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SIGNIFICANCE OF CORRELATION BETWEEN DURATION OF JUVENILE PERIOD AND EACH OF HEIGHT, EARLINESS AND PRODUCTIVITY CHARACTERS FOR EARLY SELECTION IN THE OWN ROOTED HYBRID TEA-ROSE SEEDLINGS

Abdel-Maksoud, B.A.

Department of Floriculture, Faculty of Agriculture, Alexandria University, Alexandria, Egypt.

ABSTRACT

Two successive experiments were set up using stratified seeds collected from a population of 2 and 3 years old-plants of Hybrid Tea-rose (*Rosa hybrida*, L.cv. Kardinal). Each experiment continued for 3 years in glasshouses. Seeds were sown in plastic trays, individually transplanted in the cotyledon stage into 20 cm diameter clay pots and left until the time of the apical flower bud appearance. According to this time, seedlings were divided into 12 and 11 categories in the 1st and 2nd experiments; respectively, and planted in ground beds. The number of days from germination to flower bud appearance is defined as juvenile period. The relations between juvenile period and some vegetative and flowering characters in the own rooted seedlings were studied.

One year old-seedlings, varying in juvenile periods, were budded on a rootstock *Rosa canina*, L.cv. Inermis and the grafted plants were planted in ground beds. The relations between some characters of the own rooted seedlings and those of the grafted plants were studied for 2 years. The results of the two experiments can be summarized as follows:

1- The leaf number at the flower bud appearance was 7 leaves.
2- The own rooted seedlings with short juvenile periods had shorter heights at both times of flower bud appearance and first flowering, flowered earlier and produced more flowers than those with long juvenile periods. Significant positive correlations were detected between the duration of the juvenile period and each of the height of the own rooted seedlings at flower bud appearance, the height at first flowering either for the own rooted seedlings or for the 1 year old-grafted plants and flowering time of the own rooted seedlings. Also, significant positive correlations were found between the own rooted seedlings height at flower bud appearance and their height at first flowering.
3- Significant negative correlations were found between the juvenile period and the flower yield of the own rooted seedlings. At first flowering, there were significant positive correlations between the height of the own rooted seedlings and their height on a rootstock.
4- There were significant positive correlations between the flower yield of the 1 year old-own rooted seedlings and their yield in the 2nd year and also their yield in each of the 1st and 2nd year after grafting. The same situations were recorded between the flower yield of the 2 years old-own rooted seedlings and that of the grafted plants either in the 1st or in the 2nd year after grafting. The flower yield of the 1 year old-grafted plants and that of the 2 years old-grafted ones were positively correlated.
5- It was clear that the juvenile period depends on the plant development and does not control this process. The relations between the juvenile period and the studied characters of the own rooted seedlings were probably largely inherent

and remained valid for the grafted plants. Selection was carried out firstly for short juvenile period that means for early flowering, secondarily for long height and at the end for flower yield. The obtained results were discussed.

INTRODUCTION

Rosa is a widespread genus (Fam. *Rosaceae*), contains ornamental shrubs which are grown for handsome flowers, ornamental fruits and attractive foliage. Roses are deciduous or sometimes evergreen, upright, less often climbing shrubs. Flowers are solitary or corymbose at the end of branchlets, white or coloured. Fruits are fleshy, scarlet or bright red and berry-like at maturity, containing several achenes, usually erroneously called seeds. The fruit itself is called a "hip". All true species can be propagated by seeds to obtain new varieties (Bailey, 1961). Almost all species grow from cuttings of ripened wood under glass. Also grafting are often done with roses.

In Hybrid Tea-rose most seedlings flower a few weeks after seed gramination and the number of days from germination to flower bud appearance is defined as the juvenile period (De Vries, 1976a; DeVries and Dubois, 1977 and DeVries *et al.*, 1981). The juvenile period of fruit seedligns is defined as the number of years between sowing and first flowering (Visser, 1970; Visser and DeVries, 1970; Blazek, 1985 and Kazakov and Kichina, 1988). In olive the juvenile period is defined as the time lapse from seed germination to first fruit development (Lavee *et al.*, 1996). Wilkerson *et al.* (1989) and Collinson *et al.* (1993) reported that the time from sowing to first flowering in soybean is called juvenile period. In alfalfa the time beween emergence and flowering is known as juvenile period (Major *et al.*, 1991).

In most woody plants the juvenile period is relatively long (De Vries, 1976a; Osman and Basri, 1987 and Yesiloglu and Tuzcu, 1991) and attempts to shorten the duration of the juvenile period were more or less successful (Songquan, 1984; Nyomora, 1985; Jordan and Oyanedel, 1992; Mehlenbacher and Smith, 1992; Snowball *et al.*, 1994 and Peel and Galwey, 1999). Shortening the juvenile period would improve the efficiency of plant breeding (Visser, 1970; Hsu and Lin, 1987; Harty *et al.*, 1992; Mehlenbacher and Smith, 1992 and Lavee *et al.*, 1996). Selection for short juvenile period has been shown to be a possibility of shortening the breeding cycle (DeVries, 1976a; De Vries and Dubois, 1977; Hsu and Lin, 1987; Kazakov and Kichina, 1988; Oosthuizen, 1990; Harty *et al.*, 1992 and Mehlenbacher and Smith, 1992).

The duration of the juvenile period is likely to be essentially inherent (Visser, 1970; Visser and DeVries, 1970; De Vries, 1976a; Abeysiriwardena and Buss, 1991 and Peel and Galwey, 1999). The relation between plant vigour and juvenile period is largely inherent also (Visser, 1970; Visser and De Vries, 1970; Hsu and Lin 1987; Oosthuizen, 1990; Abeysiriwardena and Buss, 1991; Mehlenbacher and Smith, 1992; Collinson *et al.*, 1993 and Peel and Galwey, 1999) and this relation may be influenced by environment where the juvenile period is generally shorter under favourable conditions (Visser and DeVries, 1970; Singh and Nanda, 1984; Koch *et al.*, 1987; Wilkerson *et*

al., 1989; Abeysiriwardena and Buss, 1991; Major et al., 1991; Ramin and Atherton, 1991; Collinson et al., 1993 and Peel and Galwey, 1999).

In breeding rose cultivars for cut flowers, rapid flowering, long cut stems and high flower yield are the main characters handled by breeders. In roses the long stemmed varieties yield fewer flowers than the short stemmed ones (De Vries, 1976b).

The relations between vegetative and flowering characters and the juvenile period were studied in many crops, but in roses these studies are scanty. Therefore, a trial was set up to reveal the relations between some growth characters and the juvenile period in rose seedlings of Hybrid Tea type and to carry out an early selection for height, early flowering and flower yield in rose seedlings, with respect to the juvenile period.

MATERIALS AND METHODS

The present work was conducted in a private nursery located at Khorshid Region on the side of the high speed way at a distance of 2 km from Alexandria. Two similar experiments were carried out in 2 glasshouses (10X20 m) provided with automatic heating and ventilation. The first experiment was carried out during the years from 1996 to 2000 and the second one from 1997 to 2001.

