RESULTS AND DISCUSSION

I-SOURCE CAPACITY :

1- Growth and growth analysis:

A- Effect of years :

The characters studied for growth of soybean plants were plant height, number of branches/plant, number of leaves/ plant, number of pods/plant, dry weight of pods/plant, dry weight of leaves/plant, dry weight of stems/plant, leaf area/plant and leaf area index/plant at 54, 82 and 110 days after sowing.

The results of the combined analysis of 1988 and 1989 seasons are shown in Table (4). The results indicated that, number of leaves/plant, dry weight of pods/plant, leaf area/ plant and leaf area index at 54 days after sowing, plant height, number of branches/plant, number of leaves/plant, dry weight of pods/plant, dry weight of leaves/plant, leaf area/ plant and leaf area index at 82 days after sowing, plant height, number of leaves/plant, number of pods/plant, dry weight of pods leaves and stems/plant, leaf area/plant and leaf area index at 110 days after sowing time were significantly affected due to years. On the other hand the differences between the averages of plant height, dry weight of leaves/ plant at 54 days after sowing, number of pods/plant and dry weight of stems/plant at 54 and 82 days after sowing, number of branches/plant at 54 and 110 days after sowing were not significant level at 5%.

able (4): The average values of growth characters of soybean plants as affected by years at 54, 82 and 110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / years	Plant height "Cm"	Number of branches/ plant	Number of leaves/plant	Number of pods/plant	Dry weight of different parts "g"			Leaf area/ plant "Cm²"	Leaf area index "cm²/cm²"
					pods/plant	Leaves/plant	Stems/plant		
				54 days after sowing time					
1988	38.92 a	1.84 a	12.78 a	21.13 a	1.70 a	5.08 a	2.17 a	913.30 a	3.044 a
1989	40.18 a	1.88 a	11.21 b	20.39 a	1.29 b	4.47 a	2.35 a	721.17 b	2.404 b
				82 days after sowing time					
1988	50.34 b	2.24 b	20.70 a	52.90 a	17.25 a	11.76 a	5.74 a	1848.34 a	6.161 a
1989	58.14 a	2.56 a	18.48 b	52.16 a	11.57 b	9.02 b	5.99 a	1294.58 b	4.316 b
				110 days after sowing time					
1988	56.03 b	2.75 a	18.83 a	67.13 a	38.61 a	12.35 a	8.88 a	1685.10 a	5.617 a
1989	68.54 a	2.58 a	14.24 b	58.39 b	28.87 b	9.66 b	7.82 b	1392.72 b	4.642 b

The highest values of number of leaves/plant, dry weight of pods/plant, leaf area/plant and leaf area index, were obtained in the first season at 82 days after sowing time, whereas the minimum ones were obtained after 82 days from sowing time in the second season. The data, recorded in Table (4) show that the highest values of number of branches and pods/plant, dry weight of pods, leaves and stems/plant were obtained in the first season at 110 days after sowing. The highest average of plant height was obtained in the second season at 110 days after sowing. The lowest values of plant height and number of branches/plant at 1988 season, whereas the number of pods/plant and dry weight of leaves/plant at 1989 season were obtained at early sampling i.e. 54 days after sowing time.

B- Effect of sowing dates :

The mean values of growth parameters of soybean plant of the combined analysis over two years are presented in Table (5). The differences between the mean values of plant height, number of branches/plant, number of leaves/plant, number of pods/plant, dry weight of pods/plant, dry weight of leaves/ plant, dry weight of stems/plant, leaf area/plant and leaf area index were significantly affected by sowing dates and this hold true at 54, 82 and 110 days after sowing time. On the other hand, the number of branches/plant and dry weight of stems/plant were not significantly affected by sowing dates at 82 days after sowing time.

Table (5): The average values of growth measurements of soybean plants as affected by sowing dates at 54, 82 and 110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / Sowing dates	Plant height "Cm"	Number of branches/ plant	Number of leaves/plant	Number of pods/plant	Dry weight of different parts "g" pods/plant	Leaves/plant	Stems/plant	Leaf area/ plant "Cm^2"	Leaf area index "cm^2/cm^2"
				54 days after sowing time					
Early	39.95 b	1.87 a	10.31 c	15.61 c	0.91 c	3.76 c	1.69 c	661.56 c	2.205 c
Medium	41.55 b	2.18 a	11.71 b	22.53 b	1.30 b	5.02 b	2.25 b	858.88 b	2.863 b
Late	32.99 c	1.46 b	10.85 bc	17.20 c	0.92 c	3.68 c	1.67 c	617.99 c	2.060 c
Very late	43.73 a	1.94 a	15.11 a	30.47 a	2.86 a	6.63 a	3.43 a	1130.53 a	3.768 a
F-test Dxy	**	*	*	N.S	N.S	**	N.S	N.S	**
				82 days after sowing time					
Early	57.92 a	2.45 a	21.27 a	47.99 b	8.95 b	9.93 b	6.12 a	1507.43 b	5.026 b
Medium	58.63 a	2.16 a	19.17 b	51.01 b	10.61 b	10.13 b	6.30 a	1510.51 b	5.035 b
Late	47.82 c	2.38 a	19.94 ab	59.72 a	19.23 a	11.51 a	5.57 a	1865.20 a	6.217 a
Very late	52.59 b	2.62 a	17.98 b	51.38 b	18.85 a	10.00 b	5.47 a	1402.70 b	4.676 b
F-test Dxy	N.S	N.S	N.S	N.S	**	N.S	*	**	**
				110 days after sowing time					
Early	63.94 ab	2.21 c	16.62 b	60.36 b	27.78 c	12.42 a	9.02 a	1671.43 a	5.571 a
Medium	66.66 a	3.24 a	19.24 a	69.94 a	41.28 a	12.76 a	9.59 a	1796.81 a	5.989 a
Late	53.68 c	2.43 c	16.29 b	57.34 b	34.56 b	9.23 b	6.38 c	1332.39 b	4.441 b
Very late	62.51 b	2.73 b	11.96 c	61.16 b	29.95 c	7.66 c	7.48 b	1113.84 c	3.713 c
F-test Dxy	**	N.S	**	N.S	**	**	N.S	**	**

* and ** significant at 0.05 and 0.01 levels of probability respectively.

After 54 days from sowing, the highest values of plant height, number of leaves and pods/plant, dry weight of pods, leaves and stems/plant, leaf area/plant and leaf area index were 43.73 "cm", 15.11, 30.47, 2.86 "g", 6.63 "g", 3.43 "g", 1130.53 "cm^2" and 3.768 "cm^2/cm^2", respectively, resulted from sowing soybean in mid-June time (i.e. very late sowing date).

After 82 and 110 days from sowing, the plant height of soybean significantly decreased by 18.4% and 10.3% in late sowing date and 19.50% and 6.2% for sowing soybean in very late sowing dates, respectively, when compared with the medium sowing date.

At 82 days old, the highest values of number of pods/ plant, dry weight of pods and leaves/plant, leaf area/plant and leaf area index were obtained from the late sowing date. Whereas at 110 days after sowing date, the plant height, number of branches, leaves and stems/plant, leaf area/plant and leaf area index, reached the highest values at medium sowing time.

The maximum and minimum values of number of branches/ plant, were 3.24 and 2.21, while for dry weight of pods/ plant, were 41.28 "g" and 27.78 "g", respectively, at 110 days old, when soybean was planted in mid-May and early May time. The maximum average values of number of leaves/plant, dry weight of leaves/plant, leaf area/plant and leaf area index were 19.24,12.76 "g",1796.81 "cm^2" and 5.989 "cm^2/cm^2", whereas the minimum averages were 11.96, 7.66 "g", 1113.84 "cm^2" and 3.713 "cm^2/cm^2", respectively, when soybean was planted in mid-May and mid-June at 110 days from sowing time.

At mid-May sowing date, the highest values of number of pods/plant and dry weight of stems/plant were 69.64 and 9.59 "g", respectively, whereas the respective lowest values were 57.34 and 6.38 "g" obtained from late sowing date at 110 days from sowing time.

These results may be due to the effects of day and night temperature and photoperiod occurred at the four sowing dates on the period of vegetative growth.

It could be concluded that the prevailing climatic conditions of medium sowing date especially temperature of day and night, light duration and light intensity especially when adequate requirements of nutritional state is available increase plant photosynthesis.

Similar results were reported by **Eid et al. (1979)** and **Eid et al. (1980)** who stated that, sowing dates on May 7 and May 11 gave the tallest plants, highest number of leaves/ plant and dry weight/plant. In addition **Galal et al. (1979)** found that, planting soybeans on April 15 and May 15 gave significantly higher plants and dry weight/plant at 60 days after sowing time. Also, **El-Assily (1984)** found that, sowing soybean in May 10 gave higher number of branches/plant. Whereas, **Settimi and Board (1988)** stated that number of branches/plant were reduced in the July sowing date when compared with May sowing date.

C- Varietal differences :

There were significant differences in growth characters i.e. plant height, number of branches/plant,number of leaves/ plant, number of pods/plant, dry weight of pods/plant, dry weight of leaves/plant, dry weight of stems/plant, leaf area/ plant and leaf area index, for the soybean varieties at 54, 82 and 110 days after sowing time.

Table (6) shows that the differences between means of plant height, number of branches, leaves and pods/plant, dry weight of pods, leaves and stems/plant, leaf area/plant and leaf area index were significant at 54 days after sowing time. Whereas, the variety Clark had the highest values of number of branches/plant (2.81), number of leaves/plant (15.01), dry weight of leaves/plant (6.60 g), dry weight of stems/plant (3.11 g), leaf area/plant (1280.10 cm^2) and leaf area index (4.267 cm^2/cm^2) at 54 days after sowing time. On the other hand, variety Crawford had the highest plant height (45.32 cm), whereas, the variety Hobbit gave the shortest one (31.54 cm) at 54 days from sowing time.

The variety McCall gave the highest values of number of pods/plant (34.01) and dry weight of pods/plant (3.34 g), whereas, the variety Mead had the lowest number of pods/plant (16.50) and dry weight of pods/plant (0.91 g) at 54 days from sowing time.

Table (6) shows that the variety Clark gave the highest number of branches/plant (3.23), number of leaves (28.38) and pods/plant (73.43). Also, variety Columbus gave the highest

