 150 days could be recommended under Kalubia conditions. In all cases, consideration should by given to the actual available contents of the nutrient in the soil itself and varies harvest date according to site, species , soil fertility , irrigation , … etc.

The effect of interaction between nitrogen treatments and harvesting dates on canola seed yield (kg/fed)





REFERENCES

Abd El-Dayem, H.M.; S.A. El-Desouky; Z.M. Khedr and Madiha M. Abd El-Hamied (2000). Response of rape seed plant to nitrogen nutrition. J . Agric. Sci. Mansoura Univ., 25 (10): 6187-6202.

Asare , E. and D. H. Scarisbrick (1995). Rate of nitrogen and sulphur fertilizers on yield , yield components and seed quality of oilseed rape (***Brassica napus, L.)*** Field Crops Res. 44: 41 – 46.

Ashoub , Abla H. ; A. Ebad, Fawzia ; A. M. Hegazi and B. A. El-Ahmar (1988). Effect of some cultural treatments on yield and its components in rape seed (***Brassica napus, L.)*** at Mariut. Annals Agric., Sci., Moshtohor, Zagazig Univ., 26 (2) 711-725

Chauhan, A.K. ; M. Singh and K.S. Dadhwal (1993). Effect of nitrogen level and row spacing on the performance of rape (***Brassica napus, L.)*** . Indian J. Agron. 37 (4): 851-583.

Cheema , M.A.; M.A. Malik ; A. Hussain ; S.H. Shah and M.A. Basra (**2001).** Effect of time and rate of nitrogen and phosphorus application on the growth and the seed and oil yield of canola (***Brassica napus, L.)*** . J. Agron. and Crop Sci., 186 : 103-110.

Grant, D. Jackson (2000). Effect of nitrogen and sulfur on canola yield and nutrient uptake. Agron. J. 92: 644- 649.

Hassan, Kh. and M. S. El-Hakeem (1996). Response of some rape seed cultivars to nitrogen rates and plant density under saline conditions at Siwa Oasis. Annals Agric., Sci., Ain Shams Univ., 41 (1) 229 – 242.

Hay, R.K.M. and A.J. Walker (1989). An introduction to the physiology of crop yield, 163-187. Longman Scientific and Technical Group, Harlow UK.

Marschner, H. (1995). Mineral nutrition of higher plant. Academic Press Inc. London LTD.

Michigan State University , (1983). MSTAT-C: Micro- computer Statistical Program, Version 2.0. Michigan State University, East Lansing.

Momoh E.J. and W. Zhou (2001). Growth and yield responses to plant density and stage transplanting in winter oilseed rape (***Brassica napus, L.).*** J. Agron. and Crop Sci. 186: 253 – 259.

Noureldin, Nemat A. ; M. S. El-Habbal ; M. A. Hamad and M. A. Hamed (1993). Yield response of two rapseed cultivars to irrigation intervals and nitrogen fertilizer under sandy soil conditions. Annals Agric., Sci., Ain Shams Univ., 38 (2) 511 – 519.

Oplinger, E.S.; L. L. Hardman ; E. T. Gritton, J.D. Doll, and K.A. Kelling (1989). Alternative field crops manual, canola (rapeseed). Ext. Bull. Nov., 1989. Univ., of Wisconsin, Madison, WI.

Rajendra, k. and M. S. Shaktawat (1992). Effect of limited water supply , nitrogen and time of sowing on production of rape (***Brassica napus, L.)***. indian J. Agron. 37 (4): 853 – 855.

Sabry G. Elias and Larry O. Copeland (2001). Physiological and harvest maturity of canola in relation to seed quality. Agron., J. 93:1054-1058.

Scarisbrik, D.H. and R.W. Daniels (1986). Oil seed rap. Collins & Grafton street, London WI.

Sharama, J. and D.R. Thakur (1993). Perfprmance of rainfed Argentine rape (***Brassica napus, L.)*** under dates of sowing and row spacings in the mid-hills of north-western Himalayas. Indian J. Agron. 38 (2) :254-256.

Varley, J.A. (1966). Automatic methods for the determination of nitrogen, phosphorus and potassium in plant material. Analyst, 91: 119-126

استجابة الكانولا لميعاد الحصاد والتسميد النيتروجيني والكثافة النباتية

ناصر خميس بركات الجيزاوي

قسم المحاصيل – كلية الزراعة بمشتهر– جامعة الزقازيق (فرع بنها)

أقيمت تجربتان حقليتان خلال موسمي ٢٠٠١ / ٢٠٠٢ ، ٢٠٠٢ / ٢٠٠٣ بمركز البحوث والتجارب الزراعية بكلية الزراعة بمشتهر جامعة الزقازيق فرع بنها لدراسة تأثير موعد الحصاد والتسميد النيتروجيني والمسافة بين النباتات علي النمو والمحصول ومكوناته ومحتوي البذور من الزيت والبروتين وقد أوضحت النتائج ما يلي:

- لم يؤثر ميعاد الحصاد معنويا علي صفات النمو و مكونات المحصول ولكن تأخير الحصاد أدى إلى تقص معنوي في كمية المحصول.
- أدى التسميد الآزوتي بمعدل ١٥٠ كجم نيتروجين / فدان إلى زيادة معنوية في جميع صفات النمو والمحصول ومكوناته ونسبة البروتين ومحصوله، بينما أدت زيادة مستويات التسميد النيتروجيني إلى تقص في محتوي البذور من الزيت:
- أدت زيادة المسافة بين النباتات من ٢٠ – ٤٠ سم إلى زيادة عدد الفروع وعدد القرون للنبات وكذلك محصول البذور
- كان للتفاعل بين ميعاد الحصاد والتسميد الآزوتي تأثير معنوي علي محصول البذور حيث وجد أن الحصاد بعد ١٥٠ يوم من الزراعة والتسميد بمعدل ١٥٠ كجم نيتروجين للفدان أعطى اعلي محصول مع الآخذ في الاعتبار محتوي التربة الفعلي من العناصر الغذائية الميسرة.