In early October, 1996 and 1997, hips were collected from 2 and 3 years old-plants of *Rosa hybrida*, L. cv. "Kardinal" (Hybrid Tea) grafted on *R.canina, L.cv.* Inermis for the 1st and 2nd experiments; respectively. The plants were individually grown in 35 cm diameter clay pots. The hips were crushed to expose the achenes which were soaked in tap water for 48 hr. The washing was repeated until the achenes were free from impurities then air dried and placed in an acid proof glass vessel. Concentrated sulphoric acid was added to form a thin film over the test of all achenes to reduce the thickness of their coats. After 30 minutes the coats turned black. The treated achenes were transferred to containers filled with tap water and the washing was repeated 3 times to remove all traces of acid. Achenes were air dried and the blackness was removed by rubbing.

On October 10, 1996 (1st experiment) and October 15, 1997 (2nd one), the temperature storage treatment was applied according to Roberts (1979). Achenes were spread thinly between layers of wet sand in plastic trays and stored at 20±1°C for 30 days followed by a period of 14 weeks at 5±1°C, then temperature treatment was terminated. On February 16, 1997 and 21, 1998 stratified seeds were treated with the fungicide vitafax captain against damping-off and sown in plastic trays filled with a mixture of 1sphagnum peat moss: 1 sand (by volume). Prior to sowing, the mixture was drenched with previcur (0.15%) and benomyl (0.05%). Trays were kept in glasshouse and watering was available when required. Germination started within 2 weeks from sowing in both experiments. After germination and in cotyledon stage, seedlings were individually transplanted into 20 cm diameter clay pots contained a mixture of sphagnum peat moss and clayed mineral soil (1:1 by volume). The pots were put on benches in the same glasshouse at

day/night temperatures of 26/18°C, photoperiod was 16 h; light energy was 94 w/m^2 (cool-white VHO Sylvania fluorescent lamps, 50w/m^2 and 60-w incandescent lamps, 44w/m^2) and RH was 70±5%. Seedlings were left until the apical flower bud appeared in all seedlings (till May 8, 1997 and May 6, 1998 in the 1st and 2nd experiments; respectively).

According to the number of days from germination to flower bud appearance (juvenile period), seedlings were divided into 12 and 11 categories in the 1st and 2nd experiments; respectively. Each category contained 3 consequent juvenile periods. On May 9, 1997 and May 7, 1998 all seedlings of the 1st and 2nd experiments; respectively, were transplanted into ground beds in the same glasshouse with no partitions in the bottom, under the same conditions mentioned before and with 12 seedlings/m^2. The number of the own rooted seedlings was 503 for the 1st experiment and 352 for the 2nd one. Prior to transplanting, nitrogen (32 g N/m^2), phosphorus (16 g P/m^2) and potassium (72 g K/m^2) were added and mixed into the soil of beds. The used fertilizers were: ammonium sulphate (20% N), mono calcium phosphate (20% P_2O_5) and potassium sulphate (50% K_2O). These rates were designed according to Johansson (1979) to bring the soil nutrient levels up to the proximity of the highest recommended values. Also, magnesium sulphate (9.9% Mg), iron as chelate (9% Fe) and manganese sulphate (24.6% Mn) were added at the rates of 6,3 and 7.5 g/m^2; respectively, (Johansson, 1979). The seedlings were grown and treated as cut roses where the soft pinch was carried out.

After one year from sowing the stratified seeds (on February 15, 1998 and February 19, 1999 for both experiments; consecutively) each of the own rooted seedling was grafted on a rootstock of *R. canina*, L. cv. Inermis, 5 weeks later the grafted plants were transplanted into ground beds in the glasshouse under the previous conditions. Thus, each plant was repeated twice; 1 year old-seedling on its own roots and 5 weeks old-plant on a rootstock. At the beginning of February of the next years, all individuals of both experiments were pruned. At the end of December 2000 and 2001 the 1st and 2nd experiments were terminated; respectively. The records of both experiments were:

I. For the own rooted seedlings:

1- Germination date.
2- Number of fully expanded leaves, at 3 days intervals, till the flower bud appearance (till the end of juvenile period).
3- Number of days from germination to the flower bud appearance (juvenile period).
4- Seedling height at flower bud appearance (in cm), in the 1st year.
5- Length of the leaved shoot, at 3 days intervals (in cm), till the first flowering in the 1st year.
6- Stalk length, at 3 days intervals (in cm), in the 1st year.
7- Date of the 1st flowering (number of days from germination till the 1st flower was about ripe to cut) or flowering date in the 1st year.
8- Seedling height at the 1st flowering (in cm) in the 1st year.

9- Flower yield in the 1st year and after bottom break formation in the 2nd year.

The characters No. 2, 5 and 6 were studied on a sample of 16 seedlings with the juvenile period of 29 days in the 1st experiment and on a sample of 12 seedlings with the juvenile period of 31 days in the 2nd experiment. The two samples were randomly chosen to reveal the development of the rose seedling and their curves were drawn.

II. For the grafted plants:

1- Plant height at 1st flowering (in cm) from the joint region with the rootstock to the apex in the 1st year after grafting.
2- Flower yield during each of the 1st and 2nd years after grafting.

The layout of both experiments, either in the stage of the own rooted seedlings or in that of the grafted plants, was a completely randomized design containing 12 or 11 categories of the juvenile periods in the 1st or 2nd experiments; respectively, with different repetitions (number) at each category. Data of the heights, flowering dates and flower yields were statistically analysed, differences among means of the different categories of the juvenile periods were calculated using least significant difference at 0.01 level of probability (Snedecor and Cochran, 1967).

III. Correlation coefficients between the following characters were calculated.

1. Height of the own rooted seedlings at flower bud appearance and height of the same seedlings at 1st flowering.
2. Duration of juvenile period and each of:
   i) height of the own rooted seedlings at flower bud appearance,
   ii) height of the own rooted seedlings at 1st flowering,
   iii) height of the grafted plants at 1st flowering,
   iv) flowering time of the own rooted seedlings,
   v) flower yield of the own rooted seedlings in the 1st year,
   vi) flower yield of the own rooted seedlings in the 2nd year.
3. Height of the own rooted seedlings at 1st flowering and height of them on a rootstock at 1st flowering.
4. Flower yield of the own rooted seedlings in the 1st year and each of:
   i) their yield in the 2nd year on the own roots,
   ii) their yield in the 1st year after grafting,
   iii) their yield in the 2nd year after grafting.
5. Flower yield of the own rooted seedlings in the 2nd year and each of:
   i) flower yield in the 1st year after grafting,
   ii) flower yield in the 2nd year after grafting,

3- Flower yield of the grafted plants in the 1st year and their yield in the 2nd year.

RESULTS AND DISCUSSION

Seed germination: The main dilemma which faced rose breeders is uneven germination of the seeds. This problem could be solved by the used treatments. A combination of acid treatment and controlled temperature

storage was applied in the present study. When seeds were stored at 20±1°C for 30 days and subsequently for 14 weeks at 5±1°C, they were ready to germinate. The germination was inhibited by low temperature. When the stratified seeds were sown in a warm greenhouse at 26°C, the viable seeds started to germinate within 2 weeks.

The germination percentages were 64 and 62% in the 1st and 2nd experiments; respectively. Roberts (1979) mentioned that the germination percentage of rose seeds following the temperature storage treatment that used in this work will vary between 65 and 75%. De Vries and Dubois (1977) reported that the average germination was 40% within 10 days after the storage of rose seeds for 3-4 months at 0°C and then sown at 22°C.