Table (6): The average values of growth characters of soybean varieties at 54, 82 and 110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / Varieties	Plant height "Cm"	Number of branches/plant	Number of leaves/plant	Number of pods/plant	Dry weight of different parts "g": pods/plant	Dry weight of different parts "g": Leaves/plant	Dry weight of different parts "g": Stems/plant	Leaf area/plant "Cm^2"	Leaf area index "Cm^2/Cm^2"
				54 days after sowing time					
McCall	38.82 cd	1.52 d	12.25 b	34.01a	3.34 a	3.86 c	1.90 de	566.98 e	1.890 e
Evans	38.75 cd	1.24 d	11.44 b	18.52 b	0.97 b	3.86 c	1.60 e	566.96 e	1.890 e
Hardin	36.54 d	1.47 d	11.46 b	18.28 b	1.18 b	3.16 c	1.72 e	447.91 e	1.493 e
Hobbit	31.54 e	2.32 ab	12.94 b	18.49 b	0.99 b	4.81 b	2.03 cde	739.94 d	2.467 d
Mead	38.08 cd	2.13 bc	11.10 b	16.50 b	0.91 b	4.96 b	2.16 cd	799.40 cd	2.665 cd
Williams 82	42.36 ab	2.24 b	12.50 b	-	-	5.42 b	2.44 bc	1015.95 b	3.386 b
Clark	40.91 bc	2.81 a	15.01 a	-	-	6.60 a	3.11 a	1280.10 a	4.267 a
Crawford	45.32 a	1.68 cd	11.97 b	-	-	5.32 b	2.71 b	1012.45 b	3.375 b
Columbus	43.65 ab	1.37 d	9.29 c	-	-	4.99 b	2.67 b	925.47 bc	3.085 bc
F-test Dxy	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
				82 days after sowing time					
McCall	38.68 e	1.76 de	11.00 g	39.51 c	16.75 ab	3.45 e	2.70 d	445.73 e	1.486 e
Evans	40.91 e	1.44 e	13.12 fg	39.86 c	13.05 cd	4.90 de	2.64 d	559.95 de	1.866 de
Hardin	40.57 e	1.79 de	16.41 e	38.51 c	13.39 cd	5.80 cd	3.06 cd	690.59 de	2.302 de
Hobbit	31.86 f	2.58 bc	14.32 ef	42.16 c	15.71 bc	7.29 c	3.92 c	862.61 d	2.877 d
Mead	49.04 d	2.23 cd	19.61 d	58.50 b	19.03 a	10.35 b	5.42 b	1401.33 c	4.671 c
Williams 82	60.97 c	2.70abc	21.77 cd	62.38 b	16.74 ab	12.08 b	6.51 b	1849.67 b	6.166 b
Clark	68.47 b	3.23 a	28.38 a	73.43 a	14.58 bc	16.63 a	9.22 a	2739.88 a	9.133 a
Crawford	78.44 a	3.03 ab	27.17 ab	58.90 b	10.80 de	16.36 a	9.97 a	2653.42 a	8.845 a
Columbus	79.22 a	2.84abc	24.54 bc	59.48 b	9.67 e	16.65 a	9.37 a	2939.97 a	9.800 a
F-test Dxy	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**	**
				110 days after sowing time					
McCall	-	-	-	-	-	-	-	-	-
Evans	-	-	-	-	-	-	-	-	-
Hardin	47.08 d	2.00 c	12.33 c	52.76 d	27.51 c	6.57 c	5.24 c	725.93 e	2.420 e
Hobbit	33.44 e	2.35 bc	12.10 c	41.10 e	23.63 c	6.80 c	5.19 c	735.08 e	2.450 e
Mead	56.19 c	2.38 bc	13.57 bc	59.40 cd	35.69 ab	7.60 bc	6.36 c	997.33 d	3.324 d
Williams 82	60.82 c	2.63 ab	15.36 b	61.98 c	36.05 ab	8.88 b	8.44 b	1314.56 c	4.382 c
Clark	69.51 b	2.93 a	20.87 a	80.80 a	39.96 a	14.13 a	10.30 a	2011.20 b	6.704 b
Crawford	81.30 a	2.86 a	18.68 a	63.90 c	33.98 b	13.64 a	10.62 a	1915.45 b	6.385 b
Columbus	76.65 a	3.01 a	18.96 a	72.49 b	37.80 ab	14.97 a	9.78 ab	2339.46 a	7.798 a
F-test Dxy	*	N.S	**	**	**	**	N.S	**	**

* and ** significant at 0.05 and 0.01 levels of probability respectively.

plant height (79.22 cm), dry weight of leaves/plant (16.65 g), leaf area/plant (2939.97 cm^2) and leaf area index (9.800 cm^2/cm^2), whereas, the variety McCall gave the lowest dry weight of leaves/plant (3.45 g), leaf area/plant (445.73cm^2) and leaf area index (1.486 cm^2/cm^2). With respect of variety Hobbit had the shortest plants (31.86 cm). The maximum average values of dry weight of pods and stems/plant were (19.03g) and (9.97 g) produced by varieties Mead and Crawford, respectively, whereas, the minimum of the same characters were (9.67 g) and (2.64 g), obtained from the varieties Columbus and Evans at 82 days after sowing time.

Regarding to the 110 days old, the variety Columbus gave the highest averages of number of branches/plant (3.01), dry weight of leaves/plant (14.97g),leaf area/plant (2339.46 cm^2) and leaf area index (7.798cm^2/cm^2),whereas the variety Hardin gave the lowest of respective characters (2.00),(6.57 g), (725.93 cm^2) and (2.420 cm^2/cm^2). The variety Crawford had the maximum values of dry weight of stems/plant (10.62 g) and highest plant height (81.30 cm), while the variety Hobbit gave the minimum values of dry weight of stems/plant (5.19 g) and plant height (33.44 cm). The greater number of leaves/ plant, number of pods/plant and dry weight of pods/plant, were (20.87), (80.80) and (39.96 g), respectively, for the variety Clark.

In this connection, it should be noticed that these differences may be due to the genetical differences between varieties, however **El-Afandy (1990)** in Egypt obtained similar conclusions.

The same trend was also realized by **Eid *et al*.(1980)** who found that Clark cultivar (IV) gave taller plants and higher number of leaves/plant than American 7 cultivar. **Beaver *et al*. (1985)** showed that the determinate genotypes (Elf and Clark) produced higher number of pods and seed weight from branches than Williams cultivar. Also, **Sultan *et al*.(1988)** indicated that, the tallest plant height and the highest number of pods/plant were obtained from the variety Kent (IV) when compared with the other cultivars under study.

2- Physiological growth parameters :

A- Effect of years :

The characters for physiological growth of soybean plants were : net assimilation rate, crop growth rate, relative growth rate for leaves, relative growth rate for pods and relative growth rate for whole plant at 54-82 and 82-110 days after sowing time.

The results of the combined analysis of 1988 and 1989 seasons are shown in Table (7). The results indicated that the differences between the averages of crop growth rate at 54-82 and 82-110 days after sowing time, relative growth rate for whole plant at 54 - 82 days old and, relative growth rate for leaves at 82 - 110 days from sowing time were significant at 5% level. On the other hand, the differences between the averages of physiological growth parameters of soybean plants under different stages i.e. NAR, RGR for leaves and RGR for pods at 54 - 82 days after sowing, NAR, RGR for pods and RGR for whole plant were not significant due to years.

Table (7): The average values of physiological characters of soybean plants as affected by years at 54-82 and 82-110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / years	Net assimilation rate (NAR) $mg/Cm^2/day$	Crop growth rate (CGR) $mg/Cm^2/day$	Relative growth rate (RGR) for leaves. mg/mg/day	Relative growth rate (RGR) for pods. mg/mg/day	Relative growth rate (RGR) for whole plant mg/mg/day
		54-82 days after sowing time			
1988	0.00088 a	0.00345 a	0.02902 a	0.09342 a	0.05124 a
1989	0.00081 a	0.00248 b	0.02598 a	0.09594 a	0.04642 b
		82-110 days after sowing time			
1988	0.00058 a	0.00339 a	0.01866 a	0.04032 a	0.0210 a
1989	0.00051 a	0.00233 b	0.01317 b	0.04194 a	0.01778 a

The results showed that the highest values of crop growth rate (CGR) and relative growth rate for whole plant (RGR) at 54-82 days after sowing time were (0.00345 $mg/cm^2/$ day) and (0.05124 mg/mg/ day), respectively, at the first season, and the minimum values of the same characters were obtained at the second years.

After 82 - 110 days from sowing, maximum and minimum values of crop growth rate (CGR) were (0.00339 $mg/cm^2/day$) and (0.00233 $mg/cm^2/day$), respectively. The relative growth rate (RGR) for leaves were (0.01866 mg/mg/day) and (0.01317 mg/mg/day), resulted in 1988 and 1989 seasons, respectively.

B- Effect of sowing dates :

Data in Table (8) show the average values of net assimilation rate (NAR), crop growth rate (CGR), relative growth rate (RGR) for leaves, relative growth rate (RGR) for pods, and relative growth rate (RGR) for whole plant at 54 -82 and 82 - 110 days from sowing in the combined analysis of the two seasons.

In the first sample (i.e. 54 - 82 days from sowing), significant high mean values for all characters were obtained from the late sowing date. Similar results were reported by **Zeition (1983).**

In the second sample (82-110) days from sowing time, significant high mean values were obtained for NAR, CGR, RGR for pods and RGR for whole plant, resulted from sowing soybean in mid-May. However, relative growth rate (RGR) for

Table (8): The average values of physiological characters of soybean plants as affected by sowing dates at 54-82 and 82-110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / Sowing dates	Net assimilation rate (NAR) mg/Cm^2/day	Crop growth rate (CGR) mg/Cm^2/day	Relative growth rate (RGR) for leaves. mg/mg/day	Relative growth rate (RGR) for pods. mg/mg/day	Relative growth rate (RGR) for whole plant mg/mg/day
		54-82 days after sowing time			
Early	0.00077 b	0.00245 c	0.03215 a	0.10575 b	0.05130 b
Medium	0.00072 b	0.00251 bc	0.02267 b	0.09173 c	0.04412 c
Late	0.00122 a	0.00404 a	0.03501 a	0.11629 a	0.06312 a
Very late	0.00068 b	0.00286 b	0.02017 b	0.07090 d	0.03678 d
F-test Dxy	**	**	**	**	**
		82-110 days after sowing time			
Early	0.00055 b	0.00296 b	0.01159 a	0.05018 a	0.02213 b
Medium	0.00078 a	0.00428 a	0.01477 a	0.05267 a	0.02659 a
Late	0.00040 c	0.00185 c	0.01949 a	0.03220 b	0.01350 c
Very late	0.00030 c	0.00143 c	0.02104 a	0.01624 c	0.00936 d
F-test Dxy	N.S	**	N.S	**	**

* and ** significant at 0.05 and 0.01 levels of probability respectively.

leaves, was not significantly affected by the sowing dates at 82-110 days after sowing time.

The lower values of, net assimilation rate, crop growth rate, relative growth rate for pods and relative growth rate for whole plant at 82-110 days old were obtained from sowing soybean in mid-June (i.e.very late sowing date). Similar trend was also realized by **Nigem (1981).**

These results may be due to the differences in photosynthetic activity of the leaves i.e. internal factor and/or because of the differences in light distribution on leaf surface of the crop canopy resulted from differences in leaf arrangement **(Abdel Gawad et al., 1980).**

C- Varietal differences :

The differences among varieties regarding to the net assimilation rate (NAR), crop growth rate (CGR), relative growth rate (RGR) for leaves, relative growth rate (RGR) for pods, and relative growth rate (RGR) for whole plant, at 54-82 and 82-110 days after sowing time reached the significant level at 5% (Table 9).

Evans and Hardin varieties had the highest mean values for net assimilation rate (0.00113 $mg/cm^2/day$) and (0.00096 $mg/cm^2/day$) at 54-82 and 82-110 days after sowing time, respectively. However, Clark and Crawford gave the lowest averages for NAR at 54-82 and 82-110 days after sowing time (0.00059 $mg/cm^2/day$) and (0.00039 $mg/cm^2/day$), respectivley.

Table (9): The average values of physiological characters of soybean varieties at 54-82 and 82-110 days after sowing time.

"Combined analysis of 1988 and 1989 seasons"

Characters / Varieties	Net assimilation rate (NAR) $mg/Cm^2/day$	Crop growth rate (CGR) $mg/Cm^2/day$	Relative growth rate (RGR) for leaves. mg/mg/day	Relative growth rate (RGR) for pods. mg/mg/day	Relative growth rate (RGR) for whole plant mg/mg/day
	54-82 days after sowing time				
McCall	0.00098 ab	0.00166 c	0.01456 d	0.09962 b	0.04215 c
Evans	0.00113 a	0.00167 c	0.01456 d	0.06184 c	0.03489 d
Hardin	0.00107 ab	0.00200 bc	0.02279 c	0.10166 b	0.04732 bc
Hobbit	0.00092 bc	0.00229 b	0.01488 d	0.10755 b	0.04365 c
Mead	0.00094 abc	0.00349 a	0.02721 c	0.12692 a	0.05606 a
Williams 82	0.00076 cd	0.00372 a	0.02854 c	-	0.05419 a
Clark	0.00059 d	0.00408 a	0.03527 b	-	0.05036 ab
Crawford	0.00064 d	0.00391 a	0.04163 a	-	0.05578 a
Columbus	0.00060 d	0.00385 a	0.04301 a	-	0.05510 a
F-test Dxy	N.S	*	**	N.S	N.S
	82-110 days after sowing time				
McCall	-	-	-	-	-
Evans	-	-	-	-	-
Hardin	0.00096 a	0.00227 c	0.01544 ab	0.02724 d	0.02064 a
Hobbit	0.00054 dc	0.00135 d	0.01383 ab	0.02074 e	0.01240 b
Mead	0.00075 b	0.00276 c	0.01092 b	0.04052 c	0.02271 a
Williams 82	0.00066 bc	0.00298 bc	0.01891 a	0.04122 c	0.02254 a
Clark	0.00045 d	0.00385 a	0.01980 a	0.04387 bc	0.02019 a
Crawford	0.00039 d	0.00296 bc	0.01619 ab	0.04804 b	0.01813 a
Columbus	0.00040 d	0.00351 ab	0.01435 ab	0.05907 a	0.02219 a
F-test Dxy	**	**	N.S	N.S	N.S

* and ** significant at 0.05 and 0.01 levels of probability respectively.

