RESULTS AND DISCUSSION

IV- RESULTS AND DISCUSSION

The results obtained will discussed under the following <u>**titles:**</u>

4-1- Effect of fertilization programs on growth characters:

4-1-1- Effects on plant height after 90 days from sowing.

4-1-2- Effects on plant height at harvesting.

4-1-3- Effects on number of leaves per plant after 90 days from sowing.

4-1-4- Effects on number of days needed by the first flower to appear.

4-1-5- Effects on flowering date.

4-1-6- Effects on number of branches per plant.

4-1-7- Effects on dry weight per plant after 90 days from sowing.

4-1-8- Effects on dry weight per plant at harvesting.

4-2- Effect of fertilization programs on yield and yield components:

4-2-1 Effects on number of pods per plant.

4-2-2- Effects on number of seeds per pod.

4-2-3- Effects on 1000- seed weight (seed index).

4-2-4- Effects on seed yield.

4-2-5- Effects on straw yield.

4-3- Effect of fertilization programs on seed quality:

4-3-1- Effects on seed oil percentage.

4-1- Effect of fertilization programs on growth characters:

4-1-1- Effects on plant height after 90 days from sowing.

Results presented in Table (2) indicate that plant height of rape seed plant after 90 days growth was significantly affected by nitrogen fertilizer levels in both growing seasons. Increasing nitrogen level from 0 to 25,50 and 75 kg/fed increased plant height by about 10.4,18.8 and 24.6% in the first season, respectively. Similar trends were obtained in the second season where the increase percentage in plant height were 17.9, 30.2 and 41.8% respectively due to the application of 25, 50 and 75 kg N / fed when compared with control treatment. The differences between the averages of all treatments were significant in the second season, but in the first season, the differences between 25 and 50 as well as 50 and 75 kg N / fed were not significant. The increase in canola plant height with the increase in nitrogen application rate may be attributed to the increase in meristimatic activity which are induced by nitrogen application, and this contribute to the increase in number of cells in rape stem. These findings are in accordance with those obtained by Qayyum *et al* 1999 and Jat *et al* 2000.

Concerning phosphorus application, data in Table (2) reveal that phosphorus application affected significantly canola plant height in the two growing seasons. Addition of 45 kg P_2O_5 / fed caused an increase in the plant height by 11 and 11.1 cm in the two seasons, respectively. The increase in plant height by phosphorus application might be due to the effect of phosphorus on nitrogen metabolism El-Baz, 1989. Sarmah 1998 and Ram *et al* 1999 stated that phosphorus fertilization significantly increased plant height of rapeseed.

With regard to potassium fertilization, the data in Table 2 clearly show that potassium fertilizer did not show any significant effect on canola plant height in both studied seasons. This might be because the soil native supplying power of potassium was enough to satisfy the requirements of canola vegetative growth Table, 1. These results are in line with those obtained by Kandil 1981.

Considering, the interaction effects between N, P and K fertilization, significantly results indicate that canola plant height could not be affected by the interaction between the studied variables. This means that each of these factors may act independently or compensatingly on plant height of canola plant.

4-1-2- Effects on plant height at harvesting:

Results in Table (3) show that plant height of canola at harvesting was significantly affected by nitrogen application in both seasons. Increasing applied nitrogen level progressively increased canola plant height. The highest plants (146.0 and 150.3 cm over the two seasons, respectively) were recorded for plants that received the highest nitrogen level, i.e. 75 kg / fed, Table (2) : Plant height after 90 days from sowing (cm) as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	53.90	50.45	52.18	65.20	67.65	66.43
	45	52.45	66.15	59.30	64.40	79.95	71.68
Mean		53.18	58.30	55.74	64.80	73.30	69.05
25	0	55.95	54.90	55.43	68.85	77.15	73.00
	45	68.35	67.0	67.68	91.50	88.15	89.83
Mean		62.15	60.95	61.55	80.18	82.65	81.42
50	0	62.25	58.35	60.30	85.40	86.55	85.98
	45	74.95	69.40	72.18	95.30	92.25	93.78
Mean		68.60	63.88	66.24	90.35	89.40	89.88
75	0	64.55	61.60	63.8	91.85	89.40	90.63
	45	73.25	78.45	75.85	105.0	105.4	105.2
Mean		68.90	70.3	69.47	98.43	97.40	97.92
Mean P	0	59.16	56.33	57.75	77.83	80.19	79.01
	45	67.25	70.25	68.75	89.5	91.19	90.12
Mean K (C)		63.21	63.29	63.25	83.44	85.69	84.57
L.S.D. at 0.05 Level	A	6.83			7.58		
	B	4.83			5.36		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

while the shortest ones (117.7 and 115.7 cm for the first and second seasons, respectively) were obtained with the plots non N fertilized plots. These results are in harmony with those obtained by Brar *et al* 1998 and Patel 1998 who reported that increasing nitrogen application for canola plants induced in plant height.

Regarding the influence of phosphorus application on canola plant height at harvesting, data in Table (3) show that application of 45 kg P_2O_5/ fed to canola plants significantly and insignificantly increased plant height in the first and second growth seasons respectively. In the first season, applying 45 kg P_2O_5/ fed resulted in significant increase in plant height by 8.6 cm over control treatment. Jat *et al* 2000 stated that P fertilization significantly increased plant height of rapeseed, while Badr 1987 and Thakur and Chand 1998 found no marked increase due to phosphorus fertilization.

With regard to potassium fertilization, data in Table (3) show that potassium fertilizer could not yield a had significant effect on canola plant height at harvesting in the second season only. The tallest plant height was obtained at 24 kg K_2O/fed. However, the shortest plant was recorded under zero level. Sarmah 1998 found that application of potash up to 15 kg K_2O/ha significantly increased the plant height of oilseed rape, while Kandil 1981 reported that increasing applied potassium rate from 0 to 24 kg / fed to oilseed rape failed to produce significant effect on plant height .

The interactions effect between N,P and K fertilization on canola plant height were not significant in both seasons, except the interaction between nitrogen and potassium fertilization in the second season only, where the highest plant (156.0cm) was obtained by addition of 75 kg N + 24 kg K_2O/fed. The shortest plant height (102.2 cm) was recorded with plants which received neither nitrogen nor potassium applications.

4-1-3- Effects on number of leaves per plant after 90 days from sowing :

Number of leaves per plant was recorded at 90 days only because they were completely fired before harvesting. Data in Table (4) show clearly that number of leaves per plant was significantly increased due to nitrogen application in both seasons. The highest number of leaves per plant was recorded with two rates of applied N i.e. 50 kg N / fed at first season and 75 kg N / fed at the second season. The increase in the number of leaves of canola plant due to nitrogen application could be mainly attributed to the role of nitrogen in encouraging meristimatic tissues in rape plant. Number of leaves could be considered an external expression of the meristimatic activity in plants. These results coincide with those obtained by Mekki 1990.

Concerning phosphorus fertilization, data in Table (4) indicate that raising phosphorus level from zero to 45 kg P_2O_5/fed insignificantly and significantly increased number of leaves per canola plant in the first and the second season, respectively. The increasing percentage due to application of 45 kg P_2O_5/fed amounted to about 4.4% for the two seasons as compared with control. Similar results were obtained by Mekki (1990) who found that number of leaves per rape plant was significantly increased by phosphorus fertilization.

Table (3) : Plant height at harvesting (cm) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	115.5	115.0	115.2	102.2	128.4	115.3
	45	119.6	120.8	120.2	110.9	121.10	116.00
Mean		117.5	117.9	117.7	106.6	124.7	115.6
25	0	131.2	127.5	129.3	126.1	136.3	131.2
	45	136.7	139.6	138.1	131.8	134.6	133.2
Mean		133.9	133.5	133.7	129.0	135.4	132.2
50	0	133.7	141.2	137.5	148.1	141.3	144.7
	45	148.3	141.7	145.0	140.1	137.3	138.7
Mean		141.0	141.5	141.3	144.1	139.3	141.7
75	0	137.1	142.1	139.6	142.3	152.1	147.2
	45	149.6	155.4	152.5	151.7	156.0	153.8
Mean		143.3	148.7	146.0	147.0	154.0	150.5
Mean P	0	129.4	131.4	130.4	129.7	139.5	134.6
	45	138.6	139.4	139.0	133.6	137.3	135.4
Mean K (C)		134.0	135.4	134.7	131.6	138.4	135.0
L.S.D. at 0.05 Level	A	6.21			7.97		
	B	4.39			N.S		
	C	N.S			4.93		
	AxB	N.S			N.S		
	AxC	N.S			9.86		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

In respect of the effect of potassium application on number of leaves per canola plant at 90 days growth, data in Table (4) indicate that application of 24 kg K_2O/fed significantly increased number of leaves compared with control in the second season only. The increase in number of leaves / plant due to application of 24 kg K_2O /fed was 0.51 compared to control. However, in the first season, application of potassium fertilizer slightly decreased number of leaves, but the difference between the two levels of applied potassium was not significant.

It is worthy to observe that all The interactions effect between nitrogen and phosphorus, nitrogen and potassium or phosphorus and potassium on the number of leaves per canola plant recorded after 90 days from sowing were insignificant in both seasons. Moreover, the interaction among the three variables insignificantly affected number of leavers per plant in the two growing seasons (Table, 4).

4-1-4- Effects on days number of first flower appearance:

Data in Table (5) presented the effect of nitrogen, phosphorus, potassium fertilization as well as their interactions on number of days needed to appearance of the first flower appearance of canola plant. The obtained results indicate that the period from sowing to first flower was significantly affected by the amount of nitrogen fertilizer added to the plants in the first season only. It is obvious that plants without nitrogen fertilization (control) produced their first flower after 82.25 days, whereas the plants fertilized with 25,50 and 75 kg N / fed produced their first flower after 80.75, 80.50 and 80.25 days from planting without any significant difference between them.