Development of the own rooted seedlings: Fig. 1 (a and b) shows the development of both seedling samples through 58 days for these of the 1st experiment and 57 days for these of the 2nd one. After 20 and 21 days from germination for the 1st and 2nd samples; respectively, the average number of true leaves was 4 which were arranged as a rosette above the cotyledons. At the same time, the averages of seedling height were 1.4 and 2.0 cm; respectively, with very short internodes.

Then the internodes began to elongate. After 29 and 31 days from germination for the 1st and 2nd samples; respectively, the apical flower bud appeared; this time represents the end of the juvenile period and the beginning of the adult phase. At the time of flower bud appearance, the average number of 7 leaves was present in both samples. De Vries (1976a) and De Vries and Smeets (1979) reported that H.T.-rose seedlings bore an average of 6 leaves when the flower bud becomes visible.

Thus in H.T-rose seedlings the visible leaf number was indicative of flower differentiation (Horridge and Cockshull, 1974 and De Vries *et al.*, 1981). According to De Vries *et al.* (1981); Wilkerson *et al.* (1989); Booij (1990); Booij and Struik (1990) and Ramin and Atherton (1991), transition from the juvenile to the adult phase occurred when specific number of leaves was formed.

The differences between the results of the forecited researchers and the present results may be due to that from seed germination to its visible result some time elapses, and also because flower bud appearance occurs some time after its initiation. Also these differences may be environmental (Grant, 1989 and Ramin and Atherton, 1991) or varietal (Booij, 1990 and Ramin and Atherton, 1991).

After germination, the successive appearance of the leaves occurs and the leaves were arranged in a rosette. The period of rosette stage differs according to seedling, clone and variety (Horridge and Cockshull, 1974 and De Vries, 1976a). At the end of the rosette stage, the internodes will elongate that means, before the development of all leaves the internode elongation will be recognized. After theformation of the last leaf in rose seedling, the flower bud will be formed. The formation of the leaves and the elongation of the internodes of the seedlings with a short rosette stage began quickly and flower bud appearance was earlier. For the seedlings which have a long rosette stage, the situation was on the opposite. Thus the former seedlings

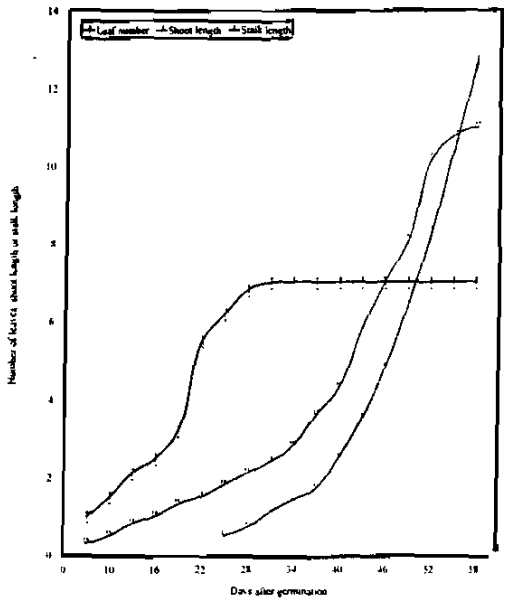

Fig. 1a: Development of Hybrid Tea-rose seedlings with the juvenile period of 29 days, through 58 days from germination to the Ist flowering in the 1st experiment.

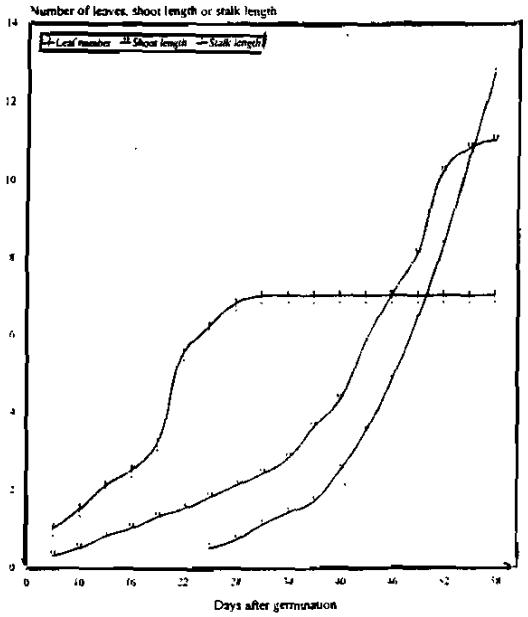

Fig. 1a: Development of Hybrid Tea-rose seedlings with the juvenile period of 29 days, through 58 days from germination to the 1st flowering in the 1st experiment.

had a shorter juvenile period than the latter ones. Also in heterozygous plants like in roses, several characters such as leaf number and formation and internode length ... etc. show a continuous distribution, reflecting a multigenic base. The appearance of the flower bud is the result of the genetically controlled development that dependent on the clone. The former points may explain why the two seedling samples of both experiments differed in the time of flower bud appearance.

Fig. 1 shows that the seedlings at flower bud appearance were short and flowered at small sizes. Visser (1970); De Vries (1976a) and Lavee *et al.* (1996) reported a minimum size for flowering in different plants. It was reported in heterozygous plants that this criterion is a variable and based on the genetically determined leaf numbers (De Vries, 1976 a) and modified by environment (De Vries, 1976a and De Vries *et al.*, 1980). Seedling height at a certain stage depends on the rate of growth and the rate of development. The rate of development is promoted more than the rate of growth by high temperature and the seedling height will reduce (De Vries and Smeets, 1979). This can explain the seedling shortness at the flower bud appearance. The seedlings were planted at a relatively high temperature in the greenhouses (26°C), therefore, the rate of development was more than the rate of growth, consequently, the seedlings were short at the flower bud appearance.

Both shoot and flower stalk exhibited a rapid growth after the flower bud appearance and the mean length of the flower stalk was longer than that of the leaved shoot (Fig. 1).

Juvenile period: In the 1st and 2nd experiments, there were 36 and 33 dates for the flower bud appearance (Table 1) with average values of 42.5 and 37.0 days; respectively. The number of these dates was large and several dates involved low number of seedlings, therefore, they were classified to 12 and 11 categories in the 1st and 2nd experiments; respectively. Each category contained 3 consequent dates (days).

As observed by De Vries (1976a) the average values for the juvenile periods in H.T.-rose seedlings were 32.9, 31.1 and 24.8 days through 3 successive years; respectively. There was a tendency towards shorter juvenile period with the years, either in the present work or in that reported by De Vries (1976a). The decrease in average duration of juvenility may be due to environmental conditions where the better cultural practices and favourable conditions promote development and growth and shorten the juvenile period (Visser and De Vries, 1970; De Vries 1976a; Nyomora, 1985; Koch *et al.*, 1987; Abeysinwardena and Buss, 1991; Mehlenbacher and Smith, 1992 and Peel and Galwey, 1999).