Mead cultivar gave the highest average values for relative growth rate (RGR) for pods (0.12692 mg/mg/day) and relative growth rate (RGR) for whole plant (0.05606 mg/mg/day) at 54-82 days after sowing time, relative growth rate (RGR) for whole plant (0.02271 mg/mg/day) at 82-110 days after sowing time. Whereas, Evans variety gave the lowest mean values for RGR for pods and RGR for whole plant at 54-82 days from sowing time. Hobbit variety had the average values of RGR for whole plant at 82 - 110 days after sowing time.

Clark variety had the highest mean values for crop growth rate at 54-82 and 82-110 days after sowing time and relative growth rate (RGR) for leaves at 82-110 days after sowing time. However, McCall variety gave the lowest mean values for crop growth rate and relative growth rate (RGR) for leaves at 54-81 days after sowing time. While, Hobbit and Mead varieties gave the lowest averages of crop growth rate and relative growth rate (RGR) for leaves at 82 - 110 days after sowing time.

Concerning relative growth rate (RGR) for leaves at 54-82 days after sowing time, and relative growth rate (RGR) for pods at 82-110 days old, Columbus variety gave the highest values of these characters, whereas Hobbit variety gave the lowest mean values for relative growth rate (RGR) for pods at 82 - 110 days old. Similar results were reported by, **Beaver and Cooper (1982) and Shah (1989).**

II- SINK CAPACITY :

1- Seed filling :

A- Effect of years:

The results in Table (10) represent the averages of seed filling in the two seasons. It is evident that the seed filling rate of soybean at 54-61, 68 - 75, 82-89, 96-103 and 110 - 117 days after sowing time were significantly variable from season to season. The higher average values for seed filling rate at 54 - 61, 68 - 75, 82 - 89, 96 - 103 and 110-117 days after sowing time were obtained in 1989 season.

B- Effect of sowing dates :

The average values of seed filling rate and effective filling period of soybean of the combined analysis over two years are presented in Table (11). The differences between the average values of seed filling rate and effective filling period were significant due to sowing dates.

At 54 - 61 and 68-75 days from sowing, the great values of seed filling rate were 0.086 and 0.201 g/day, resulted from sowing soybean in mid-June time (i.e. very late sowing date). Whereas, the lower values for seed filling rate were (0.044 g/day) and (0.084 g/day), obtained from 54 -61 and 68-75 days old when soybean was planted in mid-May and early June, respectively.

The higher values of seed filling rate at 96 - 103 days from sowing and effective filling period were 0.217 g/day and 45.84 days, resulted from mid-May sowing date. Whereas, the

Table (10): The average values of seed filling and effective filling period of soybean as affected by years.

"Combined analysis of 1988 and 1989 seasons"

Characters / Years	Seed filling rate "g /day"					Effective filling period (days)
	54-61 days after sowing time	68-75 days after sowing time	82-89 days after sowing time	96-103 days after sowing time	110-117 days after sowing time	
1988	0.047 b	0.099 b	0.176 b	0.144 b	0.132 b	43.73 a
1989	0.072 a	0.150 a	0.255 a	0.230 a	0.260 a	43.03 a

Table (11): The average values of seed filling and effective filling period of soybean as affected by sowing dates.

"Combined analysis of 1988 and 1989 seasons"

Characters / Sowing dates	Seed filling rate "g /day"					Effective filling period (days)
	54-61 days after sowing time	68-75 days after sowing time	82-89 days after sowing time	96-103 days after sowing time	110-117 days after sowing time	
Early	0.048 bc	0.093 bc	0.237 b	0.199 a	0.260 a	45.39 a
Medium	0.044 c	0.106 b	0.197 c	0.217 a	0.177 b	45.84 a
Late	0.053 b	0.084 c	0.265 a	0.170 b	0.149 c	42.79 a
Very late	0.086 a	0.201 a	0.163 d	0.161 b	0.167 bc	39.50 b
F test Dxy	*	N.S	**	**	**	N.S

* and ** significant at 0.05 and 0.01 levels of probability respectively.

lower values were (0.161 g/day) and 39.50 days) obtained from mid-June sowing date.

At 82-89 days old, the highest value of seed filling rate was 0.265 g/day, obtained from the early June sowing date. While, the lowest value 0.163 g/day, obtained from the mid - June sowing date. The maximum and minimum values of seed filling rate at 110-117 days old were 0.260 and 0.149 g/day, respectively, when soybean was planted in early May and early June date. The results also added that **seed filling** rate in g/day reached its maximum value 0.265 at the period of 82-89 days old at early June sowing date as well as at 96 -103 days after sowing at medium sowing date (i.e. mid-May). The seed filling rate was great i.e. 0.201 g/day at early growth cycle i.e. 68-75 days after sowing and this result was clear at very late sowing date (i.e. mid-June).

These results suggest that seed filling rate of soybean depends on large extent on sowing date however, it tended to increase with advancement of plants towards maturity up to 82 - 89 and 96 - 103 days after sowing time due to late and medium sowing dates, respectively.

Table (11) shows that effective filling period responded significantly to different sowing dates. Medium sowing date gave the maximum effective filling period i.e. 45.84 day. While the lowest effective filling period i.e. 39.50 day was obtained at very late sowing date.

Similar results were reported by, **Anderson and Vasilas (1985)** who showed that delaying planting resulted in reducing the rate of seed - fill in Corsoy 79 by 4 % and Williams 79 by 31%.

C- Varietal differences :

The results reported in Table (12) indicate clearly that both seed filling rate at different growth periods i.e. 54 - 61, 68 - 75, 82 - 89, 96 - 103 and 110 - 117 days after sowing and effective filling period reached the significant level at 5 %.

Columbus variety gave the highest values for seed filling rate at 110-117 days after sowing time, while Mead variety gave the lowest one.The results also added that there was a noticeable increase in seed filling rate in gram/day before maturity stage up to the period of 82 - 89 days. It was clear for McCall, Evans, Hardin, Mead, Williams 82, Clark and Crawford. These values were 0.211, 0.170,0.270, 0.255, 0.273, 0.276 and 0.207 g/day for the same respective mentioned varieties respectively.

Hobbit variety gave the highest values for seed filling rate at 68-75 days after sowing time, while Crawford variety gave the lowest one.In addition, Crawford as well as Columbus varieties reached the maximum seed filling rate later on 96 - 103 and 110 - 117 days after sowing. After it reached its maximum values a noticeable decline was exhibited in all varieties under investigation. These results suggest that seed filling rate in gram/day depends on a large extent on the variety as well as on the stage of plant development during seed filling periods.

Table (12): The average values of seed filling and effective filling period of soybean varieties.
"Combined analysis of 1988 and 1989 seasons"

Characters / Varieties	Seed filling rate "g /day"					Effective filling period (days)
	54-61 days after sowing time	68-75 days after sowing time	82-89 days after sowing time	96-103 days after sowing time	110-117 days after sowing time	
McCall	0.124 a	0.127 b	0.211 b	-	-	28.97 d
Evans	0.040 bc	0.161 a	0.170 c	0.114 e	-	31.89 cd
Hardin	0.050 b	0.120 b	0.270 a	0.160 cd	0.179 b	35.25 c
Hobbit	0.035 c	0.167 a	0.141 c	0.153 d	0.144 c	44.32 b
Mead	0.014 d	0.102 b	0.255 a	0.212 ab	0.143 c	44.42 b
Williams 82	-	0.119 b	0.273 a	0.192 bc	0.190 b	45.31 b
Clark	-	0.118 b	0.276 a	0.204 ab	0.205 b	51.52 a
Crawford	-	0.065 c	0.207 b	0.243 a	0.213 b	54.71 a
Columbus	-	0.157 a	0.136 c	0.215 ab	0.274 a	54.01 a
F-test Vxy	**	*	N.S	**	**	N.S

* and ** significant at 0.05 and 0.01 levels of probability respectively.

At 54 - 61 days after sowing time, the variety McCall gave the highest value of seed filling rate 0.124 g/day, whereas, the variety Mead gave the lowest one 0.014 g/day.

Effective filling period significantly different owning to different soybean varieties. Investigated varieties could be arranged in descending order as Crawford (the highest value i.e. 54.71 day). Columbus (54.01 day), Clark (51.52 day), Williams (45.31 day), Mead (44.42 day), Hobbit (44.32 day), Hardin (35.25 day) Evans (31.89 day) and McCall (28.97 day). These results suggest that effective filling period depends also on variety.

Similar results were reported by, **Egli __et al.__ (1978)** who showed that the effective filling period in 1975 was significant for Kanrich (III), Cutler 71 (IV) and Custer (IV). The duration of the effective filling period for Kanrich,Williams and Cutler 71 was approximately 10 days shorter in 1975 than in 1974. **Boote (1981)** found that across all years and cultivars, day from R5b when 50% of the plants had detectable been swelling in any pod to R8 full maturity averaged 32, 37, 39, 39, 43, 48, 50 and 62 days for MG 000,00,0, I,II,III,IV and V cultivars, respectively. **Gbikpi and Crookston (1981)** found that the Group 00 plants had shorter lag, but the effective filling period and rate of linear growth of the two groups (00, I) was equal. Also, **Egli __et al.__ (1984)** found that significant genotype differences were found in each year for all estimates of the filling period, however, genotypes with filling periods significantly longer than the longest filling period of a check cultivar were identified only in

1982. On the other hand, there was a consistent relationship between the growth stage estimates of seed filling period and effective filling period over all genotypes and across 2 years, however, late maturing check cultivars (MG IV and V) showed longer filling periods, based on growth stage estimates, than (MG III) check cultivars.

2- Yield and yield components :

A- Effect of years :

Results in Table (13) represent averages of the three seasons of the study concerning yield components of different soybean cultivars. From the results it is evident that yield components were differed significantly from season to another. The higher average values of plant height, number of pods/plant, number of seeds/plant, weight of pods/plant, weight of seeds/pod, seed index and weight of seeds/plant were detected in the third season i.e 1990. On the other hand, the number of seeds/pod as well as protein percentage in soybean seeds reached their maximum values in one year out of two. The oil percentage was great at the first growing season i.e 1988. It could be concluded that the differences in yield components of soybean plants owing to different growing seasons might be due to the differences in prevailing edaphic conditions especially to solar radiation and mean temperature of day and night. The more suitable environmental conditions encourage growth of plant which in turn affect on metabolities synthesized by soybean plants. In addition light intensity and proper temperature governs differentiation of reproductive organs. On the other hand, favourable growth

Table (13): The average values of yield components of soybean as affected by years.

"Combined analysis"

Characters / years	Plant height "Cm"	Number of pods/ plant	Number of seeds/ pod	Number of seeds/ plant	Weight of pods/ plant (g)	Weight of seeds/ pod (g)	Seed index (g)	Weight of seeds/ plant (g)	Oil %	Protein %
1988	50.70c	49.98 b	2.72 b	119.10 b	33.25 b	0.488 a	17.12 b	21.03 b	25.90 a	37.48 b
1989	56.43b	46.56 b	2.81 a	96.19 c	23.49 c	0.466 b	17.37 b	15.18 c	23.41 b	39.39 a
1990	69.89a	75.52 a	2.67 c	168.19 a	43.44 a	0.489 a	18.13 a	28.53 a	-	-

conditions favours production of organic matter which in turn increased biosynthesis of organic components such as oil and protein in soybean plant. Therefore fluctuation of the different environments factors can explain the differences between the averages of different yield components from year to another.

B- Effect of sowing dates :

Table (14) shows the combined analysis of the three years for the plant height, number of pods/plant, number of seeds/pod, number of seeds/plant, weight of pods/plant, weight of seeds/pod, weight of seeds/plant, seed index except the oil percentage and protein percentage the combined analysis of 1988 and 1989 seasons.

