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נושא: פיתוח שיטות להמרצת פריחה והכוונתה לחורף, וריבוי וגטטיבי בשלושה מינים של ALLIACEAE

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חוקרים שותפים: 1

תקופת מחקר: 1996-1998

מאמרים: 1

תקציר

הפרוייקט עוסק בפיתוח שיטות להפרחה וריבוי של צמחים ממשפחת השומיים.

ALLIUM AFLATUNENSE: השינויים המורפולוגיים המתרחשים בצמח בזמן התפתחות הפרח נלמדו באמצעות מיקרוסקופ אור ומיקרוסקופ אלקטרוני סורק SEM. איניציאציה של פרימורדיות עלים נצפו בבצל המתחדש עוד בזמן הפריחה של צמח האם, המריסטמה ממשיכה להתמיין באוגוסט בזמן התרדמה. טיפולי קור שונים בזמן האחסון השפיעו על התפתחות התפרחת. בטמפרטורת גידול של 20/12 מ"צ (לילה/יום) ובאורך יום של 10 שעות נמצא שטיפול הקור היעיל ביותר היה 4 מ"צ למשך 16 שבועות. טמפ' הגידול משפיעה על התארכות עלים ועל התארכות עמוד התפרחת. עמוד התפרחת הגבוה ביותר נמדד בטמפרטורת גידול של 17/9 מ"צ (לילה/יום). טמפרטורות גבוהות דכאו את התארכות עמוד התפרחת. טיפול בג'יברלין אקסוגני לא הביאו לשיפור בתאריך הפריחה ובאיכותה.

ALLIUM SPHAEROCEPHALON: לימוד התפתחות התפרחת במיקרוסקופ, הראה שבזמן האחסון אין התפתחות פלורלית. לאחר השתילה והתפתחות של 6 עלים, מתחילה איניציאציה של התפרחת. אחסון ב- 9 מ"צ ל- 6 שבועות הכרחי לפריחה של מין זה, אך אחסון ארוך יותר (8 שבועות) לא שפר את איכות הפרחים. לאחר שתילה, טמפרטורת הגידול האופטימלית להתפתחות עלים ופרח היא 17/9 מ"צ (לילה/יום). תוספת תאורה תורמת להתארכות גבעולים אך מורידה את אחוז הפריחה. טמפ' גבוהות דכאו את התפתחות הצמח.

TULBAGHIA FRAGANS: זהו צמח רב שנתי בעל מערכת שורשים מפותחות, העברה של הצמח פוגעת במערכת השורשים וכתוצאה מכך גורמת להפלת פרחים. עובדה זאת מקשה על לימוד הפיזיולוגיה של הצמח בתנאים מבוקרים. מבדיקות מורפולוגיות שנערכו בדצמבר נתגלה שבכל בצל קיימות 2-1 תפרחות מפותחות בשלבים שונים של איניאציאצית פרחים. הריבוי נעשה ע"י הסתעפות קנה שורש והתפתחות ניצנים צדדים. מקדם הריבוי הוגטטיבי הוא בין 4 ל- 10.

FINAL SCIENTIFIC REPORT

DEVELOPMENT OF METHODS FOR FORCING AND PROPAGATION OF THREE *ALLIACEAE* SPECIES FOR WINTER FLOWER PRODUCTION.

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1. Introduction

The aim of this project was to study the physiological traits and response to environmental factors during different stages of individual development of three representatives of the *Alliaceae* group, in order to work out the concept of their forcing and to optimize the horticultural protocol of their cultivation, flowering acceleration and propagation in Israel.

Three species that have been proposed as subjects of this project represent different life forms in the family *Alliaceae* and could serve as a model for the future study of this large taxon. According to permission of Prof. Dan Levanon, Chief Scientist of the Ministry of Agriculture, in October 1996 we revised our study to that of *A. sphaerocephalon* instead of that of *A. ampeloprasum*. Both studies using the same experimental design, observations and measurements.

According to the evaluation of *Allium* commercial production in Israel, the principal emphasis in this project has been done on *A. aflatunense*. This species is one of the most popular ornamental crops. Its annual production in the Netherlands is about 11 ha, which is 26% of *Allium* cut flower production in this country (De Hertogh and Zimmer, 1993). In Israel, *A. aflatunense* is cultivated for early spring flowers and their export to Europe.