Table (4) : Number of leaves / plant after 90 days from sowing as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) ($kg\ P_2O_5$/fed)	K (K_2O kg/fed)					
		1st Season			2nd Season		
		0	24	Mean	0	24	Mean
0	0	9.15	9.20	9.18	10.0	11.30	10.65
	45	9.15	9.35	9.25	10.95	11.65	11.30
Mean		9.15	9.28	9.22	10.48	11.48	11.98
25	0	11.30	9.60	10.45	11.80	12.45	12.13
	45	10.20	10.45	10.33	13.15	12.95	13.05
Mean		10.75	10.03	10.39	12.48	12.70	12.59
50	0	11.0	11.05	11.03	12.55	14.0	13.28
	45	11.30	10.80	11.05	13.45	13.50	13.48
Mean		11.15	10.93	11.04	13.0	13.75	13.38
75	0	11.10	10.70	11.90	14.45	14.30	14.38
	45	11.30	10.50	10.90	14.70	15.0	14.85
Mean		11.20	10.60	10.90	14.58	14.65	14.62
Mean P	0	10.64	10.14	10.39	12.20	13.01	12.61
	45	10.49	10.28	10.39	13.06	13.28	13.17
Mean K (C)		10.56	10.21	10.39	12.63	13.14	12.89
L.S.D. at 0.05 Level	A	0.62			0.57		
	B	N.S			0.4		
	C	N.S			0.4		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

The increase in nitrogen application up to 75 kg / fed fasterd the initiation of the first flower by abut two days compared with the control. It is worthily to mention that due to nitrogen fertilization seemed to enhance the rate of canola growth and hence the first flower appearance. The same trend was observed in the second season, but the difference between plants the deferens in the rate of N fertilization was not significant at 0.05 level. El-Baz 1989 indicated that nitrogen fertilization showed no significant effect on number of days for first flower appearance.

Results also reveal that number of days from planting to first flower appearance was significantly affected by phosphorus application at both growing seasons. The earliest flower appeared after 80.29 and 81.4 days from planting due to application of 45 kg P_2O_5/fed for the two seasons, respectively, on the other hand, in plants without phosphorus application, the first flower appeared after 81.6 and 83.66 days in the same respect. Increasing the phosphorus application rate up to 45 kg P_2O_5/ fed fastend appearance of the first flower of canola plant by about 1.4 and 2.2 days for the two seasons, respectively. These results are in disagreement with those obtained by El-Baz 1989 who stated that phosphorus fertilizer had no significant effect on number of days to first flower.

Results presented in Table (5) indicate that number of days from sowing to appear the first flower of canola plant was not affected by potassium fertilization in both seasons. These results are in cope with those obtained by El-Baz 1989 who reported that there was no relevance between number of days to first flower appearance and the amount of potassium fertilization added to rapeseed plants.

Table (5) : Number of days for first appearance flower as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	83.25	82.25	82.75	84.50	84.25	84.38
	45	82.50	81.0	81.75	83.50	80.50	82.0
Mean		82.88	81.63	82.25	84.0	82.38	83.19
25	0	81.50	81.50	81.50	83.50	83.75	83.63
	45	79.0	81.0	80.0	81.0	82.25	81.63
Mean		80.25	81.25	80.75	82.25	83.0	82.63
50	0	80.50	81.50	81.0	83.75	82.75	83.25
	45	78.75	81.25	80.0	81.50	79.0	80.25
Mean		79.63	81.38	80.50	82.63	80.88	81.75
75	0	82.25	80.0	81.13	83.75	83.38	83.38
	45	79.50	79.25	79.38	81.75	81.75	81.75
Mean		80.88	79.63	80.25	82.75	82.38	82.57
Mean P	0	81.88	81.31	81.60	83.88	83.44	83.66
	45	79.94	80.63	80.29	81.94	80.88	81.41
Mean K (C)		80.91	80.97	80.94	82.91	82.16	82.54
L.S.D. at 0.05 Level	A	1.36			N.S		
	B	0.96			1.42		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

4-1-5- Effects on flowering date:

The results reported in Table (6) show the effect of nitrogen, phosphorus and potassium as well as their interactions on flowering date, measured in terms of days from sowing to about 50% flowering. The results indicated that flowering date was not affected significantly by the different levels of nitrogen in both tested seasons. These results are in a good agreement with those obtained by Badr 1987 who reported no significant effect on number of days needed for 50% flowering of rape plant due to using three rates of nitrogen, i.e. 60,90 and 120 kg N / fed.

Considering phosphorus fertilization, data in Table (6) clearly show that the increase in applied phosphorus rate up to 45 kg P_2O_5/ fed resulted in a significant decrease in number of days to 50% flowering in the two seasons. Applying phosphorus at the rate of 45 kg P_2O_5/ fed fastend number of days to 50% flowering by about 1.4 and 0.85 days in the two seasons, respectively compared with the control treatment.

In respect of potassium application, data in Table (6) show no significant relation between flowering date and potassium application in the two growing seasons, probably because of the relatively high amount of available potassium in the experimental soil (200 and 253 ugg^{-1}; Table, 1) could be enough to supply rape seed plants with their K requirements. This results are in harmony with those obtained by El-Baz 1989.

The interaction between the three variables insignificantly affected the flowering date of canola plant. This means that each of these variables may act independently or contradicterly on flowering date.

Table (6) : Flowering date as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) ($kg\ P_2O_5$/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	95.0	95.5	95.2	95.0	95.2	95.1
	45	95.7	95.5	95.6	94.2	95.0	94.6
Mean		95.4	95.5	95.4	94.6	95.1	94.9
25	0	96.3	97.7	97.0	95.3	96.5	95.9
	45	93.0	94.8	93.9	93.8	95.0	94.4
Mean		94.6	96.2	95.4	94.5	95.7	95.1
50	0	95.5	94.3	94.9	95.7	95.7	95.7
	45	94.0	94.8	94.4	95.5	93.3	94.4
Mean		94.7	94.5	94.6	95.6	945	95.1
75	0	96.7	96.7	96.7	95.5	95.5	95.50
	45	94.8	94.0	94.4	95.7	95.3	95.50
Mean		95.8	95.4	95.6	95.63	95.38	95.50
Mean P	0	95.9	96.1	96.0	95.4	958.8	95.6
	45	94.4	94.8	94.6	94.8	94.6	94.7
Mean K (C)		95.1	95.4	95.3	95.1	95.2	95.14
L.S.D. at 0.05 Level	A	N.S			N.S		
	B	1.0			0.6		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

4-1-6- Effects on number of branches per plant:

Results in Table (7) show the effect of N, P and K fertilization treatments and their interactions on the number of branches per plant at harvesting. The variations in nitrogen fertilizer levels showed significant effect on number of branches per canola plant. Number of branches per plant increased as the level of nitrogen fertilizer increased in both growing seasons. The increasing percentage in number of branches per plant due to nitrogen application were 38.9, 39.8 and 61.2% for 25, 50 and 75 kg N/ fed in the first season, respectively, The same trend was obtained for the second season. It could be concluded that nitrogen fertilization encouraged the production of branches per plant. Such trend may be attributed to the increase in meristematic activity induced by nitrogen. Almost similar results were obtained by Badr 1987.

Regarding to phosphorus fertilization, data in Table (7) show in general that the application of 45 kg P_2O_5/ fed to canola plant increased significantly number of branches per plant in the first season only, whereas in the second growing season, the difference between number of branches per plant between 45 kg P_2O and unfertilized treatment was insignificant at 5% level. These results are in consistence with those obtained by Ram *et al* 1999.

Concerning potassium fertilization, data in Table (7) show that there was no relationship between amount of potassium fertilizer added to rapeseed plants and number of branches at harvesting. The addition of 24 kg K_2O/ fed slightly increased the number of branches per canola plants, but the difference between the plants fertilized with 24 kg K_2O/ fed and unfertilized plants fail to reach 5% significance. Similar results were obtained by Kandil 1981.

The interactions between the three variables had no effect on number of branches per canola plant, except the interaction between nitrogen and potassium fertilization in first season only, which significantly affected the number of branches per plant. The highest number of branches per plant was observed with plants fertilized with 75kg N and 24 kg K_2O/ fed.

4-1-7 Effects on dry weight per plant after 90 days from sowing:

Data illustrated in Table (8) show the influence of different levels of N,P and K fertilizers on the dry weight of rapeseed plants after 90 days from the two seasons. The obtained results show significant increases in dry weight of rape plant after 90 days from planting, which are parallel to increase nitrogen rates. Such increases are amounting to 68.2, 97.7 and 187.1% for application of 25,50 and 75 kg N / fed over control in the first season and 101.0, 198.8 and 256.7% for the second season in the same order. It is worthily to mention that treatments of the lowest applied nitrogen rates (0 or 25 kg N / fed) showed the lowest dry weight / plant, while the highest N rates (50 or 75 kg N / fed) produced the highest dry weight yield in both seasons. These results are in line with the results of plant height after 90 days from sowing (Table, 2) and number of leaves / plant (Table, 4). It is quite evident from the results obtained that, nitrogen fertilization is required for optimum or better building up of vegetative growth and reproductive plant organs. Several

Table (7) : Number of branches/plant as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	1st Season 24	1st Season Mean	2nd Season 0	2nd Season 24	2nd Season Mean
0	0	5.83	6.45	6.14	6.78	7.28	7.03
	45	7.60	6.85	7.23	7.18	8.35	7.77
Mean		6.72	6.65	6.68	6.98	7.82	7.40
25	0	10.03	8.08	9.06	9.58	9.75	9.67
	45	9.50	9.50	9.50	9.08	9.58	9.33
Mean		9.76	8.79	9.28	9.33	9.67	9.50
50	0	7.50	9.83	8.67	10.65	9.83	10.24
	45	10.78	9.25	10.02	11.08	11.00	11.04
Mean		9.14	9.54	9.34	10.87	10.42	10.64
75	0	9.33	11.25	10.29	11.75	12.65	12.20
	45	10.25	12.23	11.24	12.25	12.40	12.33
Mean		9.79	11.74	10.77	12.00	12.53	12.26
Mean P	0	8.17	8.90	8.54	9.69	9.88	9.79
	45	9.53	9.46	9.50	9.90	10.33	10.12
Mean K (C)		8.85	9.18	9.02	9.79	10.11	9.95
L.S.D. at 0.05 Level	A	0.95			0.67		
	B	0.67			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	1.3			N.S		
	BxC	N.S			N.S		
	AxBxC	1.9			N.S		

authors, pointed out that nitrogen fertilization of canola plants increased dry matter production of canola plants Brar *et al* 1998 and Jat *et al* 2000.

With regard to phosphorus fertilization, data show that the effect of phosphorus application on the dry weight per plant was significant in both growing seasons. Application of 45 kg P_2O_2/ fed caused an increase in canola dry weight at 90 days after sowing. The increases percentage due to 45 kg P_2O_2/ fed were 21.5 and 15.9% when compared with control for the two growing seasons, respectively. These results agreed with those obtained by Rashid and Bughio 1993 and Ram *et al* 1999.