As mentioned before, the formation of the leaves and the elongation of the internodes of the seedlings which have the short rosette stage began sooner and the flower bud appearance was earlier than in those with the long rosette stage. Consequently, various juvenile periods can be observed. In addition, roses are heterozygous plants for most phenomena for examples; leaf number, internode length and the time of flower bud appearance. These characters show continuous distribution, suggesting a multigenic base (De

Vries, 1976a). The result of this genetical behaviour is the various juvenile periods and the duration of juvenile period is likely to be inherent (Visser, 1970; Visser and De Vries, 1970; De Vries, 1976a; Abeysiriwardena and Buss, 1991 and Peel and Galwey, 1999).

Table (1): The numbers of the own rooted rose seedlings obtained at the different juvenile periods in both experiments.

1st experiment				2nd experiment			
Juvenile period (days)	No. of seedlings	Juvenile period (days)	No of seedlings	Juvenile period (days)	No. of seedlings	Juvenile period (days)	No of seedlings
25	20	43	22	21	10	39	16
26	18	44	20	22	12	40	14
27	19	45	19	23	11	41	12
28	18	46	18	24	12	42	10
29	16	47	19	25	11	43	11
30	17	48	17	26	11	44	10
31	14	49	14	27	10	45	9
32	15	50	13	28	12	46	8
33	14	51	13	29	13	47	7
34	13	52	12	30	14	48	8
35	14	53	12	31	12	49	8
36	12	54	10	32	11	50	5
37	13	55	6	33	12	51	1
38	15	56	9	34	14	52	1
39	14	57	7	35	14	53	2
40	17	58	1	36	16		
41	19	59	4	37	18		
42	18	60	1	38	17		
Total	503			Total	352		

Height of the own rooted seedlings at flower bud appearance: Statistical analysis showed in both experiments that there were highly significant differences among the categories of juvenile periods considering the average height of rose seedlings on their own roots at the time of flower bud appearance in the 1st year. The significant differences between the different categories of both experiments are listed in Table (2). The lowest average was recorded with the seedlings of the shortest juvenile periods (Table 2). With increasing the juvenile periods the average height was increased. These results were also demonstrated by De Vries (1976a) and Drew and Vogler (1994).

Several authors (De Vries, 1976a; De Vries and Smeets, 1979; Koch *et al.*, 1987 and Peel and Galwey, 1999) reported that there is a minimum size for flowering in different crops. This character is a variable in heterozygous plants depends on the genetically determined development process (De Vries, 1976a and Peel and Galwey, 1999) and as such modifiable by environment.

There were highly significant ($p = 0.01$) positive correlations between the duration of juvenile period and the own rooted seedling height at flower bud appearance. Correlation coefficients between the two parameters were 0.689 (n=503) in the 1st experiment and 0.765 (n=352) in the 2nd one (Table 3). Similar results were mentioned in roses by De Vries (1976a) and De Vries

and Smeets (1979). On the other hand, Blazek (1985) found a negative correlation (r=-0.3 to -0.5) between the mentioned parameters in most progenies of sweet cherry crosses.

Table (2): Mean heights (cm) with the different categories of juvenile periods of H.T.-rose seedlings at flower bud appearance and at 1st flowering when grown on their own roots, and at 1st flowering when grafted on a rootstock in both experiments.[1)]

First experiment				Second experiment			
Category of juvenile period (in days).	Seedling height (cm).			Category of juvenile period (in days).	Seedling height (cm).		
	On own roots		On rootstock at 1st flowering		On own roots		On rootstock at 1st flowering
	At flower bud appearance	At 1st flowering			At flower bud appearance	At 1st flowering	
25-27	2.2 j	3.2 l	10.7 j	21-23	2.3 j	4.0 k	11.7 k
28-30	2.3 j	3.7 k	12.4 i.	24-26	2.4 j	4.7 j	13.5 j
31-33	2.4 j	4.1 j	13.7 i.	27-29	2.6 i.	5.4 i.	15.4 i.
34-36	2.9 i.	5.4 i.	18.0 h	30-32	2.8 h	6.3 h	19.3 h
37-39	3.4 h	6.9 h	23.1 g	33-35	3.1 g	7.5 g	25.4 g
40-42	5.1 g	9.9 g	33.1 f.	36-38	4.5 f	9.0 f	31.4 f
43-45	6.6 f	13.0 f	43.4 e	39-41	6.0 e	11.2 e	38.3 e
46-48	8.1 e	16.4 e	52.8 d	42-44	7.5 d	14.1 d	48.7 d
49-51	9.7 d	20.2 d	63.6 c	45-47	8.8 c	17.5 c	62.4 c
52-54	11.3 c	24.0 c	74.4 b	48-50	10.4 b	22.0 b	75.6 b
55-57	12.2 b	26.9 b	83.6 a	51-53	11.7 a	24.8 a	85.4 a
58-60	12.7 a	27.9 a	84.5 a				

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

Height of the own rooted seedlings at the 1st flowering:

In both experiments, there were highly significant differences among the different categories respecting the average height of the own rooted rose seedlings at the 1st flowering in the 1st year. The seedlings with the short juvenile periods were significantly shorter than those with the long juvenile periods (Table 2). There was a tendency towards longer seedlings with increasing the duration of juvenile periods. These results were in accordance with those reported by De Vries (1976a); De Vries and Smeets (1979); De Vries *et al.* (1980) on roses and by Drew and Vogler (1994) on papaya.

Because rose seedling populations are highly heterozygous, considerable genetic variation exists between their heights at different development and growth stages. As mentioned before, seedling height at a certain stage depends on both the rate of development and the rate of growth. When the former rate is promoted more than the latter one, the seedling height is reduced and vice versa (De Vries and Smeets, 1979). Because of the heterozygous structure of the rose plants, the seedling populations will differ either in the rate of development or in the rate of growth, therefore they will differ in their heights at flowering.

There were significant positive correlations at p=0.01 between height of the own rooted seedlings at flower bud appearance and height of the same

seedlings at 1st flowering, where r=0.749 (n=453) in the 1st experiment and r=0.724 (n=322) in the 2nd one (Table 3). Similar results were obtained by De Vries (1976a) and De Vries and Smeets (1979) on roses.

Significant positive coefficients of correlation were found between the duration of juvenile period and height of the own rooted seedlings at 1st flowering, where r=0.510 (n=453) and r=0.488 (n=322) in the 1st and 2nd experiments; respectively, at p=0.01 (Table 3). Although the juvenile period was closely correlated with seedling height at flower bud appearance, the juvenile period was less close to seedling height at 1st flowering.

Height of the grafted plants at 1st flowering:

Statistical analysis proved the presence of highly significant differences among the different categories of both experiments, considering the height of plants grown on a rootstock at 1st flowering in the 1st year after grafting. All significant differences between the averages are shown in Table 2. It was clear that the shorter juvenile periods were associated with the shorter grafted plants and with increasing the duration of juvenile periods the average plant height increased. These results were supported by those of De Vries and Dubois (1977) and Drew and Vogler (1994).