The differences between the averages of plant height, number of pods/plant, number of seeds/pod, number of seeds/ plant, weight of pods/plant, weight of seeds/pod, seed index, weight of seeds/plant and oil percentage were significantly affected except the protein percentage due to sowing dates. The results show that, the highest averages of plant height, number of pods/plant, number of seeds/pod, number of seeds/ plant, weight of pods/plant, weight of seeds/plant and oil percentage were 62.97 "cm", 60.41, 2.75, 142.42, 37.66 "g", 24.37 "g" and 25.99%, respectively when soybean was planted in mid-May, whereas the minimum ones for the respective characters were 54.85 "cm", 51.53, 110.47, 28.80 "g", 18.33 "g" and 23.46%, obtained from sowing soybean in mid-June except the number of seeds/pod (2.71) which obtained from the early May sowing date.

Table (14): The average values of yield components of soybean as affected by sowing dates.

"Combined analysis"

Characters / Sowing dates	Plant height "Cm"	Number of pods/ plant	Number of seeds/ pod	Number of seeds/ plant	Weight of pods/ plant (g)	Weight of seeds/ pod (g)	Seed index (g)	Weight of seeds/ plant (g)	Oil %	Protein %
Early	62.37a	57.31 a	2.71 b	131.48 b	33.90 b	0.473 b	17.29 b	21.97 b	25.24 b	37.35 a
Medium	62.97a	60.41 a	2.75 a	142.42 a	37.66 a	0.478 b	17.21 b	24.37 a	25.99 a	38.93 a
Late	55.83b	59.68 a	2.73 ab	126.93 b	33.21 b	0.469 b	17.45 b	21.66 b	23.93 c	38.25 a
Very late	54.85b	51.53 b	2.74 a	110.47 c	28.80 c	0.503 a	18.22 a	18.33 c	23.46 d	39.22 a
F-test Dxy	**	**	**	**	**	**	**	**	**	N.S

* and ** Significant at 0.05, and 0.01 levels of probability respectively.

The maximum values of seeds weight/pod and seed index of soybean were 0.503 "g" and 18.22 "g", respectively, resulted from the mid-June sowing date. The minimum value of weight of seeds/pod was 0.469 "g", obtained from the early June sowing date, whereas the minimum value of seed index was 17.21 "g", resulted from sowing soybean in mid-May.

This result may be due to the prevailing of favourable temperature and day length leading to greater vegetable growth yield components of plant. It could be concluded that sowing dates governs growth and consequently yield components of soybean plant. However, growing soybean at mid May gave best results for most of the different characters of yield components. Suitable environmental conditions encourage vegetative growth as well as reproductive organs and this in turn can explain our findings. In addition, translocation of organic components from source to sink depends to a large extent on daily changes in solar radiation and minimum temperature of day and night.

Similar results were reported by **Harvey and Brighom (1971)** who found that oil content in the seed declined about 10 percent with delay in sowing date, whereas the protein content was not affected.**Omar (1977)** found that plant height, seed weight/plant, number of pods/plant and number of seeds/ plant of soybean significantly decreased with delaying planting date. Planting soybean from April 1 to May 15 is better than later planting i.e (June 1, June 15, July 1 and July 15).On the other hand,in 1974 and 1975 seasons,oil percentage decreased slightly by delaying sowing date. **Abd El-Rehman et al. (1979)** showed that sowing date did not significantly affect oil and protein contents of the seeds. **Eid et al. (1979)** found that delaying in sowing date of soybean from March 16 to May 7 caused a significant increases in pods number/plant, pods weight/plant, number of seeds/plant and seeds weight/plant. **Beatty et al. (1982)** showed that the average oil content dropped from 19.82% to 18.14% when planting date delayed either in April or May to July, in 1978 and 1979 seasons. **Anderson and Vasilas (1985)** stated that delaying sowing date of soybean from mid-May to mid-June caused a significant decrease in number of pods/ plant and number of seeds/plant. Also, **Eweida et al. (1986)** found that sowing on May gave higher values for number of pods/plant and number of seeds/plant.

C- Varietal differences :

Table (15) shows that the differences among varieties were significant for the plant height, number of pods/plant, number of seeds/pod, number of seeds/plant, weight of pods/ plant, weight of seeds/pod, seed index, weight of seeds/plant and oil percentage.

From Table (15), it is clear that the variety Crawford had the highest mean values for number of seeds/pod (2.85), number of seeds/plant (176.98), weight of seeds/plant (30.46 g), and seed index (18.93 g). While, the variety McCall had the lowest values for number of seeds/pod (2.59), number of seeds/plant (74.62), weight of seeds/plant (10.89 g), and seed index (15.03 g). Whereas, the variety Clark gave the highest value of seeds weight/pod (0.530 g), while the variety McCall gave the lowest one (0.386 g).

Table (15): The average values of yield components of soybean varieties.

"Combined analysis"

Characters / Varieties	Plant height "Cm"	Number of pods/ plant	Number of seeds/ pod	Number of seeds/ plant	Weight of pods/ plant (g)	Weight of seeds/ pod (g)	Seed index (g)	Weight of seeds/ plant (g)	Oil %	Protein %
McCall	41.82f	35.26 d	2.59 d	74.62 e	16.70 e	0.386 e	15.03 e	10.89 f	23.50 e	36.51 a
Evans	46.71e	44.12 c	2.64 c	97.31 d	21.97 d	0.421 d	16.15 d	14.49 e	24.28 d	39.87 a
Hardin	46.00e	44.37 c	2.63 c	95.40 d	23.08 d	0.441 c	16.10 d	15.72 de	24.57b-d	37.49 a
Hobbit	31.36g	44.42 c	2.74 b	96.47 d	27.53 c	0.498 b	18.45 ab	18.40 cd	25.40 a	38.25 a
Mead	54.50d	55.46 b	2.76 b	126.86 c	31.97 c	0.489 b	17.46 c	20.57 c	24.44 cd	38.12 a
Williams 82	65.18c	60.18 b	2.78 b	144.01 b	37.70 b	0.503 b	18.07 b	24.90 b	24.95a-c	37.52 a
Clark	78.50b	75.32 a	2.82 a	168.40 a	45.50 a	0.530 a	18.90 a	29.21 a	25.18 a	38.59 a
Crawford	82.43a	77.24 a	2.85 a	176.98 a	47.75 a	0.529 a	18.93 a	30.46 a	24.45 cd	39.30 a
Columbus	84.57a	78.69 a	2.78 b	170.37 a	48.33 a	0.529 a	18.78 a	29.61 a	25.13 ab	40.30 a
F-test Vxy	**	N.S	**	N.S	N.S	**	*	N.S	**	N.S

* and ** significant at 0.05 and 0.01 levels of probability respectively.

The maximum and minimum values of oil percentage were (25.40%) and (23.50%) by the varieties Hobbit and McCall, respectively at harvesting time. After the combined analysis, the variety columbus had the highest mean values for number of pods/plant and weight of pods/plant. However, the variety McCall gave the lowest mean values of these respective characters. On the other hand, the variety columbus had the tallest plants at harvesting time, while, the variety Hobbit gave the shortest plants.

In this connection it could be concluded that these results are quite expected. The different investigated varieties of soybean differed in genotypes in addition to their variability in classes of maturity date under Egyptian climatic conditions **(Ibrahim et al. 1979)**.

Similar results were reported by, **Hakam (1975)** who found that Williams (III) and Bragg (VIII) varieties gave seed oil content equal to 20.2% and 16.3% respectively. **Omar (1977)** found that Clark (IV) variety performed much better number of pods/plant and number of seeds/plant when planted on April 15. Early variety (Clark) gave the higher oil content the intermediate (Davis, Hood) and late (Hampton) varieties. **Eid et al. (1980)** reported that Clark soybean cultivar was superior to the American 7 cultivar in seeds weight/plant at harvest. **El-Bayoumi (1980)** showed that Williams (III) Clark (IV) and Clark 63 (IV) varieties gave the higher number of seeds/pod (2.48, 2.45 and 2.46 seeds, respectively). Highly significant differences were found between the averages of 100 seed weight for different varieties. Whereas, Clark variety exhibited gave the highest oil percentage followed by Lee variety (late maturing) when compared with the other varieties. **Ashour <u>et</u> <u>al.</u> (1985)** found that, Crawford and Lawrence varieties produced the higher weight of 100 seeds than the other ones. Moreover, the highest number of pods/plant was produced by Columbus variety. **Shweliya <u>et</u> <u>al</u>. (1985)** noticed that in 1978 the early maturing cultivars (i.e. Clark IV and Williams III) tended to produce higher protein and oil content than the late maturing cultivars (i.e Cobb VIII and Ransom VII).Also,**Eweida <u>et</u> <u>al</u>.(1986)** emphasised that the differences between the average of seed protein percentage of Forrest and Ransom varieties was insignificant.

Table (15) shows that the effect of interaction between varieties and years was statistically significant for plant height, number of seeds/pod, weight of seeds/pod, seed index and oil percentage. These interactions were caused mainly by the different ranking of varieties from year to year.However, the interaction between varieties and years was insignificant for the number of pods/plant, number of seeds/plant, weight of pods/plant, weight of seeds/plant and protein percentage, revealing that varieties were constant from year to year for these traits.

A- Effect of years :

The average values of seed yield, straw yield "ton/feddan", oil yield "Kg/feddan" and protein yield "Kg/feddan" as affected by seasons are presented in Table (16).

Table (16): The average values of yield of soybean as affected by years.

(Combined analysis)

Characters / years	Seed yield Ton/feddan	Straw yield Ton/feddan	Oil yield Kg/feddan	Protein yield Kg/feddan
1988	0.993 b	2.392 c	260.17 a	375.36 a
1989	0.987 b	2.952 b	232.77 b	390.38 a
1990	1.126 a	3.634 a	---	---

The results in Table (16) indicate that the seed yield, straw yield "ton/feddan" and oil yield "Kg/feddan" were significantly affected from season to season. The protein yield "Kg/feddan" was not significantly affected by seasonal variations. The highest values of seed yield/feddan and straw yield/feddan were 1.126 "ton" and 3.634 "ton", respectively detected in the third season. The lowest average of seed yield/feddan was detected in the second season, whereas the lowest average of straw yield/feddan was obtained in the first season. The highest average of oil yield/feddan was (260.17 kg), obtained from the first season. On the other hand, the lowest average of oil yield/feddan was (227.92 kg), obtained from the second season.

B- Effect of sowing dates :

The data recorded in Table (17), show that the average values of seed yield, straw yield 'ton/feddan", oil yield "Kg/feddan" and protein yield "Kg/feddan" as affected by sowing dates.

The results of 1988, 1989, 1990 seasons as well as the combined analysis, indicate that the differences between the average values of seed yield "ton/feddan" and straw yield "ton/feddan" were significant at 5% during the three seasons and the combined analysis except the seed yield/feddan in 1990 season which was not significant at 5%.

The higher values of seed yield "ton/feddan" were 1.218, 1.202 and 1.191 "ton/feddan" obtained from the mid-May sowing date in 1988, 1989 and the combined analysis, respectively.

Table (17): The average values of yield of soybean as affected by sowing dates.

Characters / Sowing dates	Seed yield "Ton /fed."				Straw yield "Ton /fed."				Oil yield "Kg /fed."			Protein yield "Kg /fed."		
	1988	1989	1990	Combined	1988	1989	1990	Combined	1988	1989	Combined	1988	1989	Combined
Early	0.898b	1.120a	1.129a	1.049 b	3.021a	3.743a	4.293a	3.686 a	241.42b	269.95a	255.68 b	329.52b	423.51b	376.51 b
Medium	1.218a	1.202a	1.154a	1.191 a	2.595b	3.532a	3.833b	3.320 b	323.74a	302.94a	313.34 a	468.64a	486.57a	477.61 a
Late	0.946b	0.782b	1.156a	0.961 c	1.967c	2.094b	3.528c	2.530 c	244.32b	172.22b	208.27 c	358.67b	306.50c	332.59 c
Very late	0.911b	0.844b	1.067a	0.941 c	1.987c	2.438b	2.881d	2.435 c	231.20b	185.97b	208.58 c	344.59b	344.90c	344.77bc
F-test Dxy	-	-	-	**	-	-	-	**	-	-	*	-	-	**

* and ** significant at 0.05 and 0.01 levels of probability respectively.