Regarding potassium fertilization, the results in Table (8) reveal that potassium application did not cause any effect on the dry matter of canola plant at 90 days after sowing in both growing seasons. This may be due to the moderate amount of available potassium in site of the experiments (Table, 1). These results are in harmony with those obtained by Mekki 1990.

<u>4-1-8- Effects on dry weight per plant at harvesting:</u>

Results in Table (9) show the effect of N P K fertilization program on the dry weight per plant at harvesting. The data obtained clearly show that, the effect of nitrogen fertilizer on canola dry weight at harvesting was significant in both growing seasons. The highest rapeseed dry weight was obtained with the application of 75 kg N / fed in both seasons. The increases in the dry weigh per plant were 36.85, 50.63 and 89.00 gm for 25,50 and 75 kg N / fed when compared with control, respectively in the first season. Similar results were obtained in the second season, where the increases of 16.2,43.0 and 64.1 gm were produced by the same order.

Table (8) : Dry weight / plant after 90 days from sowing(gm) as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	11.13	14.83	12.98	7.05	6.53	6.79
	45	15.95	18.35	17.15	10.67	13.58	12.13
Mean		13.54	16.59	15.07	8.86	10.06	9.46
25	0	21.78	22.48	22.13	19.83	16.87	18.35
	45	33.13	23.98	28.56	17.51	21.82	19.67
Mean		27.46	23.23	25.35	10.67	19.35	19.01
50	0	29.95	27.75	28.85	26.66	27.88	27.22
	45	34.40	27.05	30.73	28.96	29.67	29.32
Mean		32.18	27.40	29.79	27.76	28.78	28.37
75	0	41.35	35.58	38.47	30.30	23.51	26.91
	45	41.35	54.73	78.04	34.94	46.19	40.57
Mean		41.35	45.16	43.26	32.62	34.85	33.74
Mean P	0	26.05	25.16	25.61	20.94	18.70	19.82
	45	31.21	31.03	31.12	23.02	27.82	25.42
Mean K (C)		28.63	28.09	28.36	21.98	23.26	22.62
L.S.D. at 0.05 Level	A	7.69			5.83		
	B	5.44			4.12		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

This result is to be expected since increasing nitrogen fertilizer increased plant height and number of branches per plant at harvesting (Tables 3 and 7). These results are in line with those obtained by Gill and Narang 1993 and Thakur and Chand 1998.

Data presented in Table (9) show that phosphorus fertilizer levels had significant effect on dry weight per plant at harvesting. Application of 45 kg P_2O_5/ fed gave significantly the highest dry weight per plant when compared with control. The average of dry weights were 76.42 and 125.70 gm for zero and 45 kg P_2O_5/ fed, respectively in the first season, while they were 64.98 and 82.10 gm in the second season in the same respect. These results agree with the former explanation, i.e increasing phosphorus application increased plant height and number of branches per plant at harvesting (Table 3 and 7). Similar conclusions had been derived by Jat *et al* (2000).

Moreover, the results in Table (9) clearly show that, there was no relationship between amount of potassium fertilizer added to rapeseed plants or the interactions between the three variables and the dry weight per plant at harvesting.

4-2- Effect of fertilization programs on yield and yield components :

4-2-1- Effects on number of pods per plant :

The mean values of number of pods per one rape plant as affected by nitrogen, phosphorus and potassium fertilization during the two growing seasons are presented in Table (10). The obtained results indicated that nitrogen fertilization significantly increased number of pods per plant. Increasing nitrogen fertilizer form zero up to 25, 50 or 75 kg / fed significantly increased

Table (9) : Dry weight/plant at harvesting (gm) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[st] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	41.1	38.2	39.6	24.9	50.8	37.8
	45	70.9	68.6	96.7	85.3	42.9	47.6
Mean		55.7	53.4	54.7	38.6	46.9	42.7
25	0	61.2	81.1	66.2	47.9	61.5	54.7
	45	125.1	108.7	116.9	57.2	96.0	63.1
Mean		93.2	89.9	91.5	52.6	95.3	58.9
50	0	94.9	86.1	90.5	82.5	71.9	77.2
	45	153.8	122.5	138.2	88.0	100.4	94.2
Mean		124.4	104.3	114.3	85.2	86.2	85.7
75	0	92.1	126.6	109.4	86.0	94.4	90.2
	45	168.4	187.6	178.0	120.9	126.1	132.5
Mean		130.2	57.1	143.7	103.4	110.2	106.8
Mean P	0	72.3	80.5	76.4	60.3	96.7	65.0
	45	129.5	121.9	125.7	79.6	84.6	82.1
Mean K (C)		100.9	101.2	101.1	69.9	77.1	73.5
L.S.D. at 0.05 Level	A	21.8			14.4		
	B	15.4			10.2		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

number of pods per plant by 240.0, 377.4 and 557.7, respectively in the first season. Similar results were obtained in the second season, where the increases were 169.3, 325.3 and 608.5 in the same order. The increase in number of pods per plant due to nitrogen application may be due to the increase in meristematic activity and number of branches per plant (Table, 7) of canola which means an increase in number of flowers per plant. Moreover, plants supplied with enough nitrogen produced more pods per plant. These results are coincided with those obtained by Brar et al 1998 and Thakur and Chand 1998.

With regard to phosphorus fertilization, the results in Table (10) show that phosphorus application up to 45 kg P_2O_5/ fed significantly increased number of pods per plant in the first season. The increasing percentage due to 45 kg P_2O_5/ fed was 40.7% when compared to control in the first season, while the increase in number of pods per plant obtained in the second season was insignificant. Phosphorus is known to be involved in photosynthesis and plant metabolism. Such finding may be due to that phosphorus caused an increase in the number of flowers, fruit setting percentage and decreased the percentage of flower and fruit abscission. This results is in agreement with the results obtained by Chauhan *et al* 1995 and Arthamwar et al 1996.

Results presented in Table (10) indicate that number of pods per plant significantly increased by increasing potassium fertilization level of canola plants in both growing seasons. Increasing potassium level from zero to 24 kg K_2O/fed increased number of pods per plant from 515.65 to 595.29 and from 533.70 to 604.47 in the two growing seasons, respectively. These results are in harmony with those obtained by Mekki 1990 who reported that potassium fertilizer significantly increased number of pods per plant over the control in both seasons.

Concerning the interactions between the fertilization treatments, data in Table (10) clearly show that the number of pods per plants was affected only by the interaction among the three variables in the first season. The highest value of number of pods per plant in the first season was recorded for the canola plants fertilized with 75 kg N, 45kg P_2O_5 and 24 kg K_2O / fed, while the lowest value of number of pods was obtained for the plants without any application of nitrogen, phosphorus or potassium fertilization. Almost similar results were obtained by Joarder *et al* 1979 and El- Baz 1989.

4-2-2- Effects on number of seeds per pod:

The effects of nitrogen, phosphorus and potassium fertilization treatments as well as their interactions on the number of seeds per pod are shown in Table (11). Increasing nitrogen levels from zero to 25,50 or 75 kg / fed, led to an increase in the number of seeds per pod by 7.2,9.4 and 12.5% as compared with control in the first season and by 15.1, 14.7 and 11.0% in the second one. In the first season, only the differences between control (without nitrogen fertilization) and 50 or 75 kg N / fed were significant, while the differences between the other treatments (25, 50 and 75 kg N/ fed) were not significant. On the other hand in the second season, the differences between any of nitrogen application treatments (25, 50 and 75 kg/fed) and unfertilized treatment were significance, but the differences between 25 and 50, 50 and 75 as well as between 25 and 75 kg

Table (10): Number of pods/plant as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1St Season 0	1St Season 24	1St Season Mean	2nd Season 0	2nd Season 24	2nd Season Mean
0	0	178.3	203.7	191.0	215.0	314.9	265.0
	45	317.3	345.7	331.5	286.5	356.8	321.6
Mean		247.8	274.7	261.2	250.8	335.8	293.3
25	0	346.3	450.2	398.3	361.8	522.9	442.4
	45	582.5	634.0	608.2	488.0	477.7	482.8
Mean		484.4	542.1	503.2	424.9	500.3	462.6
50	0	437.2	628.0	532.6	602.9	613.1	608.0
	45	857.6	631.90	744.7	584.6	673.9	629.3
Mean		647.4	629.9	638.6	593.7	643.5	618.6
75	0	633.2	518.40	724.3	877.4	987.5	932.4
	45	772.9	1053.5	913.2	853.4	889.0	871.2
Mean		703.0	934.5	818.8	865.4	938.2	901.8
Mean P	0	398.7	524.3	461.5	514.3	609.6	561.9
	45	632.6	666.3	649.4	553.1	599.3	576.2
Mean K (C)		515.7	595.3	555.5	533.7	604.5	569.1
L.S.D. at 0.05 Level	A	116.9			95.4		
	B	82.7			N.S		
	C	82.07			67.5		
	AxB	N.S			N.S		
	AxC	165.3			N.S		
	BxC	N.S			N.S		
	AxBxC	233.8			N.S		

N/fed were not significant. These results are in cope with those obtained by Ibrahim *et al* 1989 and Singh *et al* 1994.

Data presented in Table (11) clearly show that phosphorus or potassium fertilization treatments did not effect the number of seeds per pod in the two growing seasons. These results are in a good agreement with those obtained by EL- Baz 1989 who found that, the number of seeds per pod did not affect by phosphorus or potassium fertilization.

Regarding to the interaction effect between the studied variables, i.e. nitrogen, phosphorus and potassium fertilization on the number of seeds per pod, the data obtained in Table (11) reveal that, all the interaction effects were not significant, except the interaction between nitrogen and potassium fertilization in the second season which exert a significant effect on the number of seeds per plant. The highest number of seeds per pods of canola plants was observed from the plants fertilized with 50 kg N and 24 kg K_2O / fed, while the lowest number of seeds per pod was recorded for the canola plants without nitrogen and potassium application.