The correlations between juvenile period and height of the grafted plants at 1st flowering were positive and significant at p=0.01, where r=0.758 (n=400) in the 1st experiment and r=0.793 (n=302) in the 2nd one (Table 3). These results were corresponded with those reported by De Vries and Dubois (1977). Regarding the height at 1st flowering, the behaviour of the grafted plants was similar to that of the original own rooted seedlings. This appears also from the fact that the significant differences among the different categories of the own rooted seedlings were nearly retained after grafting. For the two cases of growth, either on own roots or on a rootstock, the shortest plants have the shortest juvenile periods and the longest plants have the longest juvenile periods. The observations point to an important genetical component in the variability of the juvenile period (Visser, 1970; De Vries, 1976a; De Vries and Dubois, 1977; Abeysiriwardena and Buss, 1991 and Peel and Galwey, 1999). Furthermore, the close positive relationships between juvenile period and the height of each of the own rooted seedlings and the grafted plants either at flower bud appearance or at 1st flowering indicate that the variation in seedling and plant heights is mainly genetically determined too. This is supported by the fact that differences in seedlings height appear to be rather consistent throughout the different stages of seedlings growth. Therefore, the differences between seedlings height with the different juvenile periods were passed on with the buds and influenced the height of the grafted plants. This diclaration is in agreement with that mentioned by Visser (1970); Visser and De Vries (1970) and Kazakov and Kichina (1988).

Table (3): Correlations between duration of juvenile period and height of the own rooted seedlings at flower bud appearance, between height of the own rooted seedling at flower bud appearance and height of them at 1st flowering, between duration of juvenile period and each of height of the own rooted seedlings and height of the grafted seedlings both at 1st flowering, between height of the own rooted seedlings and their height after grafting both at 1st flowering, in H. T. roses in both experiments.

Characters	Coefficients of correlation [1]	
	1st experiment	2nd experiment
1. Duration of juvenile period and height of the own rooted seedlings at flower bud appearance.	0.689 (n=503)	0.765 (n=352)
2. Height of the own rooted seedlings at flower bud appearance and height of the same seedlings at 1st flowering.	0.749 (n=453)	0.724 (n=322)
3. Duration of juvenile period and height of the own rooted seedlings at 1st flowering.	0.510 (n=453)	0.488 (n=322)
4. Duration of juvenile period and height of the grafted plants at 1st flowering.	0.758 (n=400)	0.793 (n=302)
5. Height of the own rooted seedlings and height of the same seedlings on a rootstock, both at 1st flowering.	0.728 (n=400)	0.694 (n=302)

1)All correlations are significant at 0.01 level of probability.

There were significant (p=0.01) positive correlations between the height of the own rooted seedlings and their height on a rootstock, both at 1st flowering, where r=0.728 (n=400) in the 1st experiment and r=0.694 (n=302) in the 2nd one (Table 3). De Vries and Dubeis (1977) mentioned similar results. Based on these close correlations, a relatively simple method of early selection for plant height, as dependent on the juvenile period, may be derived.

Using the Table of the bivariate normal distribution function and on view of the average of the own rooted seedling height at 1st flowering during the 1st year for each experiment (Ferguson, 1965 and De Vries and Dubois, 1977), it is possible to pre-select for long grafted plants. Seedlings with a below average height will be discarded (average height of the own rooted seedlings at 1st flowering during the 1st year was 12.6 cm in the 1st experiment and 11.5 cm in the 2nd one). Thus seedlings will be screened for sufficient stem length at 1st flowering and at early time. This will lead to adequate number of the grafted plants of which about 80% with an above average height (average heights of the grafted plants at 1st flowering were 42.8 and 38.8 cm in the 1st and 2nd experiments; respectively). Effectiveness of this pre-selection method will be increased if the juvenile period of the own rooted seedlings was taken into consideration, because long juvenile periods go with long own rooted seedlings and grafted plants (De Vries and Dubois, 1977 and Drew and Vogler, 1994). In selection for long juvenile periods, selection is made for longer own rooted seedlings and afterwards for longer grafted plants and vice versa. This means that selection is carried out at an early time according to the favourable and demanded height.

Table (4): Mean flowering dates of the own rooted seedlings and mean flower yield in each of the 1st and 2nd year for the seedlings on their own roots and the plants on a rootstock with the different categories of juvenile periods of H.T.-roses in both experiments. [1]

Category of juvenile period (in days)	First Experiment					Second Experiment				
	On own roots	On rootstock				Category of juvenile period (in days)	On own roots			On rootstock
	Flowering date [2]	Flower yield		Flower yield			Flowering date [2]	Flower yield		Flower yield	
		1st year	2nd year	1st year	2nd year			1st year	2nd year	1st year	2nd year
25-27	49.6 l	10.2 a	17.9 a	15.4 a	18.3 a	21-23	40.6 k	10.8 a	19.0 a	15.9 a	18.8 a
28-30	57.5 k	9.5 b	16.8 b	14.6 b	17.4 b	24-26	47.6 j	9.8 b	17.3 b	14.1 b	18.0 b
31-33	65.9 j	8.9 c	16.1 c	13.9 c	16.9 bc	27-29	52.9 i	9.3 c	16.3 c	13.1 c	17.3 c
34-36	72.8 i	8.9 c	15.2 d	13.6 cd	16.3 cd	30-32	59.5 h	9.0 c	15.5 d	13.1 c	17.0 cd
37-39	80.4 h	8.5 cd	14.4 e	13.2 d	16.0 d	33-35	66.2 g	8.9 c	14.1 e	13.0 c	16.5 d
40-42	86.3 g	8.3 d	14.3 e	13.0 d	15.6 de	36-38	70.2 f	8.4 d	13.7 e	12.8 c	15.7 e
43-45	90.4 f	7.4 e	12.5 f	12.4 e	15.2 ef	39-41	75.5 e	7.9 e	13.6 e	12.2 d	15.0 f
46-48	94.4 e	7.0 f	11.5 g	11.9 f	14.8 fg	42-44	82.2 d	7.6 e	11.2 f	12.0 d	14.5 f
49-51	96.7 d	6.2 g	10.5 h	11.1 g	14.1 gh	45-47	89.4 c	6.8 f	10.8 f	11.5 e	14.6 f
52-54	99.8 c	6.2 g	10.3 h	10.8 g	13.6 h	48-50	94.4 b	6.5 f	9.9 g	11.0 f	13.9 g
55-57	103.4 b	5.4 h	9.2 i	9.8 h	12.7 i	51-53	99.6 a	6.0 g	9.7 g	10.3 g	13.0 h
58-60	107.8 a	4.8 i	8.6 j	8.7 i	12.2 i						

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

2) Number of days from germination till the 1st flower was about ripe to cut.

Flowering date of the own rooted seedlings:

There were highly significant differences among the different categories of the juvenile periods considering flowering dates of the own rooted seedlings in the 1st year in each experiment. Table (4) shows that there was a significant difference between each flowering date and other one in each experiment. The more earliness in the commencement of the 1st flowering was apparent in the 1st experiment in the own rooted seedlings of the 1st category of 25-27 days and in the 2nd one in those of the 1st category of 21-23 days. With increasing the duration of juvenile period, the necessary number of days for the 1st flowering increased. The differences between the more early flowering seedlings and the more late flowering ones were nearly 58 and 59 days in the 1st and 2nd experiments; respectively, (Table 4). Similar results were reported by Visser (1970); Visser and De Vries (1970); De Vries (1976a); De Vries and Dubois (1977); De Vries and Smeets (1979); Wiebe (1987); Kazakov and Kichina (1988); Abeysiriwardena and Buss (1991); Sinclair and Hinson (1992); Collinson *et al.*, (1993); Drew and Vogler (1994) and Lavee *et al.*, (1996). They reported that the main effect of the long juvenile period was to retard the overall development of the plants toward flowering.