The minimum ones were 0.898, 0.782 and 0.941 "ton/feddan" in 1988, 1989 seasons and the combined analysis, obtained from sowing soybean in early May time, early June time and mid-June time, respectively.

The increase in the average values of seed yield "ton/feddan" resulted from the increases in number of pods/plant, weight of pods/plant, number of seeds/plant and weight of seeds/plant (Table 14).

The highest average values of oil yield "Kg/feddan" were 323.74, 302.94 and 313.34 kg, also, protein yield "Kg/feddan" were 468.64, 486.57 and 477.61 Kg in 1988, 1989 and the combined analysis, respectively, resulted from sowing soybean in mid-May. Whereas, the lowest average values of oil yield/feddan were 231.20, 172.22 and 208.27 Kg/feddan, obtained from the mid-June, early June and early June in 1988, 1989 and combined analysis, respectively, while protein yield/feddan were 329.52, 306.50 and 332.59 Kg/feddan, obtained from early May, early June and early June in 1988, 1989 and the combined analysis, respectively. These results may be due to the increase in seed yield/feddan which resulted from sowing soybean in mid-May.

Similar trend was also realized by, **Eid <u>et</u> <u>al</u>. (1979)** who found that delaying sowing date of soybean from March 16 to May 7 caused significant increases in seed yield/feddan. **Anderson and Vasilas (1985)** stated that delaying sowing date of soybean from mid-May to mid-June resulted in a significant decrease in seed yield/ha. **Board (1985)** showed that the average seed yield in the early April and mid-June plantings were significantly lower than in the mid-May planting date in both years. **Eweida et al. (1986)** found that sowing soybean on May 10 gave higher values of seed yield/feddan than other sowing dates. **Quresh and Rahim (1987)** showed that sowing soybean at May 15 gave the highest yields, whereas the yields significantly decreased when delaying the sowing date.

The differences between the means of straw yield "ton/ feddan" in the separate season and the combined analysis of the three seasons, were significant. It is clear that the highest straw yield (ton/feddan" were 3.021, 3.743, 4.293 and 3.686 "ton/feddan" for 1988, 1989, 1990 seasons as well as the combined analysis of the three years, respectively, when sowing soybean in early May time. The lowest averages of straw yield were 1.967 and 2.094 "ton/feddan", obtained in 1988 and 1989, respectively when sowing date at early June, whereas the average of 1990 and combined analysis were 2.881 and 2.435 "ton/feddan", respectively at mid-June sowing date.

The increase in the average of straw yield of soybean might be due to the increases in plant height, number of branches/plant and number of leaves/plant (Table 5).

Similar results were reported by, **Eid et al. (1979)** who showed that delaying in sowing date of soybean from march 16 to May 7 caused a significant increase in straw yield/feddan **Zeition (1983)** showed that straw yield/feddan signific-antly decreased when delaying sowing date from May 1 to July 1 time.

C- **Varietal differences :**

The differences between the averages of seed yield per feddan, straw yield per feddan, oil yield per feddan and protein yield per feddan reached the significant level at 5% (Table 18) due to the varieties.

Crawford variety had the highest mean value of seed yield/feddan and Columbus ranked the second. Both Crawford and Columbus varieties outyielded McCall, Evans, Hardin, Hobbit, Mead, Williams 82 and Clark by 178.8%, 175.1% and 135.97%, 132.87% and 118.68%, 115.80% and 72.56%, 70.29% and 39.63%, 37.80% and 31.09%, 29.37% and 19.28%, 17.71%, respectively. However, McCall variety gave the lowest mean value of seed yield/feddan followed by Evans in the combined analysis.

The effect of interaction between varieties and years was statistically significant for seed yield/feddan, straw yield/feddan and oil yield/feddan (Table 18). These interactions with years revealed that varieties were unconstant from year to year for these traits. Crawford variety had the highest mean values for seed yield/feddan in the first and second years, also oil yield/feddan in second year. While, Columbus variety had the highest value for seed yield/feddan in the third year, whereas oil yield/feddan in the first season (i.e 1988).

The high seed yield/feddan of Crawford and Columbus varieties could be attributed to the increases in number of seeds/pod, number of seeds/plant, weight of seeds/pod, seed index and weight of seeds/plant (Table 15). Also, plant height, Table (18): The average values of yield of soybean varieties.

Characters / Varieties	Seed yield "Ton/fed."				Straw yield "Ton/fed."				Oil yield "Kg/fed."			Protein yield "Kg/fed."		
	1988	1989	1990	Combined	1988	1989	1990	Combined	1988	1989	Combined	1988	1989	Combined
McCall	0.464d	0.520 e	0.655d	0.546 f	0.835d	1.031 f	1.896 e	1.254 e	107.27f	123.27d	115.27 e	165.40d	197.09d	181.24 e
Evans	0.546d	0.581 e	0.809c	0.645 ef	1.109d	1.654ef	2.637 d	1.800 d	137.63ef	136.94d	137.28 e	218.99d	225.51d	222.25 e
Hardin	0.590d	0.602 e	0.895c	0.696 e	1.250d	1.725 e	2.868 d	1.948 d	153.92e	141.91d	147.92 e	212.32d	236.67d	224.49 e
Hobbit	0.814c	0.895 d	0.938c	0.882 d	2.147c	2.395 d	3.654 c	2.732 c	220.52d	213.25c	217.18 d	301.90c	354.39c	328.15 d
Mead	1.009b	1.065cd	1.195b	1.090 c	2.299c	2.614 d	3.930bc	2.948 c	253.69cd	253.25bc	253.47 c	373.74bc	416.19bc	394.96 c
Williams 82	1.075b	1.186bc	1.222b	1.161 c	2.878b	3.670 c	4.177abc	3.575 b	282.36bc	283.01ab	282.68bc	400.56b	448.08bc	424.32bc
Clark	1.169b	1.238abc	1.420a	1.276 b	2.976b	3.714 c	4.519 a	3.736 b	316.70b	290.51ab	303.61 b	438.78b	491.97ab	465.37 b
Crawford	1.636a	1.429 a	1.501a	1.522 a	3.412b	4.476 b	4.399ab	4.096 a	420.65a	334.84a	377.74 a	620.99a	583.17a	602.08 a
Columbus	1.634a	1.369ab	1.503a	1.502 a	4.624a	5.287 a	4.623 a	4.845 a	448.79a	317.33a	383.06 a	645.55a	560.39a	602.97 a
F-test Dxy	-	-	-	**	-	-	-	**	-	-	*	-	-	N.S

* and ** significantly at 0.05 and 0.01 levels of probability respectively.

number of branches/plant and dry weight of leaves/plant (Table 6).

It could be concluded that the Crawford and/or Columbus varieties which could be recommended to be cultivated under Shalakan, Kalubia Governorate Conditions i.e silty clay soil. Also, the Williams 82 and Clark were considered the more stable varieties from year to year and relatively high yield.

The same trend was also realized by, **Omar (1977)** who found that, Clark variety performed much better seed yield/ feddan when planted on April 15. **Eid et al. (1980)** reported that, Clark soybean cultivar was superior to the American 7 cultivar in average seed yield/feddan at harvest. **Ashour et al. (1985)** found that, Crawford and Lawrence produced the higher seed yield than the other varieties.

Columbus variety gave the highest average value of straw yield/feddan followed by Crawford variety in the combined analysis. On the other hand, McCall variety gave the lowest mean value for straw yield/feddan in the combined analysis.

The interaction effect between varieties and years was significant revealing that varieties were unconstant from year to year for this trait (Table 18). Also, the ranking of varieties was differed from year to year, i.e. the high mean value was recorded by Columbus followed by Crawford and then by Clark in the first and second years. While, in the third year,the highest mean value was obtained by Columbus followed by Clark and then by Crawford variety.

D- Effect of interaction between sowing dates and varieties :

The differences between the averages of plant height, number of pods/plant, number of seeds/pod, number of seeds/plant, weight of pods/plant, weight of seeds/pod, seed index, weight of seeds/plant, seed yield/feddan and straw yield/feddan were significant due to the interaction effect between sowing dates and varieties (Table 19,20 and 21). These interactions with sowing dates were due mainly to the different ranking of varieties from one sowing date to another.

The highest value of plant height (96.22 cm) was obtained when Columbus variety sown in mid-May. On the other hand, the highest value for number of pods/plant (94.52) was obtained from sowing soybean Crawford variety in mid-May. However, the lowest value for plant height (29.59 cm) was obtained from the mid-May sowing date with Hobbit variety. The lowest value for number of pods/plant was (32.60), resulted from mid-June (i.e. very late) sowing date with McCall variety.

The maximum values of number of seeds/pod and number of seeds/plant were (2.87) and (219.67) respectively, obtained from the mid-May sowing date with Crawford variety. Whereas McCall variety gave the minimum values which were (2.49) and (69.51), for the respective characters at early May sowing date.

Table (20) shows that the differences between the averages of weight of pods/plant, weight of seeds/pod, seed index and weight of seeds/plant were significant due to the effect of interaction between sowing dates and varieties.The highest

Table (19): The average values of plant height, number of pods per plant, number of seeds per pod and number of seeds per plant at harvesting time as affected by the interaction between sowing dates X varieties.

"Combined analysis of 1988, 1989 and 1990 seasons"

Sowing dates / Varieties	Plant height				Number of pods/plant				Number of seeds/pod				Number of seeds/plant			
	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First-June (Late)	Mid-June (very late)
McCall	mn 42.78	l-n 44.13	n 40.13	n 40.22	no 35.18	m-o 39.74	no 33.53	o 32.60	p 2.49	m-o 2.59	m-o 2.60	h-l 2.69	o 69.51	no 81.68	no 70.68	no 76.62
Evans	k-m 50.22	l-n 47.34	l-n 45.11	l-n 43.95	l-o 42.33	m-o 41.31	i-m 50.29	l-o 42.54	no 2.58	k-o 2.63	i-m 2.67	h-l 2.69	m-o 82.99	f-l 110.22	g-m 103.91	j-o 92.13
Hardin	kl 51.29	l-n 45.34	n 41.46	l-n 45.90	i-m 49.12	m-o 40.30	k-o 45.00	l-o 43.05	l-o 2.61	g-k 2.70	op 2.56	j-n 2.66	f-l 110.22	j-n 96.36	l-o 83.67	l-o 91.35
Hobbit	o 32.36	o 29.59	o 29.94	o 33.54	k-o 44.29	l-o 42.89	l-o 43.84	j-n 46.66	h-l 2.69	d-i 2.75	c-h 2.77	d-i 2.73	k-o 92.04	h-n 101.30	j-o 93.46	i-n 99.09
Mead	jk 57.43	ij 58.90	kl 51.31	k-m 50.36	h-m 52.22	g-m 52.82	f-k 57.63	f-j 59.18	d-i 2.75	b-g 2.78	c-h 2.76	d-i 2.75	e-j 121.56	e-i 128.72	e-g. 129.61	e-i 127.53
Williams 82	gh 70.08	h-j 63-58	ij 62.11	hi 64.96	f-j 59.97	e-h 64.52	f-i 60.76	g-l 55.47	a-d 2.82	a-e 2.81	f-k 2.71	b-g 2.78	de 151.64	cd 166.20	ef 133.63	e-i 124.56
Clark	d-f 80.91	bc 89.00	fg 73.93	gh 70.14	d-f 69.04	c-e 77.29	ab 90.23	e-h 64.73	a-d 2.82	a-c 2.84	a-e 2.80	a-e 2.80	cd 171.87	bc 183.91	bc 188.29	e-h 129.54
Crawford	cd 84.59	ab 92.45	de 82.04	gh 70.63	a-c 84.04	a 94.52	c-e 76.71	g-m 53.23	a 2.87	a 2.87	ab 2.86	a-e 2.81	ab 203.41	a 219.67	cd 170.23	f-k 114.60
Columbus	ab 91.70	a 96.22	e-g 76.43	fg 73.93	b-d 79.08	ab 90-29	b-d 79.13	d-g 66.27	c-h 2.77	a-f 2.79	a-e 2.80	d-i 2.75	b-d 180.10	a-c 193.70	cd 168.88	ef 138.79

Table (20): The average values of weight of pods per plant, weight of seeds per pod, seed index and weight of seeds per plant at harvesting time as affected by the interaction between sowing dates X varieties.