4-2-3- Effects on 1000-seed weight :

Data presented in Table (12) show the weight of 1000 rape seeds as affected by nitrogen, phosphorus and potassium fertilization and their interactions. The obtained results reveal that, in general, there was a significant decrease in seed index (1000-seed weight) of rape plant caused by the increasing of nitrogen fertilization level up to 50 kg / fed, and then increased by increasing the nitrogen level up to 75 kg / fed when compared with control in the first season. The average values are 2.80, Table (11) : Number of seeds/pod as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) ($kg P_2O_5$/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	26.8	24.1	25.4	19.9	25.0	22.5
	45	23.3	26.0	24.7	21.4	22.7	22.0
Mean		25.05	25.05	25.05	20.6	23.9	22.25
25	0	25.10	27.10	26.10	25.90	27.75	26.83
	45	27.58	27.60	27.59	25.00	23.75	24.38
Mean		26.34	27.35	26.85	25.45	25.75	25.60
50	0	26.6	27.00	26.80	24.75	24.50	24.63
	45	26.93	29.00	27.97	24.95	27.90	26.43
Mean		26.77	28.00	27.39	24.85	26.20	25.53
75	0	28.48	30.43	29.46	25.85	21.50	23.48
	45	26.15	27.67	26.91	26.70	25.10	25.90
Mean		27.32	29.05	28.18	26.075	23.30	24.69
Mean P	0	26.73	27.15	26.94	2401	24.69	24.35
	45	26.00	27.57	26.79	24.50	24.86	24.68
Mean K (C)		26.37	72.36	26.87	24.25	24.78	24.52
L.S.D. at 0.05 Level	A	2.29			2.18		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			3.1		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

2.46, 2.53 and 2.92 g / 1000 seeds under nitrogen levels of 0, 25, 50 and 75 kg / fed, respectively in the first season. The decrease in 1000-seed weight due to increasing nitrogen levels up to 50 kg / fed may be due to the increase in number of pods per plant and number of seeds per pod (Tables 10 and 11) might be drain photosynthetic to such developing organs, and thus seed index decreased. The reduction in seed index by nitrogen fertilization may compensated by the greater number of pods per plant and seeds per pod. These results are partly similar to those obtained by El-Baz 1989. On the other hand there was no relevance between nitrogen application and 1000-seed weight of canola plant in the second season. Similar results were obtained by Singh *et al* 1994 and Ali and Ullah 1995 who concluded that nitrogen application did not effect 1000-seed weight of canola.

The results obtained in Table (12) show that 1000-seed weight of canola plant was not affected by both phosphorus or potassium fertilization as well as the interactions between the three variables in both growing seasons. These results are in line with those obtained by Kandil 1981 and Badr 1987 for phosphorus application, EL-Baz 1989 and Mekki 1990 for potassium fertilization and Joarder *et al* 1979 for the interaction effects between nitrogen, phosphorus and potassium fertilization on 1000-seed weight of canola plant.

4-2-4- Effects on seed yield:

Seed yield as affected by nitrogen, phosphorus and potassium fertilization levels as well as their interactions are presented in Table (13). In both seasons, i.e. 2000/2001 and 2001/2002, significant differences were found in canola seed

Table (12) : 1000-seed weight (gm) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	2.83	2.68	2.76	2.53	2.54	2.54
	45	2.86	2.81	2.84	2.72	2.42	2.57
Mean		2.85	2.75	2.80	2.63	2.48	2.55
25	0	2.22	2.49	2.36	2.29	2.47	2.38
	45	2.50	2.62	2.56	2.47	2.54	2.51
Mean		2.36	2.56	2.46	2.38	2.51	2.44
50	0	2.55	2.76	2.66	2.74	2.71	2.73
	45	2.78	2.04	2.41	2.69	2.19	2.44
Mean		2.67	2.40	2.53	2.72	2.45	2.58
75	0	3.29	3.11	3.20	3.04	3.03	3.04
	45	2.67	2.61	2.64	2.63	2.54	2.59
Mean		2.98	2.86	3.92	2.84	2.79	2.81
Mean P	0	2.72	2.74	2.73	2.65	2.69	2.76
	45	2.70	2.52	2.61	2.63	2.42	2.53
Mean K (C)		2.71	2.64	2.68	2.64	2.56	2.60
L.S.D. at 0.05 Level	A	0.29			N.S		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

yield per fed due to varying nitrogen fertilizer levels. The lowest seed yield was produced from the unfertilized plants. However, the highest nitrogen fertilization rate, i.e.75 kg/fed gave the highest seed yield. The averages seed yield were 327.7, 486.9, 612.2 and 645.1 and 182.3,245.7,350.2 and 422.5 kg/fed in 2000/2001 and 2001/2002 upon 0,25,50 and 75 kg N / fed respectively. It is clear that increasing nitrogen level up to 75 k/fed significantly increased seed yield of canola plant. However, the insignificant effects on seed yield per fed of canola plant were obtained between 0 and 25 and 25 and 50kg N/ fed in the two seasons, respectively. It could be concluded that the highest canola seed yield was obtained from plants given 75 kg N / fed. This may be due to that application of nitrogen to plants caused an increased number of leaves of canola plant (Table,4) consequently, increased the metabolic activity of the plant. Moreover, nitrogen fertilization increased the dry weight, number of pods per plant and number of seeds per pod, (Tables, 8, 9, 10 and 11) and consequently the yield of seeds was increased. The increase in yield of canola seeds with the increase in nitrogenous fertilization is in agreement with results obtained by Nanwal *et al* 2000 and Cheema *et al* 2001.

Irrespective of N and K fertilization treatments, the results obtained in Table (13) show that seed yield of rapeseed plant per fed was significantly affected by phosphorus application in both seasons, where the highest yield per fed (547.8 and 318.9 kg in the two growing seasons, respectively) was obtained by application of as Kg P_2O_5/ fed. The increases percentage due to application of 45 Kg P_2O_5/fed were 12.2 and 13.4% as compared with control in the two seasons, respectively. The higher seed yield per fed for canola plant caused by the application of phosphorus may be the results nducing one or more of plant growth parameters. (Tables, 2 and 3), number of leaves per plant (Table, 4), number of branches per plant (Table, 7), dry weight per plant (Tables 8 and 9) and number of pods per plant (Table, 10) due to important role of phosphorus in physiological processes in rapeseed plant. Some investigators reported that phosphorus fertilization increased seed yield Sharma, 1995.

Data in Table (13) clearly show that seed yield per fed was not affected by potassium application or by the interactions between the three studied variables, i.e. nitrogen, phosphorus and potassium fertilization in both growing seasons. Many reports indicated that potassium produced nonsignificant increases in seed yield of rape plants Singh *et al* 1997. On the other hand Sheppard and Bates 1980 reported no positive interaction between N, P and K when all three were applied at high rates in one treatment.

4-2-5- Effects on straw yield:

Data on canola straw yield in ton/fed as affected by nitrogen, phosphorus and potassium fertilization as well as their interactions are shown in Table (14). In both seasons, i.e. 2000/2001 and 2001/2002, significant differences were found in straw yield of canola plant per fed due to varying nitrogen level. It could be noticed that the differences between nitrogen application levels (25, 50 and 75 kg / fed and control (without nitrogen fertilization) were significant in both growing seasons, while the differences between them were not significant in the

Table (13) : Seed yield (kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	1st Season 24	1st Season Mean	2nd Season 0	2nd Season 24	2nd Season Mean
0	0	374.1	264.9	319.5	136.2	204.1	170.1
	45	316.8	355.0	335.9	206.5	182.4	194.4
Mean		345.5	309.9	327.7	171.3	193.2	182.3
25	0	398.7	444.5	421.6	178.9	250.9	214.9
	45	584.9	519.3	552.1	315.0	237.9	276.5
Mean		491.8	481.9	486.9	246.9	244.4	245.7
50	0	547.8	562.2	554.9	393.8	293.7	343.7
	45	749.7	589.3	669.5	386.4	326.9	356.7
Mean		648.7	575.8	612.2	390.1	310.3	350.2
75	0	939.2	673.8	656.5	404.9	388.5	396.7
	45	624.1	643.4	633.8	453.3	443.1	448.2
Mean		631.7	658.6	645.1	429.1	415.8	422.5
Mean P	0	489.9	486.3	488.1	278.4	284.3	281.4
	45	568.9	526.3	547.8	340.3	297.6	318.9
Mean K (C)		529.4	506.5	517.9	309.4	290.9	300.1
L.S.D. at 0.05 Level	A	102.8			70.3		
	B	51.7			35.2		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

first season and between 50 and 75 kg / fed in the second one. The lowest straw yield was obtained for the plants without nitrogen fertilization in both seasons. On the other hand the highest value for the canola straw yield was recorded for the plots fertilized with 50 kg N / fed in the first season and 75 kg N / fed in the second season without any significant between 75 and 50 kg N / fed. Nitrogen fertilizer regulated straw yield through the number of branches per plant (Table, 7) and dry weight (Tables, 8 and9). Similar results were obtained by Brar *et al* (1998) and Qian and Schoenau (2000).

Data given in Table (14) show that phosphorus application had significant effect on straw yield per fed of canola plant. Applying 45 kg P_2O_5/fed increased significantly straw yield per fed by 14.4 and 9.7% relative to unfertilized treatment in two seasons, respectively. This increment may be due to the increase in plant height (Tables, 2 and 3), number of branches per plant (Table,7) and dry weight per plant of canola (Tables 8 and 9).

Regarding potassium fertilization, the data obtained in Table (14) show that straw yield per fed of canola plant was not affected significantly by potassium application in both seasons. This may be due to enough amounts of soil native available potassium in the experimental soil (260 and 253 $\mu g g^{-1}$ in sites of the two growing seasons, respectively). Moreover, Soper 1971 concluded that rape yield responds to potassium fertilization when grown in soils of exchangeable K content of 200 μg /g or less. Such statements are in line with those derived by Singh *et al* 1997.

Data in Table (14) show that the interaction among nitrogen, phosphorus and potassium fertilization on straw yield was significant in the first season only. The highest straw yield (2.92 ton /fed)in the first season was obtained by applying 75 kg N+ 45 kg P_2O_5+ 24kg K_2O/fed, while the lowest value of the straw yield of canola plant per fed (1.54 ton) was observed for the plants without any of nitrogen, phosphorus or potassium fertilization. Almost similar results were obtained by El-Baz (1989) who stated the interaction between N,P and K significantly affected straw yield of canola plant.

4-3- Effect of fertilization programs on seed quality

4-3-1- Effects on seed oil percentage:

Data presented in Table (15) show the effect of different levels of nitrogen, phosphorus and potassium fertilization as well as their interactions on oil percentage of rapeseed plant at maturity stage. Data reveal significant increase in oil percentage of rapeseed plant as a result of increasing nitrogen fertilization level in the second season only, but no clear trends could be observed in the first one. The average values of oil percentage are 48.4, 49.5, 50.5 and 51.2% for nitrogen levels of 0,25,50 and 75 kg /fed , respectively in the second season. These results are in cope with those obtained by Zahao *et al* 1993 who reported that nitrogen fertilization increased the percentage of oil in canola seed. In contrary, Mekki 1990 found that oil percent did not respond similarly to application of nitrogen fertilization.