Variation in the flowering dates may be due to that the own rooted seedlings with the short juvenile periods showed the flower bud sooner than those with the long juvenile periods. Consequently, it is expected that the former seedlings will flower earlier than the latter ones. Abeysiriwardena and Buss (1991) stated that flowering date is genetically controlled and the long juvenile period is recessive trait.

Significant ($p=0.01$) positive correlations were found between the duration of the juvenile period and the time of 1st flowering, where $r=0.788$ ($n=435$) and $r=0.761$ ($n=322$) in the 1st and 2nd experiments; respectively, (Table 5). These results were in agreement with those reported by De Vries (1976a); De Vries and Dubois (1977) and De Vries and Smeets (1979).

The average number of days to 1st flowering was 70.7 days in the 1st experiment and 81.4 days in the 2nd one. Using the Table of bivariate distribution function (Ferguson, 1965) it is possible to select the early flowering seedlings, where the seedlings with an above average days to 1st flowering will neglected.

This procedure will increase chances of finding the grafted plants of which about 80% have a below average of days to 1st flowering. This method will be more efficient if the juvenile period was considered. In the selection for short juvenile periods the early seedlings were found, but at the same time selection was made for short seedlings. This shortness was not restricted in the own rooted seedlings but will pass on with the buds to the grafted plants. Evidently long plants and early flowering are opposite traits in the present work.

The effectiveness of early selection in general is greatly influenced by growth conditions (De Vries and Smeets, 1979 and Peel and Galwey, 1999), which should be as uniform as possible to reduce environmental variability (Visser, 1970). This variability determines the extent to which the correlations between growth characters and juvenile period can express themselves

(Visser, 1970; De Vries, 1976a and De Vries and Smeets, 1979). These information imply that correlations between juvenile period and each of seedling height and flowering date, even high, are not perfect and correlation breakers do occur (De Vries and Dubois, 1977). To overcome the opposition between long stemmed plant and early flowering, rose breeder can select firstly for short juvenile period to make sure of early flowering, but selected seedlings will be short. Afterwards, breeder can select for long seedlings among the selected lot and this means that selection will carried out against the rule (Visser, 1970; De Vries, 1976a and De Vries and Dubois, 1977). Using Ferguson's Table (1965), it will help in retaining 50% of seedlings with short juvenile period, about 20% of them with an above average seedling height and at the same time will have a below average time of the 1st flowering. Subsequently clonal propagation will conducted to get early-tall grafted plants (Visser, 1970; De Vries and Dubois, 1977 and De Vries *et al.*, 1980).

Flower yield of the own rooted seedlings:

Analysis of variance indicated that there were highly significant differences among the averages of the flower yield of the own rooted seedlings at the different categories of the juvenile periods in the 1st and 2nd years for the both experiments. The flower yield was found to be more when the juvenile period had been shorter and it began to decrease with increasing the juvenile period (Table 4). The highest average of flower yield was recorded with the first category of the juvenile periods in both experiments (10.2 and 10.8 flowers/1 year old-seedling in the 1st and 2nd experiments; respectively, and 17.9 and 19.0 flowers/2 years old seedling in both experiments; respectively). In both experiments and during each of the 1st and 2nd years, there was significant difference between the 1st and 2nd categories and between each of them and any other category. On the other hand, there was significant reduction in the average flower yield with the latest category of the juvenile periods comparing with the other categories in both experiments during each of the two years (the lowest averages were 4.8 and 6.0 flowers/ 1 year old-seedling in the 1st and 2nd experiments; respectively, and 8.6 and 9.7 flowers/2 years old-seedling in both experiments; respectively). Similar results were mentioned by De Vries (1976a); De Vries and Dubois (1977); Osman and Basri (1987); Yesiloglu and Tuzcu (1991) and Drew and Vogler (1994).

Roses are heterozygous for most characters and show a continuous distribution, suggesting a multigenic base. Due to this genetical background various juvenile periods can be observed with various flowering dates (De Vries, 1976a). The own rooted seedlings with early flowering were usually most productive (Blazek, 1985 and Drew and Vogler, 1994).

In both experiments and through the 1st year of growth there were significant ($p=0.01$) negative correlations between the duration of the juvenile period and the flower yield of the own rooted seedlings. Correlation coefficients were -0.784 ($n=380$) and -0.750 ($n=300$) in the 1st and 2nd experiments; respectively. Similar situation was obtained through the 2nd year and the correlation coefficients between the two parameters were -0.720

(n=380) and -0.741 (n=300) in both experiments; respectively, (Table 5). The present results are supported with those reported by De Vries (1976a) and De Vries and Dubois (1977).

It was clearly pointed to an important genetical component in the variability of the juvenile periods. The close inverse relationship between juvenile period and flower yield in the 2nd year, as it was reported in the 1st year, indicates that the variation in the flower yield is mainly genetically determined too. This is supported by the fact that the differences in the flower yield appear to be rather consistent throughout the 1st and 2nd years. Therefore, such differences can be measured either in the 1st or in the 2nd year with a fair chance that they reflect genetical differences sufficiently reliably to serve as a basis for an effective early selection. This is confirmed by Visser (1970).

The flower yield of each own rooted seedlings group with each category of the juvenile period increased with the aging of seedlings (Table 4) and the yearly average of flower numbers of each experiment increased from the 1st year to the 2nd one. The annual averages number of flowers in the 1st experiment were 7.8 and 13.5 flowers/seedling through the 1st and 2nd years; respectively, while in the 2nd experiment, they were 8.3 and 13.7 flowers/seedling through the two years; respectively. These increments in flower yields with the aging of seedlings may be due to that the seedlings were more adapted to the environmental conditions in the 2nd year and started their reproductive growth earlier than that happened in the 1st year.

Highly significant (p=0.01) positive correlations were found between the flower yield of the own rooted seedlings in the 1st year and their flower yield in the 2nd one, where r=0.682 (n=380) and r=0.721 (n=300) in the 1st and 2nd experiments; respectively, (Table 5). These results were supported by those reported by De Vries (1976b). This indicates that the yields of the own rooted seedlings in the 1st year determine to a large extent the yields in the following year, but the level may increase. This observation is useful to carry out an early selection in the own rooted seedlings of roses for flower yield. De Vries (1976a and b) and De Vries and Dubois (1977) reported that most characters that determine the value of rose plants can be detected in an early stage.

In the present work, H.T.-rose seedlings with the short juvenile periods produced more flowers than those with the long juvenile periods, at the same time the former tended to be shorter than the latter. The most productive seedlings to occur among seedlings with short juvenile periods; in extreme cases such seedlings may produce two fold as many flowers as those with the longest juvenile periods (Table 4). In selecting for short juvenile periods the best producers and more earliness are found, but selection is carried out for shorter seedlings. Thus early flowering and flower production on one side and seedling height, on the other side, are opposite characters.

Flower yield of the grafted plants:

Analysis of variance for both experiments proved the presence of highly significant differences among the different averages of the flower yield

Table (3): Response of borage (*Borago officinalis*, L.) plant to different rates of some organic fertilizers during the first season (1999-2000).