"Combined analysis of 1988, 1989 and 1990 seasons"

Sowing dates / Varieties	Weight of pods/plant "g"				Weight of seeds/pod "g"				Seed index "g"				Weight of seeds/plant "g"			
	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First-June (Late)	Mid-June (very late)
McCall	q 15.04	o-q 17.30	o-q 18.35	pq 16.10	mn 0.389	mn 0.389	n 0.373	mn 0.393	j-l 15.68	l 14.50	kl 15.44	l 14.49	n 10.02	l-n 11.32	l-n 11.56	mn 10.67
Evans	o-q 19.53	L-q 23.90	L-q 25.28	o-q 19.17	mn 0.409	lm 0.422	k-m 0.431	lm 0.423	i-k 16.11	i-k 16.29	i-k 16.00	i-k 16.20	l-n 12.79	h-n 15.83	g-m 16.96	l-n 12.38
Hardin	L-p 25.94	m-q 22.28	n-q 21.19	m-q 22.18	k-m 0.432	k-m 0.431	k-m 0.429	h-j 0.473	kl 15.40	j-l 15.59	j-l 15.69	e-h 17.71	f-m 17.08	i-n 15.49	k-n 15.06	j-n 15.25
Hobbit	k-o 27.86	j-n 30.00	k-o 26.75	l-q 25.51	e-j 0.496	f-j 0.489	e-j 0.492	c-i 0.513	b-f 18.59	e-h 17.72	d-g 17.95	ab 19.52	f-l 17.78	f-k 20.43	f-l 18.09	f-m 17.31
Mead	h-n 31.48	i-n 30.82	h-n 30.95	g-l 34.61	d-j 0.501	i-k 0.470	j-k 0.463	b-g 0.522	h-k 16.49	e-h 17.69	g-j 16.91	b-f 18.73	f-k 19.96	e-j 21.22	f-k 19.77	e-i 21.34
Williams 82	e-h 40.85	d-g 43.48	g-l 34.00	h-m 32.46	ij 0.478	e-j 0.495	e-j 0.498	a-d 0.543	g-j 16.89	f-i 17.32	a-c 19.41	b-f 18.65	c-e 25.94	b-d 29.35	d-h 22.83	e-i 21.47
Clark	e-i 40.70	a-d 52.43	a-d 52.03	f-k 36.85	e-j 0.494	ab 0.561	c-i 0.513	a-c 0.553	b-e 18.78	a-d 19.21	b-f 18.58	a-e 19.05	b-e 27.92	bc 32.04	ab 33.97	d-g 22.92
Crawford	a-c 53.87	a 61.48	d-g 43.42	h-n 32.22	c-i 0.514	b-e 0.528	d-j 0.500	a 0.575	b-f 18.70	c-g 17.99	b-f 18.76	a 20.27	ab 34.46	a 40.13	b-e 27.63	f-k 19.61
Columbus	b-e 94.79	ab 57.25	c-f 46.21	e-j 40.08	a-c 0.547	c-h 0.516	b-f 0.524	b-e 0.531	a-e 19.00	b-f 18.55	b-g 18.26	a-d 19.32	bc 31.74	b 33.53	b-d 29.11	d-f 24.04

Table (21): The average values of seed yield and straw yield per feddan as affected by the interaction between sowing dates X varieties.

"Combined analysis of 1988, 1989 and 1990 seasons"

Sowing dates / Varieties	Seed yield "Ton/feddan"				Straw yield "Ton/feddan"			
	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)	First May (Early)	Mid-May (Medium)	First June (Late)	Mid-June (very late)
McCall	mn 0.549	mn 0.593	mn 0.427	mn 0.617	p 1.161	p 1.032	p 1.141	m-p 1.682
Evans	j-m 0.734	k-m 0.704	mn 0.600	mn 0.541	k-o 2.130	k-o 2.024	m-p 1.636	op 1.411
Hardin	k-m 0.673	k-m 0.891	l-n 0.633	mn 0.585	k-o 2.149	k-n 2.226	l-o 1.907	n-p 1.509
Hobbit	h-k 0.877	g-j 0.955	i-l 0.843	i-l 0.854	e-i 3.232	f-j 3.137	k-o 2.152	j-m 2.407
Mead	f-h 1.091	d-f 1.234	f-i 1.032	f-i 1.002	d-g 3.528	d-g 3.532	i-l 2.477	k-n 2.255
Williams 82	f-i 1.014	cd 1.377	e-g 1.132	e-g 1.120	b 4.831	d-f 3.888	g-k 2.793	g-k 2.789
Clark	c-e 1.302	bc 1.462	d-f 1.209	e-g 1.129	b 4.920	cd 4.056	e-i 3.221	h-k 2.749
Crawford	ab 1.610	a 1.770	bc 1.440	c-e 1.269	b 5.100	bc 4.679	d-h 3.510	g-j 3.094
Columbus	ab 1.592	a 1.733	c-e 1.336	c-e 1.347	a 6.121	b 5.305	de 3.933	cd 4.021

value of weight of pods/plant was (61.48 g), resulted from the mid-May sowing date with Crawford variety. However, the lowest one was (15.04 g) when soybean McCall variety was planted in early May. On the other hand, the highest value for weight of seeds/pod of Crawford variety was (0.575 g), obtained from sowing soybean in mid-June (very late).Whereas, the lowest value for this character was (0.373 g), obtained from the early June sowing date with McCall variety.

The highest value of seed index of Crawford variety was (20.27g) when soybean sowing in mid-June (very late).However, the lowest value of seed index of McCall variety was (14.49 g) obtained from the early May sowing date.

The highest value for weight of seeds/plant of Crawford variety was (40.13 g) obtained from the mid-May sowing date but, without significant differences over early sowing with this variety and late sowing with Clark variety. This result could be attributed to the high number of pods per plant. Whereas, the lowest average of seeds weight/plant for McCall variety was (10.02 g), resulted from the early May sowing date because it is very early variety.

The results listed in Table (21),reveal that the average values of soybean seed yield and straw yield in ton/feddan significantly affected due to the interaction between sowing dates and varieties.

The highest average value of seed yield of Crawford variety was (1.770 ton/feddan), resulted from the mid-May sowing date but, without significant superiority over this variety in the early sowing and Columbus in early and/or medium sowing dates. The high seed yield ton/feddan of both varieties in early May and/or mid-May sowing dates could be attributed to the high number of pods/plant, number of seeds/ pod and seed yield/plant. However, the lowest average of seed yield of McCall variety was (0.427 ton/feddan), obtained from the early June sowing date.

Generally, the low yield of McCall, Evans and Hardin with planting dates could be attributed to the low number of pods/plant, seed index, number of seeds/pod and seed yield/ plant. This result might be attributed to the fact that these varieties belong to group 00,0,I (early maturity).

The highest value of straw yield ton/feddan was obtained from Columbus variety with early May sowing date. This result might be attributed to the short day in the later sowing date, such condition induces soybean plants to flowering, maturity and limited the growth attributes.On the other hand, the lowest value for straw yield/feddan of McCall variety was obtained from the mid-May sowing date. This result might be attributed to the fact that the variety Columbus and McCall belong to group IV and oo maturity, respectively.

III- Correlation and path coefficient analysis :

The simple correlation coefficient between individual plant yield and each of the some yield components at harvest i.e. number of seeds/plant, number of pods/plant, weight of pods/plant,seed index and number of seeds/pod were calculated within the sowing date for each variety.Studying the association between plant yield and some of its components gives very useful information to the plant breeder who wants to incorporate desirable characters.

The phenotypic covariance between seed yield per plant and each of some yield components were estimated for individual sowing date in each cultivar. These covariances were used to estimate the phenotypic correlation and they are presented in Table (22).

Data show that significant positive phenotypic correlation coefficient was detected between seed yield/plant and each of number of seeds/plant and weight of pods/plant in varieties and dates of planting under test. This result indicates that selection for high number of seeds/plant and weight of pods/plant would be accompanied by high seed yield per plant. Similar trend was obtained by, **Egli (1975), El-Bayoumi (1980), Moursi <u>et</u> <u>al</u>. (1983), Zeition (1983) and Nakamura <u>et</u> <u>al</u>. (1986).**

Seed yield/plant was positively correlated with number of pods/plant in Hardin, Hobbit, Williams 82, Crawford and Columbus varieties at four planting dates (i.e. 1 May, mid-May,1 June,mid-June) and three out of the four planting dates in Evans, Mead, and Clark varieties. While, McCall cultivar highly significant positive correlation coefficients were detected between seed yield/plant and number of pods/plant at the first and fourth planting dates.This results,also indicates that high number of pods/plant is important in developing new varieties.This result is agreement with those previously, Table (22): Correlation coefficient between seed yield and some characters in soybean varieties.

1990 season.

Seed yield / Characters / Varieties / sowing dates		Number of seeds/plant	Number of pods/plant	Weight of pods/plant	Seed index	Number of seeds/pod
McCall	D1	0.987**	0.727**	0.994**	0.591*	0.041
	D2	0.813**	0.217	0.996**	0.203	0.033
	D3	0.592*	0.506	0.994**	0.262	0.259
	D4	0.970**	0.968**	0.995**	0.270	0.092
Evans	D1	0.906**	0.576*	0.988**	0.296	0.543*
	D2	0.688**	0.668**	0.994**	0.530*	0.359
	D3	0.961**	0.166	0.989**	0.144	0.059
	D4	0.970**	0.900**	0.996**	0.280	0.379
Hardin	D1	0.845**	0.741**	0.994**	0.477	0.404
	D2	0.721**	0.870**	0.986**	0.253	0.238
	D3	0.733**	0.873**	0.997**	0.094	0.677**
	D4	0.983**	0.887**	0.992**	0.643**	0.380
Hobbit	D1	0.985**	0.675**	0.993**	0.377	0.062
	D2	0.958**	0.713**	0.996**	0.750**	0.003
	D3	0.761**	0.592*	0.550*	0.281	0.640*
	D4	0.953**	0.950**	0.997**	0.022	0.049
Mead	D1	0.939**	0.744**	0.886**	0.243	0.297
	D2	0.781**	0.791**	0.799**	0.040	0.123
	D3	0.926**	0.131	0.916**	0.141	0.094
	D4	0.950**	0.939**	0.959**	0.370	0.204
Williams 82	D1	0.967**	0.711**	0.987**	0.495	0.042
	D2	0.988**	0.875**	0.987**	0.137	0.115
	D3	0.989**	0.830**	0.998**	0.284	0.657*
	D4	0.948**	0.734**	0.881**	0.414	0.084
Clark	D1	0.757**	0.849**	0.814**	0.297	0.311
	D2	0.505	0.312	0.952**	0.190	0.330
	D3	0.961**	0.793**	0.995**	0.502	0.016
	D4	0.860**	0.583*	0.965**	0.402	0.563*
Crawford	D1	0.646*	0.812**	0.900**	0.013	0.079
	D2	0.844**	0.744**	0.992**	0.318	0.180
	D3	0.977**	0.974**	0.996**	0.127	0.537*
	D4	0.717**	0.684**	0.847**	0.692**	0.103
Columbus	D1	0.937**	0.718**	0.857**	0.406	0.109
	D2	0.768**	0.727**	0.904**	0.030	0.063
	D3	0.978**	0.818**	0.958**	0.371	0.240
	D4	0.965**	0.966**	0.938**	0.766**	0.198

D1 First May sowing date. D2 Mid - May sowing date

D3 First June sowing date D4 Mid - June sowing date

obtained by, **Malhotra et al. (1972), Sengupta and Sen (1972), Shetter et al. (1978), Moursi et al. (1983) and Khattab (1984).**

Significant positive phenotypic correlation coefficient was found between seed yield/plant and seed index at the second planting dates for Evans and Hobbit cultivars, fourth planting date for Hardin, Crawford and Columbus, and first planting date for McCall cultivar. These results indicate that a high seed yield/plant may be accompanied by a heavy seed index in cases mentioned above. Similar trends were obtained by, **Rohewal and Kopper (1973) Pal and Saxena (1977), Moursi et al. (1983), Shweliya et al. (1985), and Nakamura et al. (1986).** On the other hand, insignificant phenotypic correlation coefficient was detected between seed yield/plant and seed index in other cases (Table 22), indicating that the heavy seeds had no effect on seed yield/plant. The same trend was also realized by, **Pal and Saxena (1977).**

Significant positive phenotypic correlation values were found between seed yield/plant and number of seeds/pod at the early May planting date for Evans, and early June planting date for Hobbit and Crawford varieties, and mid-June planting date for Clark variety. For the rest cases, insignificant correlation coefficients were obtained. This result indicates that high seed yield/plant might be resulted from the increase in seeds per pod in some cases. These findings are supported by, **Kaw and Menon (1972),Rohewal and Kopper (1973), El-Bayoumi (1980), Khattab (1983), Tayo (1983) and Shweliya et al. (1985).**

The method of path coefficient investigated included some yield components, i.e. number of seeds/plant, number of pods/plant, weight of pods/plant, seed index and number of seeds/pod. Path analysis was practised in order to find out the relative importance of these yield components under investigation contributing to soybean seed yield.