The results obtained indicated that neither phosphorus nor potassium fertilization as well as the different interactions between the three fertilizer treatments did not affect significantly

Table (14) : Straw yield (ton/fed.) as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	1.54	0.99	1.26	1.15	1.42	1.29
	45	1.28	1.33	1.31	1.29	1.36	1.32
Mean		1.41	1.16	1.29	1.22	1.39	1.31
25	0	1.82	1.69	1.76	1.37	1.81	1.59
	45	2.64	2.41	2.53	2.13	1.94	2.03
Mean		2.23	2.05	2.14	1.75	1.88	1.81
50	0	2.13	2.45	2.29	2.54	2.15	2.34
	45	3.11	2.25	2.68	2.62	2.36	2.49
Mean		2.62	2.435	2.49	2.58	2.25	2.42
75	0	2.61	2.35	2.48	2.92	2.35	2.64
	45	1.87	2.92	2.39	2.79	2.68	2.74
Mean		2.24	2.63	2.44	2.86	2.52	2.69
Mean P	0	2.03	1.87	1.95	1.99	1.93	1.96
	45	2.22	2.23	2.23	2.22	2.09	2.15
Mean K (C)		2.13	2.05	2.09	2.11	2.01	2.06
L.S.D. at 0.05 Level	A	0.45			0.39		
	B	0.21			0.14		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	0.89			N.S		

seed oil percentage of canola plant in both growing seasons. Almost similar results were obtained by Jain *et al* (1996)and El-Zeky (1999) for phosphorus application, and Mekki (1990) and Mankotia *et al* (1994) for potassium application and Badr (1987) for the interaction between nitrogen and phosphorus fertilizers.

4-3-2- Effects on oil yield per fed:

Table (16) illustrated the mean values of oil yield in kg per fed for canola seeds as affected by nitrogen, phosphorus and potassium fertilization levels and their interactions over the two seasons 2000/2001 and 2001/2002. The nitrogen application caused significant increases in oil yield per fed. The nitrogen fertilizer tended to increase the oil yield per fed when applied at rates of 25, 50 and 75kg/fed by 47, 72.5 and 89%, respectively as compared with the zero level in the first season, while these increments are 39.8 , 100.8 and 144.5% for the second season in the obove mentioned order. This increases are mainly due to the increase in seed yield of rape plant with increasing nitrogen application rates as shown before. These results are in acordance with those obtained by Hamed 1988 and Cheema *et al* 2001.

The same data show that application of 45 kg P_2O_5 /fed resulted in a significant increase in oil yield of canola plants. The results obtained reveal that the increment of oil yield due to application of phosphorus fertilizer level at rate of 45kg/fed were 8.6 and 13% when compared with control in the two growing seasons, respectively. Cheema *et al* 2001 came to the same conclusion and they added that, the higher oil yield with increasing rate of phosphorus was probably due to higher seed yield (Table, 13).

Data of Table (16) show that there is no significant effect on oil yield of rape plant as a result of potassium fertilization or the interactions between the three studied factors. These results may be due to high available potassium in the experimental soil (Table,1). Similar conclusions were obtained by Horodyski and Pieczka 1970 who reported that oil yield of canola seed responses to potassium application depended upon the content of this element in the soil.

4-3-3- Effects on seed protein percentage:

Data in Table (17) show the effects of fertilizer treatments on protein percentage in seeds of canola plants in both seasons. Protein percentage significantly differed due to nitrogen fertilizer treatments, i.e 0, 25, 50 and 75 kg /fed in the first season only, but no clear trends could be observed in the second one . In the first season, the increasing percentages of protein percentage due to application of 25, 50 and 75 Kg N/fed were 3.3, 5.1 and 16.3% as compared with control, respectively. The present result clearly show the influence of nitrogen in increasing the nutritive value of canola seeds. This result is mainly due to the effect of nitrogen application on increasing nitrogen content in rapeseed (Table, 20). Also, this could be because nitrogen plays an important role in development of protoplasm, as an essential constituent of all proteins. Almost similar results were obtained by Satyavan *et al* 1999 and Brennan *et al* 2000.

The same data indicated that there is no significant effect on protein percent as a result of phosphorus and potassium application as well as the interactions between the three studied variables. Similar results were obtained by Mankotia *et al* 1994

Table (15) : Seed oil percentage as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1[st] Season 0	24	Mean	2[nd] Season 0	24	Mean
0	0	46.4	44.73	45.56	48.04	48.33	48.19
	45	45.33	45.23	45.28	48.53	48.46	48.50
Mean		45.86	44.98	45.42	48.28	48.40	48.35
25	0	45.35	44.55	44.95	46.12	50.38	48.26
	45	45.5	45.43	45.46	49.86	51.48	50.67
Mean		45.43	44.99	45.21	48.00	50.93	49.47
50	0	43.88	45.08	44.48	50.74	49.53	50.14
	45	44.95	45.18	45.06	51.13	50.61	50.87
Mean		44.41	45.13	44.77	50.93	50.08	50.51
75	0	43.8	44.05	43.93	51.52	51.91	51.71
	45	43.78	44.00	43.89	50.90	50.35	50.62
Mean		43.79	44.03	43.91	51.21	51.23	51.17
Mean P	0	44.86	44.60	44.73	49.10	50.04	49.57
	45	44.89	44.96	44.92	50.10	50.23	50.17
Mean K (C)		44.87	44.78	44.83	49.61	50.13	49.87
L.S.D. at 0.05 Level	A	N.S			1.95		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

who reported that potassium fertilization up to 100 kg K_2O/ha did not influence crude protein. On the other hand, Mekki 1990, in Egypt found that the highest protein content in rape plant were observed with application of N, P, K at 30 kg N+ 30 kg P_2O_2+ 24 Kg K_2O, 45 Kg N + 30 Kg P_2O_2 + 24 Kg K_2O or 45 Kg N + 24 Kg K_2O.

4-3-4- Effect on seed protein yield :

The results presented in Table (18) show the effect of nitrogen, phosphorus and potassium fertilization levels and the interactions between them on protein yield in kg per fed for canola plants. The data obtained indicate that increasing nitrogen level significantly increased protein yield in both seasons of experimentation. In the first season, applying nitrogen at rate of 25,50 and 75 kg/fed increased yield by 29.59 ,25.22 and 68.05 kg /fed, respectively when compared with control (unfertilized treatment). Wlile, in the second season, the respective nitrogen levels induced increases in protein yield by 11.42, 34.79 and 42.90 kg/fed. This result is mainly due to the effect of nitrogen application on increasing protein content in seeds (Table, 17) as well as seed yield (Table, 13). These results are in harmony with those obtained by Ramsey and Callinan 1994 and Patel and Thakur 1998.

Concerning, phosphorus fertilization, the statistical analysis of the experimental data showed that phosphorus application did not exert any significant effect on protein yield in Kg /fed in both seasons. However, a slightly increases in protein yield were observed due to increasing phosphorus level from zero to 45 Kg P_2O_5/fed in both seasons, but the different between

Table (16) : Seed oil yield (kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	174.5	120.4	147.5	65.7	98.9	82.3
	45	145.2	159.3	152.3	101.4	89.3	95.4
Mean		159.9	139.9	149.9	83.6	94.1	88.9
25	0	181.8	198.0	189.9	84.5	130.7	107.6
	45	266.4	235.2	250.8	159.6	122.2	140.9
Mean		224.1	216.6	220.4	122.1	126.5	124.3
50	0	242.1	254.2	248.2	202.2	147.9	175.1
	45	271.6	266.3	269.0	198.8	165.1	182.0
Mean		256.9	260.3	258.6	200.5	156.5	178.5
75	0	280.6	297.7	289.2	211.8	201.6	206.7
	45	273.7	281.1	277.4	231.7	224.1	227.9
Mean		277.2	289.4	283.3	221.8	212.9	217.4
Mean P	0	219.8	217.6	218.7	141.1	144.8	143.0
	45	239.2	235.5	237.4	172.9	150.2	161.6
Mean K (C)		229.5	226.5	228.0	156.9	147.4	152.2
L.S.D. at 0.05 Level	A	23.59			41.31		
	B	15.75			17.11		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

the two treatments was not great enough to reach the 5% level of significance.

Also, the same data in Table (18) show that protein yield did not affect by both potassium fertilization or the interactions effect of the possible combination for the three variables. Similar results were obtained by Mankotia *et al* 1994 who reported that seed protein of rape plant were not affected by fertility level of K.

4-4- Effect of fertilization programs on NPK components:

4-4-1- Effects on NPK concentrations:

4-4-1-1- Nitrogen concentration:

The average of nitrogen concentration in plant top of rapeseed estimated at 90 days after sowing, seeds and straw in relation to fertilization with nitrogen, phosphorus and potassium application are given in Tables (19, 20 and 21). It could be noticed from data that nitrogen concentration in canola plants at 90 days after sowing was significantly affected by nitrogen fertilization levels in both seasons. The highest mean value of nitrogen concentration (3%) was obtained under the highest nitrogen fertilization treatment, i.e. 75 kg N/fed, while the lowest mean value of nitrogen concentration (1.47%) was obtained in plants without nitrogen application. Also, nitrogen percentage in seeds was affected significantly by nitrogen application rate at the first season only. With increments in nitrogen percentage amounting to 3.9, 5.1 and 16.5% due to 25, 50 and 75 Kg applied N, respectively. These results are in accordance with those

Table (17) : Seed protein percentage as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	14.00	16.00	15.00	21.00	20.13	20.57
	45	17.00	16.50	16.75	20.50	21.00	20.75
Mean		15.50	16.25	15.88	20.75	20.57	20.66
25	0	16.88	17.67	17.28	20.25	21.38	20.82
	45	15.63	15.75	15.69	19.89	20.00	19.95
Mean		16.26	16.71	16.41	20.07	20.69	20.38
50	0	16.63	17.00	16.82	20.50	20.38	20.44
	45	16.50	16.63	16.57	20.89	21.00	20.95
Mean		16.57	16.82	16.69	20.700	20.69	20.69
75	0	18.50	18.88	18.69	20.25	19.75	20. 00
	45	18.50	18.00	18.25	17.50	19.38	18.44
Mean		18.50	18.44	18.47	18.88	19.57	19.22
Mean P	0	16.50	17.39	16.95	20.50	20.41	20.46
	45	16.91	16.72	16.82	19.70	20.35	20.03
Mean K (C)		16.71	17.05	16.88	20.10	20.38	20.24
L.S.D. at 0.05 Level	A	1.103			N.S		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

obtained by Sheppared and Bates (1980) who stated that nitrogen content in leaves of rape plant increased with further increament of nitrogen fertilization. On the other hand, data obtained show that nitrogen concentration in canola straw was not affected by nitrogen fertilizer levels in both growing seasons.