Characters / Treatments	Plant height (cm)	No. of branches / plant	Herb Fresh weight (kg/plant)	Herb fresh yield (ton/fed.)	Herb dry weight (kg/fed.)	Herb dry yield (ton/fed.)	Inflore- scences fresh weight (kg/plant)	Inflore-scences fresh yield (ton/fed.)	Inflore-scences dry weight (kg/plant)	Inflore-scences dry yield (ton/fed.)
1. Control*	58.35g	9.32e	0.848f	11.30g	0.254g	3.39e	0.165g	2.20g	0.044g	0.587g
2- CM** (18 m³/fed.)	67.39e	13.05c	1.088c	14.50d	0.363d	4.84bc	0.176f	2.35f	0.047f	0.628f
3- CM (24 m³/fed.)	86.31a	13.07c	1.204b	16.05c	0.406b	5.41ab	0.191e	2.57e	0.051e	0.680e
4- CM (30 m³/fed.)	80.13b	14.92a	1.215a	16.20a	0.420a	5.60a	0.265a	3.53a	0.078a	1.040a
5- FYM*** (36 m³/fed.)	61.64f	11.17d	0.971e	12.95f	0.303f	4.04de	0.249b	3.32b	0.070b	0.933b
6- FYM (48 m³/fed.)	75.68c	11.20d	1.015d	13.53e	0.330e	4.40cd	0.227c	3.03c	0.062c	0.827c
7- FYM (60 m³/fed.)	72.59d	13.99b	1.208ab	16.11b	0.410c	5.47ab	0.219d	2.92d	0.059d	0.787d

Values within each column followed by the same letter are not statistically different at 5% level. * Control = 100% (NPK) recommended rate.
** CM = chicken manure. *** FYM = farm yard manure as cattle manure.

Table (4): Response of borage (*Borago officinalis*, L.) plant to different rates of some organic fertilizers during the second season (2000-2001).

Characters / Treatments	Plant height (cm)	No. of branches / plant	Herb Fresh weight (kg/plant)	Herb fresh yield (ton/fed.)	Herb dry weight (kg/fed.)	Herb dry yield (ton/fed.)	Inflore-scences fresh weight (kg/plant)	Inflore-scences fresh yield (ton/fed.)	Inflore-scences dry weight (kg/plant)	Inflore-scences dry yield (ton/fed.)
1. Control*	50.13e	8.98f	0.784g	10.45g	0.245g	3.26g	0.198g	2.640g	0.053g	0.707g
2- CM** (18 m³/fed.)	63.72d	11.97d	1.033e	13.77e	0.324e	4.33e	0.208f	2.773f	0.056f	0.747f
3- CM (24 m³/fed.)	73.53c	13.98c	1.121c	14.95c	0.361c	4.81c	0.234e	3.240e	0.064e	0.853e
4- CM (30 m³/fed.)	80 90b	15.71a	1.151a	15.35a	0.384a	5.11a	0.307a	4.093a	0.095a	1.267a
5- FYM*** (36 m³/fed.)	66.36d	9.97e	0.953f	12.71f	0.300f	4.01f	0.300b	4.000b	0.086b	1.147b
6- FYM (48 m³/fed.)	73.31c	13.98c	1.090d	14.53d	0.350d	4.67d	0.278c	3.707c	0.077c	1.027c
7- FYM (60 m³/fed.)	87.85a	14.97b	1.131b	15.08b	0.376b	5.03b	0.263d	3.507d	0.072d	0.960d

Values within each column followed by the same letter are not statistically different at 5% level. * Control = 100% (NPK) recommended rate.
** CM = chicken manure. *** FYM = farm yard manure as cattle manure.

m^3/fed. and those fertilized with FYM at 36 m^3/fed. or 48 m^3/fed. in the 2nd season, respectively. The most significant increases in plant height were obtained from plants received CM at the rate of 24 m^3/fed. and those received FYM at 60 m^3/fed. in the 1st and 2nd seasons, respectively.

Results recorded in Tables (3 & 4) also show that, both organic manures were more significantly effective in increasing number of branches/plant at any rate used than the control in both seasons. Moreover, both organic fertilizers were significantly more effective at the highest rates than at the two relatively lower rates in both seasons. No significant differences were observed in number of branches between applying CM or FYM at the lowest rates and applying them at the medium rates in the 1st season. Generally, CM appeared to be more effecting in promoting the branching of borage plants more than FYM in both seasons. The highest values were obtained from plants fertilized with CM at 30 m^3/fed. in both seasons.

These results were in harmony with those reported by El-Ghadban (1998) on spearmint and margoram; Jacoub (1999) on *Ocimum basilicum* and *Thymus vulgaris*; Sakr (2001) on *Mentha piperita* and Mohsen (2002) on sweet basil.

Moreover data presented in Tables (3 & 4) indicate that, organic fertilization in a sense governed the fresh and dry weights of borage plants comparing to the control. These results hold true in both seasons. On the whole, there was a constant gradual increase in herb fresh and dry weights (kg/plant or ton/fed.) by adding CM and FYM up to 30 m^3/fed. and 60 m^3/fed., respectively. Among the different organic fertilization treatments, CM at 30 m^3/fed. was the most effective treatment in this respect, giving significantly the highest values compared to any of the other treatments in both seasons. These values were followed by those obtained from plants fertilized with FYM at 60 m^3/fed. and CM at 24 m^3/fed., respectively in both seasons. The varied differences observed between adding CM at 30 or 24 m^3/fed. and FYM at 60 m^3/fed. were not enough to reach the level of significancy with respect to herb fresh weight kg/plant or herb dry weight (ton/fed.). Moreover, no significant differences in both criteria were observed between adding either of organic manures at the medium rate or adding them at the highest rate in the 1st season. The lowest means value of herb fresh and dry weights (kg/plant or ton/fed.) were significantly obtained from plants fertilized with FYM at the lowest rate (36 m^3/fed.) in both seasons. Similar results were reported by Khandkar and Nigam (1996) on *Zingiber officinale*; Saleh and Abd El-Fattah (1997) on sorgum El-Ghadban (1998) on *Mentha viridis* and *Origanum majorana*, Abd-El-Moez and Saleh (1999) on roselle, and El-Kader (2002) on potato, who found that, the addition of organic manures (chicken manures and FYM) increased the growth of previous plants when compared with mineral fertilizers. They added that, plant growth was increased with increasing the application rate of organic wastes to the soil.

having 3 rows of three meter long with a total area of 5.4 m²/plot. Data were analyzed according to the Dunkan's new multiple range test. The standardized least significant range (LSR) at 0.05 level used was according to Armitage (1972).

Table (1): Soil physical and chemical analysis (average of two seasons).

Soil physical analysis							
Texture		Sand %		Silt %		Clay %	
Sandy		69.0		19.8		11.2	
Soil chemical analysis							
pH (water 1:2.5)		E.C. (mmhos/cm)				Organic matter (%)	
8.7		1.09				0.60	
Soluble cations (mg/100 g)				Soluble anions (mg/100 g)			
Ca^{++}	Mg^{++}	K^{+}	Na^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{-}
1.4.	1.9	0.43	2.40	3.40	2.50	3.61	0.016
Total (N)		Available (ppm)		Available micronutrients (ppm)			
(mg/100 g)		P	K	Fe	Zn	Mn	Cu
0.10		0.51	33	1.71	0.16	0.91	0.13

Table (2): The chemical analysis of organic manure used in 1999/2000 and 2000/2001 seasons.