The effect of direct and indirect path coefficients of number of seeds/plant, number of pods/plant, weight of pods/plant, seed index and number of seeds/pod on soybean seed yield as affected by different sowing dates (1st May, 15th May, 1st June and 15th June) are shown in Table (23).

These estimates were computed by partitioning the total correlation coefficient into its components. In early sowing date (1 May), weight of pods/plant proved to have a high direct effect on seed yield compared with that of number of seeds/plant, number of pods/plant, seed index and number of seeds/pod. Since the average mean of the direct effect was 0.616,0.285,0.060, 0.049 and 0.025 for these five components, respectively (Table 23). Again, as mentioned before, total correlation coefficient was most pronounced in weight of pods/plant (r=0.935) than in number of seeds/plant (r=0.885), in number of pods/plant (r=0.728) and in seed index (r=0.352) or in number of seeds/pod (r = 0.192), (Table 22).

The relative importance of yield components contributing to soybean seed yield as recorded as percentage of variation for number of seeds/plant, number of pods/plant, weight of pods/plant, seed index and number of seeds/pod and their

Table (23):Partitioning of simple correlation coefficients between seed yield/ plant and some yield components of soybean varieties under different sowing dates.

Source	Correlation			
	D1	D2	D3	D4
Seed yield via. number of seeds/plant				
Direct effect	0.2853	0.132	0.318	0.4452
Indirect via. number of pods/plant	0.0402	0.034	0.005	0.0634
Indirect via. weight of pods/plant	0.543	0.613	0.551	0.5247
Indirect via. seed index	0.011	0.003	0.0001	0.0182
Indirect via. number of seeds/pod	0.005	0.003	0.001	0.0008
Total correlation	0.885	0.785	0.875	0.924
Seed yield via. number of pods/plant				
Direct effect	0.06	0.058	0.007	0.0741
Indirect via. number of seeds/plant	0.192	0.077	0.207	0.3806
Indirect via. weight of pods/plant	0.465	0.468	0.416	0.5201
Indirect via. seed index	0.01	0.002	0.0004	0.0203
Indirect via. number of seeds/pod	0.001	0.004	0.0007	0.0009
Total correlation	0.728	0.609	0.631	0.846
Seed yield via. weight of pods/plant				
Direct effect	0.6162	0.814	0.663	0.5857
Indirect via. number of seeds/plant	0.2513	0.10	0.264	0.399
Indirect via. number of pods/plant	0.045	0.035	0.004	0.0658
Indirect via. seed index	0.018	0.008	0.0006	0.0341
Indirect via. number of seeds/pod	0.004	0.001	0.0009	0.0008
Total correlation	0.935	0.956	0.933	0.952
Seed yield via. seed index				
Direct effect	0.049	0.038	0.0035	0.0979
Indirect via. number of seeds/plant	0.065	0.10	0.0111	0.0828
Indirect via. number of pods/plant	0.013	0.003	0.0009	0.0153
Indirect via. weight of pods/plant	0.226	0.175	0.1147	0.2038
Indirect via. number of seeds/pod	0.001	0.005	0.0002	0.0002
Total correlation	0.352	0.231	0.130	0.369
Seed yield via. number of seeds/pod				
Direct effect	0.025	0.06	0.0034	0.0044
Indirect via. number of seeds/plant	0.06	0.006	0.095	0.0766
Indirect via. number of pods/plant	0.003	0.004	0.0015	0.0144
Indirect via. weight of pods/plant	0.107	0.013	0.1711	0.1107
Indirect via. seed index	0.003	0.003	0.0002	0.0035
Total correlation	0.192	0.086	0.271	0.172

D1 First May sowing date. D2 Mid - May sowing date

D3 First June sowing date D4 Mid - June sowing date

interactions for early sowing date is presented in Table(24). The path analysis revealed that the direct effect for weight of pods/plant was 42.4% being higher than that of number of seeds/plant, number of pods/plant, and seed index or number of seeds/pod. The joint effect of weight of pods/plant with number of seeds/plant, number of pods/plant, seed index and with number of seeds/pod amounted to 34.68%, 6.26%, 2.46% and 0.56% of the variation, respectively. Number of seeds/plant with number of pods/plant, seed index and with number of seeds/pod amounted to 2.57%, 0.67% and 0.34%, respectively, while number of pods/plant with seed index and with number of seeds/pod was 0.11% and 0.01%, respectively, and seed index with number of seeds/pod was 0.02% of the variation.

Again, as mentioned before, weight of pods/plant formed the most percentage contributed direct effect which had 42.4% of the total variation and their path coefficient was high (0.616). On the other hand, path coefficient of number of seeds/plant, number of pods/plant, and seed index or number of seeds/pod was 0.285, 0.060, 0.049 and 0.025 respectively, where,contribute 9.06%,0.44% and 0.22% or 0.11%,respectively, of the total variation. Here, it is worthy to mention that weight of pods/plant was the most effective in contributing much soybean seed yield under the early sowing date condition (1 May), since R^2 was 99.91% of the total variation of seed yield and the residual effects contributing 0.09% of the total variation.

Table (23), shows that weight of pods/plant, also, proved to have a high direct effect on seed yield of soybean under the medium sowing dates condition (i.e. sowing in mid-May)

Table (24): Coefficient of determination and percentage contributed of seed yield variation in soybean as affected by different sowing dates.

Source	Coefficient of determination				Contributed Percentage			
	D1	D2	D3	D4	D1	D2	D3	D4
Number of seeds/plant.	0.081	0.017	0.1011	0.198	9.05	1.83	11.2	16.26
Number of pods/plant.	0.004	0.003	0.00005	0.005	0.44	0.32	0.01	0.41
Weight of pods/plant.	0.380	0.663	0.4396	0.343	42.4	71.21	48.70	28.16
Seed index	0.002	0.001	0.00001	0.010	0.22	0.11	0.001	0.82
Number of seeds/pod	0.001	0.004	0.00001	0.00002	0.11	0.44	0.001	0.002
Number of seeds/plant X number of pods /plant	0.023	0.009	0.0029	-0.0564	2.57	0.99	0.26	4.63
Number of seeds/plant X weight of pods /plant	0.31	0.162	0.3504	0.4673	34.68	17.40	38.82	38.37
Number of seeds/plant X seed index	0.006	0.001	0.00008	0.0162	0.67	0.11	0.009	1.33
Number of seeds/plant Xnumber of seeds /pod	0.003	0.001	0.00065	-0.0007	0.34	0.11	0.07	0.057
Number of pods/plant X weight of pods/ plant	0.056	0.054	0.0058	-0.0771	6.26	5.80	0.64	6.33
Number of pods/plant X seed index	0.001	0.0002	0.00001	-0.003	0.11	0.02	0.001	0.246
Number of pods/plant X number of seeds /pods	0.0001	0.0005	0.00001	0.0001	0.01	0.05	0.001	0.008
Weight of pods/plant X seed index	0.022	0.013	0.0008	0.04	2.46	1.40	0.009	3.284
Weight of pods/plant X number of seeds /pods.	0.005	0.002	0.0012	-0.001	0.56	0.22	0.13	0.082
Seed index X number of seeds/pods	-0.0002	0.0004	-0.000001	-0.00003	0.02	0.04	0.00001	0.002
R^2	0.8939	0.9311	0.9026	0.9414	99.91	99.94	99.851	99.991
Residual	0.1061	0.0689	0.0974	0.0586	0.09	0.06	0.149	0.009
Total	1.00	1.00	1.00	1.00	100	100	100	100

D1 First May sowing date. D2 Mid - May sowing date

D3 First June sowing date D4 Mid - June sowing date

when compared with number of seeds/plant, number of pods/ plant and seed index or number of seeds/pod.Since the average mean of the direct effect was 0.814, 0.132, 0.058 and 0.038 or 0.060 for these five parameters, respectively. Also, as mentioned before (Table 22), the correlation coefficient was most pronounced in weight of pods/plant (r = 0.956) than in number of seeds/plant (r = 0.785), number of pods/plant (r = 0.609) and seed index (r = 0.231), or number of seeds/pod (r = -0.086). Moreover, the path analysis revealed that the direct effect of weight of pods/plant was 71.21% being higher than that,obtained from number of seeds/plant,number of pods/ plant and seed index or number of seeds/pod which were 1.83%, 0.32% and 0.11% or 0.44%, respectively. The joint effect of weight of pods/plant with number of seeds/plant, number of pods/plant, seed index and number of seeds/pod was 17.40%, 5.80%, 1.40% and 0.22%, respectively. Furthermore, the joint effect of number of seeds/plant with number of pods/plant, seed index and number of seeds/pod was 0.99%, 0.11% and 0.11% respectively, number of pods/plant with seed index and number of seeds/pod was less (0.02% and 0.05%), and seed index with number of seeds/pod was 0.04%. The results, mentioned above show that, weight of pods/plant was the most effective in contributing to soybean seed yield in mid-May (medium sowing date), since path coefficient was 0.814 having 71.21% of the total variation and R^2 was 99.94% of the total variation of seed yield and the residual effects contributing 0.06% of the total variation.

On the other hand, partitioning correlation coefficient at 1-June (late sowing date) into its components presented in

(Table 23). The weight of pods/plant, again, proved to have a high direct effect on seed yield when compared with that of number of seeds/plant, number of pods/plant, seed index and number of seeds/pod, where, the average means of the direct effect were, 0.663, 0.318, 0.007, 0.004 and 0.003 for the five yield attributes, respectively. Recording to the (Table 22), simple correlation coefficient was higher pronounced in weight of pods/plant (r = 0.933) than the number of seeds/ plant (r = 0.875), number of pods/plant (r = 0.631), seed index (r = 0.130) or number of seeds/pod (r=0.271).Moreover, the path analysis revealed that the direct effect for weight of pods/plant was 48.70% being higher than that of number of seeds/plant, number of pods/plant, seed index and number of seeds/pod which was 11.20%, 0.01%, 0.001% and 0.001%,respectively. Table (24) shows that the joint effect of weight of pods/plant with number of seeds/plant, number of pods/plant, seed index and number of seeds/pod was 38.82%, 0.64%, 0.009% and 0.13% of the variation, respectively, number of seeds/ plant with number of pods/plant, seed index and number of seeds/pod was less, i.e. 0.26%, 0.009% and 0.07% of variation, respectively, in number of pods/plant with seed index and number of seeds/pod was 0.001% and 0.001% and in seed index with number of seeds/pod was 0.00001%, respectively. Thus, weight of pods per plant reflected the greatest effect in contributing seed yield of 1-June (late sowing date) where path coefficient was 0.663 having 48.7% of the total variation, since R^2 was 99.851% of the total variation of seed yield and the residual effects of contributing was 0.149% for the total variation.