With regard to phosphorus and potassium fertilization as well as the interactions between the three studied variables, the data obtained in the abovementioned Tables clearly show that nitrogen percentage in rape plant estimated at 90 days after sowing, seeds and straw did not affect by neither phosphorous nor potassium fertilization in both growing seasons. Also, all the interactions between nitrogen, phosphorus and potassium not show any significant effect on nitrogen content in rape plant organs at both growing seasons. These results are in harmony with those obtained by Racz et al 1965 who stated that addition of phosphorus had no effect on nitrogen content in rape straw.

4-4-1-2- Phosphorus concentration:

Data in Tables (22, 23 and 24) indicate the response of phosphorus concentration in canola plant at 90 days after sowing, seed and straw to different levels of nitrogen, phosphorus and potassium fertilizers and their interactions. Increasing nitrogen fertilization rate up to 75 kg N/fed significantly increased phosphorus percentage in rapeseed plant estimated at 90^{th} days after sowing in the second season only, where the highest averages of phosphorus content were recorded in tops of plants that received 75kgN/fed, while plants without nitrogen fertilization exerted the lowest average of phosphorus concentration. Phosphorus content in seeds was not affected by

Table (18) : Seed protein yield (kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	51.33	36.66	44.00	28.52	40.60	34.56
	45	52.86	60.11	56.49	42.82	38.30	40.56
Mean		52.10	48.39	50.25	35.67	39.45	37.56
25	0	67.22	78.96	73.09	34.46	52.53	43.50
	45	91.49	81.66	86.58	61.45	47.47	54.46
Mean		79.36	80.31	79.84	47.96	50.00	48.98
50	0	92.17	95.05	93.61	81.00	60.28	70.64
	45	124.05	98.58	111.32	80.38	67.74	74.06
Mean		108.11	96.82	102.47	80.69	64.01	72.35
75	0	118.06	125.96	122.01	81.16	76.29	78.73
	45	112.72	116.45	114.59	79.43	84.92	82.18
Mean		115.39	121.21	118.30	80.30	80.61	80.46
Mean P	0	82.20	84.16	83.18	56.29	57.43	56.86
	45	95.28	89.2	92.24	66.02	59.61	62.82
Mean K (C)		88.74	86.68	87.71	61.15	58.52	59.84
L.S.D. at 0.05 Level	A	17.74			14.88		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (19) : N percentage in plant after 90 days from sowing as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[st] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	1.50	1.38	1.44	1.38	1.50	1.44
	45	1.50	1.48	1.49	1.74	1.34	1.54
Mean		1.50	1.43	1.47	1.56	1.42	1.49
25	0	2.74	2.34	2.54	1.76	1.96	1.86
	45	2.38	2.66	2.52	1.84	1.66	1.75
Mean		2.56	2.50	2.53	1.80	1.81	1.81
50	0	2.72	2.80	2.76	2.54	2.54	2.54
	45	2.84	2.68	2.76	2.58	2.72	2.65
Mean		2.78	2.74	2.76	2.56	2.63	2.60
75	0	2.82	2.92	2.87	2.66	2.50	2.58
	45	3.02	3.22	3.12	2.60	2.46	2.53
Mean		2.92	2.07	3.00	2.63	2.48	2.56
Mean P	0	2.45	2.36	2.41	2.09	2.13	2.11
	45	2.44	2.51	2.48	2.19	2.05	2.12
Mean K (C)		2.44	2.44	2.44	2.14	2.09	2.12
L.S.D. at 0.05 Level	A	0.30			0.21		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (20) : N percentage in seeds as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[st] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	2.24	2.56	2.40	3.36	3.22	3.29
	45	2.72	2.64	2.68	3.28	3.36	3.32
Mean		2.48	2.60	2.54	3.32	3.29	3.31
25	0	2.70	2.83	2.77	3.24	3.42	3.33
	45	2.50	2.52	2.51	3.18	3.20	3.19
Mean		2.60	2.68	2.64	3.21	3.31	3.26
50	0	2.66	2.72	2.69	3.28	3.26	3.27
	45	2.64	2.66	2.65	3.34	3.36	3.35
Mean		2.65	2.69	2.67	3.31	3.31	3.31
75	0	2.96	3.02	2.99	3.24	3.16	3.20
	45	2.96	2.88	2.92	2.80	3.10	3.95
Mean		2.96	2.95	2.96	3.02	3.13	3.08
Mean P	0	2.64	2.78	2.71	3.28	3.27	3.28
	45	2.71	2.68	2.70	3.15	3.26	3.21
Mean K (C)		2.67	2.73	2.70	3.22	3.26	3.24
L.S.D. at 0.05 Level	A	0.174			N.S		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

nitrogen fertilization in both growing seasons. Whereas, phosphorus percentage in straw was significantly affected by nitrogen application in the second season only, where the first nitrogen fertilizer level of 25 kg/fed increased phosphorus content in canola straw, which decreased as the nitrogen fertilizer rate increased up to These results are in a good agreement with those obtained by Holmes and Ainsley 1977 who stated that addition of nitrogen to rapeseed plant tends to decrease phosphorus content.

Concerning phosphorus fertilization, the same data reveal that phosphorus percentage in the different studied canola plant organs, i.e. top plant at 90 days after sowing, seeds and straw were significantly increased due to phosphorus addition at rate of 45kg P_2O_5 /fed in both seasons, with exception of phosphorus percentage in seeds and straw in the first season, which did not affect by phosphorus fertilization. These results are in coincide with those obtained by Sheppard and Bates 1980 and EL-Zeky 1999.

The same data in the aforementioned Tables clearly show that phosphorus percentage in the different organs of rapeseed plant did not affect by potassium fertilization, except of the phosphorus content in plant at 90 days after planting in the first season only which significantly decreased due to addition of 24 kg K2O/fed. Similar results were obtained by Mekki 1990 and Bullock and Sawyer 1991 who reported that it is no effect of potassium fertilization treatments on phosphorus percentages of rape plant.

Table (21) : N percentage in straw as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1st Season			2nd Season		
		0	24	Mean	0	24	Mean
0	0	0.14	0.34	0.24	0.62	0.58	0.60
	45	0.32	0.24	0.28	0.60	0.52	0.56
Mean		0.23	0.29	0.26	0.61	0.55	0.58
25	0	0.36	0.24	0.30	0.70	0.50	0.60
	45	0.20	0.28	0.24	0.42	0.48	0.45
Mean		0.28	0.26	0.27	0.56	0.49	0.53
50	0	0.32	0.34	0.33	0.72	0.42	0.57
	45	0.36	0.30	0.33	0.66	0.60	0.63
Mean		0.34	0.32	0.33	0.69	0.51	0.60
75	0	0.40	0.30	0.35	0.62	0.68	0.65
	45	0.32	0.92	0.62	0.48	0.44	0.46
Mean		0.36	0.61	0.49	0.55	0.56	0.56
Mean P	0	0.31	0.31	0.31	0.67	0.55	0.61
	45	0.30	0.44	0.37	0.54	0.51	0.53
Mean K (C)		0.30	0.37	0.34	0.60	0.53	0.57
L.S.D. at 0.05 Level	A	N.S			N.S		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (22) : P percentage in plant after 90 days from sowing as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed.)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	0.48	0.49	0.49	0.23	0.24	0.24
	45	0.56	0.51	0.54	0.36	0.30	0.33
Mean		0.52	0.50	0.51	0.30	0.27	0.29
25	0	0.62	0.41	0.52	0.29	0.25	0.27
	45	0.51	0.49	0.50	0.34	0.30	0.32
Mean		0.57	0.45	0.51	0.32	0.28	0.30
50	0	0.53	0.55	0.54	0.26	0.33	0.30
	45	0.56	0.60	0.58	0.38	0.36	0.37
Mean		0.55	0.58	0.56	0.32	0.35	0.34
75	0	0.48	0.39	0.44	0.33	0.26	0.30
	45	0.65	0.45	0.55	0.38	0.36	0.37
Mean		0.57	0.42	0.50	0.36	0.31	0.34
Mean P	0	0.53	0.46	0.50	0.28	0.27	0.28
	45	0.57	0.51	0.54	0.37	0.33	0.35
Mean K (C)		0.55	0.49	0.52	0.32	0.30	.031
L.S.D. at 0.05 Level	A	N.S			0.042		
	B	0.058			0.030		
	C	0.058			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (23) : P percentage in seeds as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed.) 1st Season 0	1st Season 24	1st Season Mean	2nd Season 0	2nd Season 24	2nd Season Mean
0	0	0.96	1.06	1.01	0.80	0.73	0.77
	45	1.06	1.01	1.04	0.86	0.91	0.89
Mean		1.01	1.04	1.02	0.83	0.82	0.83
25	0	0.89	0.92	0.91	0.86	0.77	0.82
	45	0.81	0.94	0.88	0.90	0.85	0.88
Mean		0.85	0.93	0.89	0.88	0.81	0.85
50	0	0.90	0.92	0.91	0.64	0.80	0.72
	45	0.87	0.82	0.85	0.86	0.79	0.83
Mean		0.89	0.87	0.88	0.75	0.800	0.78
75	0	0.97	0.92	0.95	0.70	0.77	0.74
	45	0.94	0.91	0.93	0.84	0.79	0.82
Mean		0.96	0.92	0.94	0.77	0.78	0.78
Mean P	0	0.93	0.96	0.95	0.75	0.77	0.76
	45	0.92	0.92	0.92	0.87	0.84	0.86
Mean K (C)		0.93	0.94	0.94	0.81	0.80	0.81
L.S.D. at 0.05 Level	A	N.S			N.S		
	B	N.S			0.06		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

4-4-1-3- Potassium concentration:

The influence of nitrogen, phosphorus and potassium fertilization and their interactions on potassium concentration in canola plant tops after 90 days from sowing, seeds and straw is presented in Tables (25,26 and 27). The obtained data show that potassium percentage in top plant at 90 days after planting was significantly affected by nitrogen application in both seasons. The mean values of potassium concentration were 1.96, 2.45, 255 and 2.55% in the first season under 0, 25, 50 and 75 kg N/ fed, respectively, while it were 1.97, 2.52 , 2.68 and 2.68% in the second one in the same respect. It could be noticed that potassium concentration in top plant at 90 days after sowing increased as increasing nitrogen fertilizer level up to 50 kg/fed, then addition of more nitrogen did not influence potassium concentration in both seasons. Also, nitrogen application was not significantly affected by potassium content in canola seeds in the second season only, where increasing nitrogen fertilization levels decreased potassium concentration in seeds. Similar results were obtained by Sheppard and Bates 1980 concluded stated that increasing soil nitrogen level trends todecreased potassium content in rapeseed leaves. They attributed that tend to nitrogen fertilization which suppresses the absorption of potassium, an inducing K deficiency particularly at high rates of application nitrogen. However, the data obtained show that potassium percentage in the straw of canola plant was affected significantly by nitrogen application in both seasons.