Fertilizer	Chicken manure		Cattle manure	
Characters	1st season	2nd season	1st season	2nd season
Organic matter	64.7	80.25	58.20	60.40
%	33.75	46.50	30.80	43.30
Organic carbon	2.50	3.63	1.75	1.88
Total N (%)	13.5	12.81	17.6	23.03
C : N ratio	1.10	0.46	1.00	0.60
Total P (%)	2.3	2.6	1.80	1.60
Total K (%)	1700.3	1818.6	1880.8	2139.5
Fe (ppm)	120.9	168.6	189.030	181.30
Mn (ppm)	85.30	88.60	90.00	130.80
Zn (ppm)	30.80	55.20	41.10	44.20
Cu (ppm)				

RESULTS AND DISCUSSION

1.Plant growth and seed production

Data presented in Tables (3 & 4) show that, organically fertilized plants were significantly taller than the control in both seasons. With CM, the tallest plants in the 1st season were obtained from plants received the medium rate (24 m³/fed.) followed by those fertilized with the higher rate (30 m³/fed.). While the shortest plants were obtained from applying CM at the lowest rate (18 m³/fed.). The same trend was observed with FYM. In the 2nd season, the effect of increasing the fertilization rate was much clearer than in the 1st season. Increasing the application rate of any organic fertilizer used resulted in a steady increase in plant height. No significant differences were observed in plant height between plants received CM at 18 m³/fed. or 24

MATERIAL AND METHODS

Two field experiments were conducted in 1999/2000 and 2000/2001 growing seasons at the Graduated Farm of El-Hussein Village, Nobaria, El-Behera Governorate. Before planting, physical and chemical properties or the farm soil (Table 1) were determined using the method described by Chapman and Pratt (1978). Seeds of borage (*Borago officinalis*, L.) were obtained from the Medicinal and Aromatic Department, Ministry of Agriculture, Dokki, Giza.

Seeds of borage were sown on September 21st of both seasons of 1999/2000 and 2000/2001 on rows 60 cm apart in hills 50 cm in between with 3-4 seeds/hill. One month after sowing, plants were thinned down to one plant/hill. The open field were prepared before planting by three weeks and supplemented during preparation with chicken manure and FYM as cattle manure after composting for one month at different rates [Chemical analysis of the used CM and FYM is shown in Table (2). All agricultural management practices were carried out as usually rcommended for borag production in Egypt. The experiment included 6 treatments representing the different rates of CM and FYM in addition to the control (recommended rate of chemical fertilizers) as follows :

1. Control : Full dose of 100% NPK-recommended rate = [100 kg/fed. ammonium sulphate (20.5 N) + 300 kg/fed. calcium superphosphate (16.5 P_2O_5) + 100 kg/fed. potassium sulphate (48% K_2O)]. Ammonium sulphate was applied in three equal portions starting directly after thinning date at 30 days intervals, calcium superphosphate was applied 10 days before sowing date,, while potassium sulphate was applied at the beginning of January.
2. 25% NPK-recommended rate +18 m^3/fddan chicken manure (CM).
3. 25% NPK-recommended rate + 24 m^3/feddan chicken manure (CM).
4. 25% NPK-recommended rate + 30 m^3/feddan chicken manure (CM).
5. 25% NPK-recommended rate + 36 m^3/feddan (FYM).
6. 25% NPK-recommended rate + 48 m^3/feddan (FYM).
7. 25% NPK-recommended rate + 60 m^3/feddan (FYM)

At full blooming stage, random samples from each treatment were taken to determine plant height (cm), number of branches/plant, fresh and dry weights of herb and inflorescences kg/plant and ton/fed. in both seasons. At fruiting stage, seed yield g/plant were recorded and then estimated as kg/feddan.

Fixed oil percentage in dry seeds was estimated using soxhlet apparatus according to the method described by A.O.A.C. (1990), then, fixed oil yield g/plant and kg/fed. were calculated. The methyl ester derivatives of the fixed oil was prepared according to Johnson and Dasvenpart (1971). GLC analysis of the methyl ester of fatty acids which was conducted only in the second season was performed according to the method of IUPAC (1978). N, P and K percentages were determined according to Chapman and Pratt (1978). Crude protein content in dry seeds was estimated using nitrogen percentage bases. The treatments were arranged in a complete randomized block system with three replicates. Each replicate comprised of 7 plots, each

regulation of a wide variety of body functions, including cell growth, metabolic functions and the productive cycle in the mammalian systems which indirectly delayed senescence as reported by White *et al.* (1978). Gamma-linolenic acid is of particular values in controlling symptoms of the premenstrual syndrom, atopic eczema, diabetes, maintenance of smooth healthy-looking skin and supple joints and it may have possibly function as a preventive treatment against heart diseases. It is also used as a mild diuretic, diaphoretic and demulcent properties (El-Gengaihi *et al.*, 2000). In herbal medicine it is used as infusions for urinary infections, colds, bronchitis and rheumatic conditions (Stodola and Volak, 1992). The growing attention towards the cultivation of borage plants based also on the importance of the herb use as a flavor and aroma natural addition used in commercial food industry production such as jams, pickles and sauces (Zaied, 1993).

Organic culture or growing are both terms used to express a fairly new method of bio-dynamic agriculture which is used to produce and/or improve yield and/or quality of edible products like aromatic and medicinal crops without the use of any synthetic chemicals for fertilization and for pest and disease control.

Organic fertilization by using farmyard manure (FYM) as a cattle manure and chicken manure (CM) is a practice for providing plants with their nutritional requirements without having an undesirable impact on the environment. In the newly reclaimed land areas, where sandy soils prevail, it would help in not only improving physical characters of the soil, but also sustain and increase soil fertility. Such agricultural practices are of special interest specially in vergin unpolluted areas like deserts where, they would preserve the environment as clean as possible and ensure edible products with no hazards or bad residual effects on human health. With regard to the effect of farm yard manure on plant growth and yield Farrag (1996) showed that the addition of FYM at 30 m^3/fed. significantly increased number of pea pods/plant and harvest index. Ram and Kumar (1997) mentioned that fertilizing *Mentha arvensis* plants with 20 t FYM/ha at planting and 20 t/ha after the first harvest, increased the total herb and essential oil. El-Mansi *et al.* (1999) and Gupta *et al.* (1999) indicated that, the application of 40 m^3 FYM/fed. significantly favoured number of pea pods/plant and total yield/plant as well as per feddan. Jacoub (1999) on *Ocimum basilicum* detected that, cattle manure (CM) at 20 or 30 m^3/fed. increased plant height, chlorophyll a & b, carotenoid and Mn contents than the control. On *Thymus vulgaris*, he also found that, herb fresh and dry weights/plant were increased with 40 m^3 CM/fed. compared to the control.

The urge for the cultivation and production of aromatic and medicinal plants is felt needed and recognized in Egypt nowadays to cover the increasing demands of both local rising industries and export purposes.

Therefore, the aim of this study was to evaluate the productivity of borage when cultivated and grown organically in newly reclaimed land by estimating the effect of different sources and rates of two organic fertilizers, i.e. chicken manure (CM) and FYM as cattle manure on plant growth, yield and chemical components with the final goal of providing more applied information and tips about its growing under such conditions.