Data illustrated in Table (23) show that weight of pods/plant, also in mid-June (very late sowing date) proved to have a high direct effect on seed yield when compared with the number of seeds/plant, seed index, number of seeds/pod and number of pods/plant, where, the mean estimates of the direct effect was 0.5857, 0.4452, 0.0979, -0.0044 and -0.0741 for these five parameters, respectively. However, data shown in Table (22) indicate that correlation coefficient was most pronounced in weight of pods/plant (r = 0.952) than in number of seeds/plant (r = 0.924), number of pods/plant (r = 0.846), seed index (r = 0.369) and number of seeds/pod (r = 0.172). Also, data in Table (24) show that the direct effect for weight of pods/plant was 28.16% being higher than that of number of seeds/plant, seed index, number of pods/plant and number of seeds/pod which was 16.26%, 0.82%, 0.41% and 0.002% respectively. Moreover, the joint effect of weight of pods/plant with number of seeds/plant, number of pods/plant, seed index and number of seeds/pod was 38.37%, 6.33%, 3.284% and 0.082%, respectively, number of seeds/plant with number of pods/plant, seed index and number of seeds/pod was 4.63%, 1.33% and 0.057%, respectively, of number of pods/plant with seed index and number of seeds/pod was 0.246% and 0.008%, respectively, and of seed index with number of seeds/pod was less (0.002%). It could be concluded that, weight of pods/plant had the highest effect in contributing soybean seed yield at mid-June (very late sowing date) since path coefficient was 0.5857, having 28.16% of the total variation and R^2 was 99.991% of the total variation and the residual effects contributing was 0.009% of the total variation.

Here, it is noteworthy to mention that these parameters of pods weight/plant and number of seeds/plant could contribute much of soybean seed yield in the all sowing dates, i.e. 1 May, mid-May, 1 June and mid-June. Since weight of pods/plant contributing to soybean seed yield as percentage of variation were 42.4%,71.21%,48.7% and 28.16% and number of seeds/plant contributes were 9.06%, 1.83%, 11.2% and 16.26% of the total variation for the four sowing dates, respectively. Whereas the R^2 for the respective sowing dates were 99.91%, 99.94%, 99.85% and 99.991% and the residual effects contributing were 0.09%,0.06%,0.149% and 0.009%,respectively.

Similar results were reported by, **Pandey and Torrie (1973), Moursi *et al.* (1983), Zeition (1983) and Bargale *et al.* (1988).**

IV- Stability for seed yield/feddan :

This kind of study reported provides on opportunity to supply soybean breeder with evaluation of different breeding stocks in a large number of environments. Many factors, such as soil, temperature, soil fertility, humidity, air movement, presence or absence of other organisms (insects, pathogens, weeds, etc....) and many other factors (densities, planting date) make up an environment. The average yields of cultivars in replicated trials appears to be the best method available for measuring differences in yield environments.

The analysis of variance for single environment (four planting dates in the three years) and the combined analysis over environments were made for seed yield/feddan Bartlet's test of homogeneity of variances showed that the variance estimates were homogenous.

The analysis of variance for single environment (planting date) as well as the combined analysis for seed yield/feddan are given in Table (25). The results of analysis of variance showed that the presence of significance differences between genotypes at all environments revealing that the genotypes varied in their performances from one to another. These results suggested that the comparison between genotypes should be made in order to determine the best. performing genotypes at planting date.

Mean squares of environments, varieties and varieties x environments interaction were significant Table (25). Significant mean square for environment was detected indicating that the performance of this trait differed from environment to another. Significant varieties and varieties x environment interaction mean squares were detected, revealing that varieties carried genes with different additive and additive x additive gene effects which seemed to be inconstant from environment to another.

Similar trend was also realized by, **Walkar and Fehr (1978), Eid et al. (1980), Beaver and Johnson (1981), Ashour et al. (1985), Abul-Naas et al.(1988) and Abo-El-Zahab et al. (1990).**

Environments effects :

Mean values of seed yield/feddan in each environment are given in Table (26). The mean ranged from 0.898 ton/feddan in

Table (25): Analysis of variance for seed yield (Ton/feddan).

Source of variation	d.f		Mean squares												
			Environments												comb-ined
			First year				Second year				Third year				
	Env.	Comb	Early sow-ing 1	Medium sowing 2	Late sow-ing 3	Very late sow-ing 4	Early sow-ing 5	Medium sowing 6	Late sow-ing 7	Very late sow-ing 8	Early sow-ing 9	Medium sowing 10	Late sowing 11	Very late sow-ing 12	
Environm-ent		11	-	-	-	-	-	-	-	-	-	-	-	-	0.613**
Varieties (V-1)	8	8	0.80**	0.86**	0.49**	0.42**	0.41**	0.58**	0.44**	0.21*	0.37**	0.36**	0.28**	0.28**	4.778**
Replicat-ion (r-1)	2	24	0.15	0.03	0.003	0.03	0.10	0.05	0.03	0.10	0.01	0.05	0.00005	0.08	0.053
Env. X V.		88	-	-	-	-	-	-	-	-	-	-	-	-	0.061*
Error (V-1)X (r-1)	16	192	0.02	0.02	0.06	0.05	0.07	0.11	0.06	0.06	0.03	0.03	0.03	0.02	0.046

* and ** significant at 0.05 and 0.01 levels of probability respectively.

Table (26): Mean yield (Ton/feddan) at each environment and overall environments.

Varieties	Mean values environments												Mean variety
	First year				Second year				Third year				
	Early sow-ing 1	Medium sowing 2	Late sowing 3	Very late sow-ing 4	Early sow-ing 5	Medium sowing 6	Late sowing 7	Very late sow-ing 8	Early sow-ing 9	Medium sowing 10	Late sowing 11	Very late sow-ing 12	
McCall	0.429	0.532	0.365	0.531	0.541	0.538	0.315	0.685	0.676	0.708	0.602	0.635	0.546 f
Evans	0.581	0.607	0.529	0.466	0.733	0.778	0.352	0.459	0.888	0.729	0.920	0.698	0.645ef
Hardin	0.494	0.856	0.598	0.413	0.723	0.803	0.364	0.519	0.803	1.015	0.936	0.825	0.696 e
Hobbit	0.631	0.870	0.840	0.915	1.123	1.148	0.611	0.696	0.877	0.846	1.079	0.952	0.882 d
Mead	0.832	1.348	0.926	0.932	1.247	1.197	0.852	0.963	1.194	1.158	1.317	1.111	1.090 c
Williams 82	0.645	1.367	1.188	1.099	1.321	1.382	1.019	1.022	1.078	1.381	1.190	1.238	1.161 c
Clark	0.936	1.461	1.222	1.058	1.382	1.450	1.074	1.044	1.587	1.476	1.333	1.285	1.276 b
Crawford	1.767	1.987	1.437	1.353	1.555	1.778	1.296	1.089	1.507	1.547	1.587	1.365	1.522 a
Columbus	1.765	1.934	1.406	1.433	1.457	1.741	1.159	1.118	1.555	1.523	1.444	1.491	1.502 a
X for Environm-ents	Cd 0.898	a 1.218	c 0.946	c 0.911	ab 1.120	a 1.202	d 0.782	cd 0.844	ab 1.129	ab 1.154	ab 1.156	b 1.067	1.036

0.343 %5

S.E.I = 0.175119 L.S.D. V X E = 0.45 %1

were kept the some at all planting dates. Therefore, the differences between the planting dates and years used herein were attributed to temperature, disease or pest insect damage and slightly to soil productivity.

Varietal performance :

The differences among varieties overall environments regarding seed yield/feddan reached the significant level Table 26.Crawford had the highest value,but without superiority over Columbus. However, the lowest values were recorded by McCall and Evans. All investigators using different varieties reached this findings. Similar results were reported by, **Abul-Naas et al. (1988).**

Mean values of seed yield/feddan for all varieties in each environment are given in Table (26). Mean values of seed yield/feddan ranged from 0.315 ton/feddan for McCall at E7 (third planting date in the second year) to 1.987 ton/feddan for Crawford at E2 (second planting date in the first year). Generally, Crawford and Columbus showed the highest mean values in the second, first and third planting dates in the three seasons. While, McCall had the lowest mean values at E3 and E7.

Stability analysis :

Eberhart and Russell Model (1966).

This model provides a mean of partitioning the genotype environment interaction for each variety into two parts: (1) The variation due to the response of the variety to varying environmental index (sum of squares due to regression), (2) the unexplainable deviations from the regression on the environmental index. They added that a stable preferred variety would have approximately :

1- bi = 1.0

2- S^2d = 0.0

3- A = high mean yield.

Differences among variety mean values were statistically significant. The range varies from 0.546 to 1.522 ton/feddan in different varieties.

Data in Table (27) showed that the linear response of environment was highly significant,consquently,the regression coefficient (bi) of seed yield on the environmental index and deviation from regression mean squares (S^2di) pooled over the twelve environments were calculated for each variety are presented in Table (27).

Significant varieties x environments was detected in Table (28). This indicated that the differences among varieties for their regression on the environmental index. Proceeded further to estimate the (bi) values: when this interaction is significant. Pooled deviations mean square was insignificant suggesting linear regressions also assume importance considering deviation mean square for individual variety.Significant bi values were obtained for all varieties and the slope of regression lines did not deviate significantly from unity in the all varieties. The deviation from regression mean squares (S^2di) were significant for Crawford and Columbus.

Table (27): Mean seed yield/feddan over environments regression coefficient (bi) and deviation mean squares (S^2di) for nine genotypes.

No.	Varieties	$\overline{X}$	b	S^2di
1	McCall	0.546	0.876	+0.0174
2	Evans	0.645	0.956	-0.0042
3	Hardin	0.696	1.268	-0.0059
4	Hobbit	0.882	0.872	0.000
5	Mead	1.090	1.092	-0.0095
6	Williams 82	1.161	0.980	0.0094
7	Clark	1.276	1.204	-0.0044
8	Crawford	1.522	1.104	0.0187
9	Columbus	1.502	0.992	0.0197
General mean		1.036	1.038	0.0046
S.E.		0.051	0.255	0.016

Table (28): Analysis of variance for seed yield (Ton/feddan) of nine varieties.

No.	Source	d.f	S.S	M.S
1	Total	(NV-1) = 107	16.676	0.1559
2	Varieties	(V-1) = 8	12.740	1.5925**
3	Environment	V (N-1) = 99	3.936	0.0398**
	(Env) + VxENN			
	a) Env.(Linear)	(1) = 1	2.153	2.153**
	b) VxEnv. (linear)	(V-1) = 8	0.315	0.0394*
	c) Pooled deviations	V(N-2) = 90	1.468	0.0163
	1. Variety 1	(N-2) = 10	-0.018	-0.0018
	2	(N-2) = 10	0.114	0.0114
	3	(N-2) = 10	0.097	0.0097
	4	(N-2) = 10	0.156	0.0156
	5	(N-2) = 10	0.061	0.0061
	6	(N-2) = 10	0.250	0.0250
	7	(N-2) = 10	0.112	0.0112
	8	(N-2) = 10	0.343	0.0343*
	9	(N-2) = 10	0.353	0.0353*
4	Pooled error	N(r-1)(V-1)= 192		0.0156

* Significant at P = 0.05

** Significant at P = 0.01

The highest yielding varieties were Crawford, Columbus, Clark and Williams 82. Also, the minimum deviation from regression mean square (S^2di) pooled over twelve environments were obtained for Williams 82 and Clark. These results revealed that the two varieties (Williams 82 and Clark) were more stable than the Crawford and Columbus under the environments study. **Eberhart and Russell (1966)** reported that the stable variety has a high mean yield, bi value equal one and the deviation from regression near zero. **Again, Eberhart and Russell (1969) and Brecse (1969)** reported that the most important stability parameter appeared to be the minimum deviations mean squares. According to these reports, Williams 82 and Clark were more stable than others under the environments studied.

The unstable varieties i.e. (Crawford and Columbus) seemed to have high seed yields above grand mean. These varieties, however, could be over looked because their high yield potential was limited to particular environments. The two varieties gave the highest yield in the second planting date (Table 26). Meanwhile, other genotypes were the regression coefficient value equal one and the deviation from regression near zero and usually had yields ($\bar{x}i$) below the grand mean. These varieties might be fruitful under poor environments.

These finding were also obtained by **Finlay and Wilkinson (1963), Rowe and Androw (1964), Ghaderi et al. (1980), Abul-Naas et al. (1988) and EL-Hosary et al. (1988).**