Regarding phosphorus and potassium fertilization and the interactions between these nutrients, the data obtained for potassium concentration in rapeseed plant after 90 days from sowing, reveal that plants seed and straw did not respond significantly to any of the studied treatments. These results are in cope with those obtained by Sheppard and Bates 1980 and EL-Zeky 1999 for the effect of phosphorus fertilization on potassium percentage. Only potassium percentage in canola plant after 90 days from sowing significantly increased by application of 24 Kg K_2O/fed in the second season only.

4-4-2- Effects on NPK uptake:

4-4-2-1- Nitrogen uptake:

The effects of nitrogen, phosphorus and potassium fertilization and their interactions on nitrogen uptake by seeds and straw of rape plant as well as total uptake (seed nitrogen uptake + straw nitrogen uptake) are presented in Tables (28 , 29 and 30). Data reveal a significant positive relationship between nitrogen fertilizer levels and nitrogen uptake by seeds and/ or straw in the two studied seasons. The mean values of total nitrogen uptake were 11.49, 18.43, 24.61 and 27.06 under 0, 25, 50 and 75 kg N/fed in the first season, corresponding to 13.55, 17.23, 26.29 and 27.78 kg/fed in the second season under the above mentioned four nitrogen fertilizer levels, respectively. The same trend was obtained for nitrogen uptake by canola seeds or straw. This increment may be due to the effect of nitrogen application on both seed and straw yield (Tables 13 and 14) as well as the effect on nitrogen percentage in seeds and straw (Tables 20 and 21), since the uptake is derived from both variables. These results are in accordance with those obtained by

Table (24) : P percentage in straw as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed.) 1[St] Season 0	24	Mean	2[nd] Season 0	24	Mean
0	0	0.21	0.26	0.24	0.12	0.08	0.10
	45	0.27	0.29	0.28	0.15	0.16	0.16
Mean		0.24	0.28	0.26	0.14	0.12	0.13
25	0	0.35	0.31	0.33	0.13	0.14	0.14
	45	0.32	0.27	0.30	0.14	0.13	0.14
Mean		0.34	0.29	0.32	0.14	0.14	0.14
50	0	0.39	0.28	0.34	0.08	0.07	0.08
	45	0.29	0.30	0.30	0.14	0.09	0.12
Mean		0.34	0.29	0.32	0.11	0.08	0.10
75	0	0.29	0.24	0.27	0.05	0.04	0.05
	45	0.25	0.24	0.25	0.09	0.09	0.09
Mean		0.27	0.24	0.26	0.07	0.07	0.07
Mean P	0	0.31	0.27	0.29	0.10	0.08	0.09
	45	0.28	0.28	0.28	0.13	0.12	0. 13
Mean K (C)		0.30	0.27	0.29	0.11	0.10	0.11
L.S.D. at 0.05 Level	A	N.S			0.03		
	B	N.S			0.02		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (25) : K percentage in plant after 90 days from sowing as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	1.97	1.96	1.97	1.82	1.99	1.91
	45	1.90	1.98	1.94	1.96	2.08	2.02
Mean		1.94	1.97	1.96	1.89	2.04	1.97
25	0	2.48	2.50	2.49	2.46	2.62	2.54
	45	2.43	2.47	2.41	2.44	2.55	2.50
Mean		2.41	2.49	2.45	2.45	2.59	2.52
50	0	2.60	2.70	2.65	2.68	2.75	2.72
	45	2.47	2.43	2.45	2.62	2.65	2.64
Mean		2.54	2.57	2.55	2.65	2.70	2.68
75	0	2.55	2.54	2.55	2.64	2.70	2.67
	45	2.45	2.64	2.55	2.53	2.84	2.69
Mean		2.50	2.59	2.55	2.59	2.77	2.68
Mean P	0	2.40	2.43	2.42	2.40	2.52	2.46
	45	2.29	2.38	2.34	2.39	2.53	2.46
Mean K (C)		2.35	2.40	2.38	2.39	2.52	2.46
L.S.D. at 0.05 Level	A	0.13			0.17		
	B	N.S			N.S		
	C	N.S			0.12		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (26) : K percentage in seeds as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	1.03	1.07	1.05	1.10	0.95	1.03
	45	0.97	0.99	0.98	0.98	1.02	1.00
Mean		1.00	1.03	1.02	1.04	0.99	1.02
25	0	1.03	0.98	1.01	0.98	1.10	1.04
	45	1.06	0.98	1.02	0.93	0.96	0.95
Mean		1.05	0.98	1.02	0.96	1.03	1.00
50	0	0.97	0.99	0.98	0.99	0.92	0.96
	45	0.99	1.03	1.01	0.92	0.95	0.94
Mean		0.98	1.01	1.00	0.96	0.94	0.95
75	0	1.01	1.01	0.94	0.88	0.95	0.92
	45	0.97	0.86	0.95	0.84	0.96	0.90
Mean		0.99	0.92	0.94	0.86	0.96	0.91
Mean P	0	1.01	0.89	1.00	0.99	0.98	0.99
	45	1.00	0.98	0.99	0.92	0.97	0.95
Mean K (C)		1.00	0.98	0.99	0.95	0.98	0.97
L.S.D. at 0.05 Level	A	N.S			0.07		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Mekki 1990, Singh *et al* 1998, Thakur and Chand 1998 and Satyavan *et al* 1999.

In general, the data obtained reveal significant effects of phosphorus and potassium fertilization levels and the interaction between the three studied fertilizer treatments on seed and straw as well as total nitrogen uptake in both growing seasons, except the effect of potassium fertilization on straw nitrogen uptake in the second season only, which decreased from 12.56 to 10.58 kg N /fed in the second season by application of 24 Kg K_2O per fed.

4-4-2-2- Phosphorus uptake:

The averages phosphorus uptake by seed and / or straw in kg /fed as affected by nitrogen, phosphorus and potassium application as well as their interactions are given in Tables (31, 32 and 33). Significant differences were observed between nitrogen application and the studied phosphorus uptake in the two growing seasons. Increasing nitrogen fertilization level up to 75 kg/fed increased seed phosphorus uptake in both seasons and total uptake in the second season only. While, phosphorus uptake by rape plant straw as well as total uptake in the first season increased as increasing nitrogen level up to 50 kg/fed, and further increases in nitrogen fertilizer caused a insignificant decrease in phosphorus uptake (Tables 32 and 33). The mean values of total phosphorus uptake were 6.63, 10.95, 13.08 and 12.22 under 0, 25, 50 and 75 kg N/fed in the first season, respectively. The same trend was observed in the second one. Similar results were obtained by Singh et al 1998, Thakur and Chand 1998 and Mishra and Kurchania 1999 who reported that phosphorus uptake increased with increasing nitrogen rate.

Table (27) : K percentage in straw as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[st] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	1.52	1.57	1.55	1.86	1.91	1.89
	45	1.81	1.52	1.67	1.99	1.73	1.86
Mean		1.67	1.55	1.61	1.93	1.82	1.88
25	0	1.75	1.58	1.67	2.06	1.69	1.88
	45	1.56	1.51	1.54	1.86	1.81	1.84
Mean		1.66	1.55	1.61	1.96	1.75	1.86
50	0	1.61	1.73	1.67	1.77	1.89	1.83
	45	1.70	1.57	1.64	1.88	1.81	1.85
Mean		1.66	1.65	1.66	1.83	1.85	1.84
75	0	1.86	1.66	1.76	1.59	1.78	1.69
	45	1.58	1.77	1.68	1.83	1.90	1.87
Mean		1.72	1.72	1.72	1.71	1.84	1.78
Mean P	0	1.69	1.63	1.66	1.82	1.82	1.82
	45	1.66	1.59	1.63	1.88	1.81	1.85
Mean K (C)		1.6	1.61	1.64	1.86	1.82	1.84
L.S.D. at 0.05 Level	A	N.S			N.S		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (28) : Seed nitrogen uptake (kg/fed) as affected by N, P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed.)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	8.38	6.78	7.58	4.57	6.57	5.57
	45	8.62	9.37	9.00	6.77	6.13	6.45
Mean		8.5	8.08	8.29	5.67	6.35	6.01
25	0	10.76	12.57	11.67	5.79	8.58	7.19
	45	14.62	13.09	13.86	10.02	7.61	8.82
Mean		12.69	12.83	12.76	7.91	8.10	8.00
50	0	14.57	15.29	14.93	12.91	9.57	11.25
	45	19.79	15.68	17.74	12.92	10.98	11.95
Mean		17.18	15.49	16.33	12.915	10.28	11.60
75	0	18.92	20.35	19.64	13.12	12.28	12.70
	45	18.47	18.53	18.5	12.69	13.74	13.22
Mean		18.70	19.44	19.07	12.91	13.01	12.96
Mean P	0	13.16	13.75	13.45	9.10	9.25	9.18
	45	15.38	14.17	14.77	10.60	9.62	10.11
Mean K (C)		14.27	13.96	14.11	9.85	9.43	9.64
L.S.D. at 0.05 Level	A	2.84			2.38		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (29) : Straw nitrogen uptake (kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	1st Season 24	1st Season Mean	2nd Season 0	2nd Season 24	2nd Season Mean
0	0	2.15	3.36	2.76	7.11	8.25	7.68
	45	4.10	3.20	3.65	7.74	7.06	7.40
Mean		3.13	3.28	3.20	7.43	7.66	7.54
25	0	6.57	4.06	5.32	9.59	9.07	9.33
	45	5.29	6.74	6.02	8.93	9.32	9.13
Mean		5.93	5.40	5.67	9.26	9.20	9.23
50	0	6.83	8.34	7.59	18.27	9.02	13.65
	45	11.18	6.74	8.96	17.32	14.16	15.74
Mean		9.01	7.54	8.27	17.80	11.59	14.69
75	0	10.43	7.05	8.74	18.10	15.98	17.04
	45	5.97	8.51	7.24	13.41	11.80	12.61
Mean		8.20	7.78	7.99	15.76	13.89	14.82
Mean P	0	6.50	5.70	6.10	13.27	10.58	11.92
	45	6.64	6.30	6.46	11.85	10.59	11.22
Mean K (C)		6.57	6.00	6.28	12.56	10.58	11.57
L.S.D. at 0.05 Level	A	2.48			2.51		
	B	N.S			N.S		
	C	N.S			1.77		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

With regard to phosphorus fertilization, data obtained clearly show that seeds and /or straw uptake in kg/fed significantly affected by phosphorus application in the second season only. The increasing percentage due to applied 45 kg P_2O_5 were 28.48, 59.05 and 41.61% for seed, straw and total uptake, respectively in the second season when compared with control. These results are in harmony with those obtained by Rana and Angier 1995 and Sumeriya *et al* 2000 who stated that increasing phosphorus application levels increased phosphorus uptake by oilseed rape plant.

On the other hand, data reveal that phosphorus uptake by seeds or straw and the total uptake of both components were not significantly affected by potassium fertilization or by the interactions between the three studied in both seasons.

4-4-2-3- Potassium uptake:

Tables (34, 35 and 36) show the effect of nitrogen, phosphorus and potassium application and their interactions on potassium uptake by seeds and straw as well as total uptake (seed + straw uptake) for rapeseed plant. The effect of nitrogen application on potassium uptake by canola plant seeds and straw as well as total uptake was found to be significant in both seasons. It could be noticed that increasing nitrogen rate up to 75 kg/fed increased seed and / or straw uptake in both seasons, but the difference between application of 50 and 75 kg N/fed was not significant. The increments percentage of total potassium uptake due to applying 25, 50 and 75 kg N/fed were 63.15, 97.87 and 101.77% in the first season corresponding to 36.64, 81.76 and 95.84 or the second season, respectively. These results are in

Table (30) : Total nitrogen uptake (kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	10.53	10.14	10.34	11.68	14.82	13.25
	45	12.72	12.57	12.65	14.51	13.19	13.85
Mean		11.63	11.36	11.49	13.10	14.01	13.55
25	0	17.33	16.63	16.98	15.38	17.65	16.52
	45	19.91	19.83	19.87	18.95	16.93	17.94
Mean		18.62	18.23	18.43	17.17	17.29	17.23
50	0	21.40	23.63	22.52	31.19	18.59	24.89
	45	30.97	22.42	26.70	30.23	25.14	27.69
Mean		26.19	23.03	24.61	30.71	21.87	26.29
75	0	29.35	27.40	28.38	31.22	28.26	29.74
	45	24.44	27.04	25.74	26.10	25.54	25.82
Mean		26.90	27.22	27.06	28.66	26.90	27.78
Mean P	0	19.65	19.45	19.55	22.37	19.83	21.1
	45	22.01	20.47	21.24	22.45	20.20	21.32
Mean K (C)		20.83	19.96	20.40	20.04	20.02	20.03
L.S.D. at 0.05 Level	A	4.81			3.94		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (31) : Seed phosphorus uptake(kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	3.95	2.81	3.20	1.09	1.49	1.29
	45	3.37	3.57	3.47	1.78	1.66	1.72
Mean		3.48	3.19	3.34	1.44	1.58	1.51
25	0	3.56	4.10	3.83	1.54	1.93	174
	45	4.76	4.88	4.82	2.84	2.02	2.43
Mean		4.16	4.49	4.33	2.19	1.98	2.08
50	0	4.95	5.17	5.06	2.52	2.35	2.44
	45	6.48	4.81	5.65	3.32	2.58	2.95
Mean		5.72	4.99	5.35	2.92	2.47	2.69
75	0	6.19	6.2	6.20	2.83	2.99	2.91
	45	5.89	5.85	5.87	3.81	3.50	3.66
Mean		6.04	6.03	6.03	3.32	3.25	3.28
Mean P	0	4.57	4.57	4.57	2.00	2.19	2.09
	45	5.13	4.78	4.95	2. 94	2.44	2.69
Mean K (C)		4.85	4.67	4.76	2.47	2.32	2.39
L.S.D. at 0.05 Level	A	1.00			0.62		
	B	N.S			0.44		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (32) : Straw phosphorus uptake(kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed)					
		1[St] Season			2[nd] Season		
		0	24	Mean	0	24	Mean
0	0	3.28	2.55	2.92	1.38	1.14	1.26
	45	3.46	3.87	3.67	1.94	2.17	2.06
Mean		3.37	3.21	3.29	1.66	1.66	1.66
25	0	6.33	5.24	5.79	1.78	2.54	2.16
	45	8.33	6.57	7.45	2.98	2.52	2.75
Mean		7.33	5.91	6.62	2.38	2.53	2.46
50	0	8.28	6.79	7.54	2.03	1.50	1.77
	45	9.00	6.81	7.91	3.67	2.12	2.90
Mean		8.64	6.80	7.72	2.85	1.81	2.33
75	0	7.48	5.52	6.5	1.46	0.94	1.2
	45	4.67	7.05	5.86	2.51	2.41	2.46
Mean		6.08	6.29	6.18	1.99	1.68	1.83
Mean P	0	6.34	5.03	5.68	1.66	1.53	1.60
	45	6.37	6.08	6.22	2.78	2.31	2.54
Mean K (C)		6.35	5.55	5.95	2.22	1.92	2.07
L.S.D. at 0.05 Level	A	2.03			N.S		
	B	N.S			0.52		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

line with those obtained by Singh *et al* 1998 and Mishra and Kurchania 1999.

Concerning the effect of phosphorus fertilization , data obtained show that potassium uptake by rape straw was significantly affected by phosphorus fertilization in the second season only. Application of 45 kg P_2O_5/fed increased straw potassium uptake by 13.07% in the second season. Phosphorus application have a slightly increase in seeds and total uptake, but the difference between 0 and 45 kg P_2O_5 was not great enough to reach the 5% level of significance. These results are in agreement with those gained by Jain *et al* 1995, Kumar 1995 and EL-Zeky 1999.

On the other hand, potassium fertilization could not significantly affect K up take in seed; straw or whole plants in both growing seasons. These could be explained by a relatively high native potassium supplying power in the experimental soil that could be enough for plant requirements,. Also the interactions between the three studied variables did not effect potassium uptake by plant seed and /or straw in the two seasons.

Table (33) : Total phosphorus uptake(kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1[St] Season 0	24	Mean	2[nd] Season 0	24	Mean
0	0	6.87	5.36	6.12	2.47	2.63	2.55
	45	6.83	7.44	7.14	3.72	3.83	3.78
Mean		6.85	6.40	6.63	3.10	3.23	3.17
25	0	9.89	9.34	9.62	3.32	4.47	3.90
	45	13.09	11.45	12.27	5.82	4.54	5.18
Mean		11.49	10.40	10.95	4.57	4.51	4.54
50	0	13.23	11.96	12.60	4.55	3.85	4.20
	45	15.48	11.62	13.55	6.99	4.70	8.85
Mean		14.36	11.97	13.08	5.77	4.28	5.03
75	0	13.67	11.72	17.70	4.29	3.93	4.11
	45	10.56	12.90	11.73	6.32	5.91	6.12
Mean		12.12	12.31	12.22	5.31	4.92	5.12
Mean P	0	10.92	9.60	10.26	3.66	3.72	3.69
	45	11.49	10.85	11.17	5.71	4.75	5.23
Mean K (C)		11.20	10.22	10.71	4.69	4.23	4.43
L.S.D. at 0.05 Level	A	2.62			1.09		
	B	N.S			0.77		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (34) : Seed potassium uptake(kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	3.85	2.84	3.35	1.50	1.94	1.72
	45	3.08	3.51	3.30	2.02	1.86	1.94
Mean		3.47	3.18	3.32	1.76	1.90	1.83
25	0	4.09	4.37	4.23	1.75	2.76	2.26
	45	6.20	5.09	5.65	2.93	2.28	2.61
Mean		5.15	4.73	4.94	2.34	2.52	2.43
50	0	5.30	5.55	5.43	3.90	2.70	3.30
	45	7.44	6.08	6.76	3.55	3.11	3.33
Mean		6.37	5.82	6.09	3.73	2.91	3.32
75	0	6.46	5.79	6.13	3.56	3.69	3.63
	45	6.04	5.93	5.99	3.81	4.25	4.03
Mean		6.25	5.86	6.06	3.69	3.97	3.83
Mean P	0	4.93	4.64	4.78	2.68	2.77	2.73
	45	5.69	5.15	5.42	3.08	2.88	2.98
Mean K (C)		5.31	4.94	5.10	2.88	2.82	2.85
L.S.D. at 0.05 Level	A	1.08			0.67		
	B	N.S			N.S		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		

Table (35) :Straw potassium uptake(kg/fed) as affected by N,P and K fertilization levels.

N(A) (kg N/fed)	P(B) (kg P_2O_5/fed)	K (K_2O kg/fed) 1st Season 0	24	Mean	2nd Season 0	24	Mean
0	0	23.38	15.47	19.43	21.33	27.18	24.26
	45	23.10	20.28	21.69	25.67	23.49	24.58
Mean		23.24	17.88	20.56	23.50	25.34	24.42
25	0	31.92	26.67	29.30	28.22	30.66	29.44
	45	41.25	36.24	38.75	39.54	35.13	37.34
Mean		36.59	31.46	34.02	33.88	32.90	33.39
50	0	34.31	42.47	38.39	44.92	40.60	42.76
	45	52.69	35.15	43.92	49.33	42.72	46.03
Mean		43.5	38.81	41.16	47.13	41.66	44.39
75	0	48.49	38.89	43.69	46.43	41.83	44.13
	45	29.43	51.68	40.56	51.11	50.94	51.03
Mean		38.96	45.29	42.12	48.77	46.39	47.58
Mean P	0	34.53	30.88	32.70	35.23	35.07	35.15
	45	36.62	35.84	36.23	41.41	38.07	39.74
Mean K (C)		35.57	33.36	34.47	38.32	36.57	37.44
L.S.D. at 0.05 Level	A	7.82			6.84		
	B	N.S			4.83		
	C	N.S			N.S		
	AxB	N.S			N.S		
	AxC	N.S			N.S		
	BxC	N.S			N.S		
	AxBxC	N.S			N.S		