Taxonomically, *A. aflatunense* belongs to the subgenus *Melanocrommyum*, which includes about 120 species, most of which are confined to the oriental Turanic region and especially to its Turkestanic floristic province (Fritsch, 1993; Hanelt *et al*, 1992). These xerophilous and heliophilous plants are native to dry steppes, semi-desert and desert plateaus, stony slopes and arid mountains. In natural conditions, they flower late in the spring, and enter a dormant phase in the summer, where the underground dry bulbs survive the hot dry season (Le Nard and De Hertogh, 1993). At bloom, the 70-80 cm long scapes bear hemispherical, multifloral, dense umbels with deep purple color (Vedensky,1968; De Hertogh and Zimmer 1993).

Vernalization of *A. aflatunense* bulbs is required for optimal growth of leaves, stem and inflorescence (De Hertogh and Zimmer, 1993). Yet, only little is known on the exact development and the response of the bulbs to cold induction.

2. Materials and methods

2.1. Plant material

Bulbs of *A. aflatunense*, cv. 'Purple Sensation' at flowering size (ca. 12 cm in circumference) were obtained from a local Israeli grower Mr. Gideon Peleg (Shadmot Dvora) in June 1996. After harvest, the mature bulbs were sorted, cleaned and dried prior to storage in an open shed under ambient conditions for four months. On August (1996, 1997) the bulbs were randomly selected and placed in a cold rooms for different vernalization treatments. Control bulbs were kept under ambient conditions throughout this period. Developmental changes were studied by stereoscope and SEM, as detailed below.

In December all bulbs were planted in cinder in 15-cm diameter pots containing, at one bulb per pot. The pots were placed in the Phytotron in the Volcani Center, Bet Dagan, at different thermo- and photoperiod, as detailed below. Plant growth analysis was performed from sprouting to bulb harvesting.

Bulbs of *A. sphaerocephalon* were obtained from Mr. Dan Schori (Mazor) in September, 1996. Bulbs of *Tulbagia fragans* were obtained from Mr. Yair Frank (Ra'anana) in August, 1996.

2.2. Preparations for scanning electron microscopy (SEM)

A detailed study of the florogenesis was carried out in 1996/97 and in 1997/98 using light and Scanning Electron microscopy.

Organ initiation and development were studied twice a month with light stereoscopy (Zeiss Stemi 2000-C, Zeiss, Germany) connected with video system (video camera, tape recorder and computer Macintosh 8100), and further morphological analysis of floral development was performed by Scanning Electron Microscopy. As described by Kamenetsky (1994), freshly harvested plants were carefully stripped of their leaves, and spathes were removed from the young floral buds. Meristems were isolated under a stereomicroscope in small Petri dishes containing distilled water to prevent dehydration. The excised meristems were fixed in a mixture of glacial acetic acid: formalin (40%): ethanol (70%) at 5:5:90 and dehydrated in a graded acetone series (35, 70, 90, 100%). Immediately thereafter, tissues were dried, using liquid CO_2 in a Biorad 750 (England) critical-point dryer. Samples were then mounted on SEM stubs with double-stick tape, sputter-coated with a 10 NM layer of gold, and studied in a

JSM-35C scanning electron microscope (JEOL, Japan) using an accelerating potential of 15-kV.

3. Results.

3.1. *ALLIUM AFLATUNENSE*

3.1.1. Morphogenesis of the monocarpic shoot.

In Israel, the development of the monocarpic shoot of *A. aflatunense* starts with the differentiation of leaf primordia and undifferentiated floral meristem during the flowering stage of the mother plant in February-March (Fig. 1a). The differentiation of leaf primordia ceases in June-July with the formation of spathe, which arises as a nearly uniform ring. Initiation of individual flowers begins in August (Fig. 1b). At this time the apical meristem is enlarged considerably and differentiates several peripheral swellings, which produce a row of flower primordia, i.e. cyme. Between these peripheral swellings, the flat meristematic surface becomes enlarged and smoothly rounded and finally divides into many centers, each of which gives rise to the central cyme. The peripheral bigger cymes consist of 12-15 flowers, while the central cymes are smaller and consist of 8-10 flowers. As the flower primordia develop, the spathe grows upward and envelops them.

Each cyme has a spiral order of flower differentiation and could be considered a complex monochasium: cincinnus. The new flower primordia are still being formed within each cyme at the time that the flower parts are already differentiated in the oldest flower primordia. The youngest flower primordia in the cyme is usually aborted. *Allium* flowers are protandrous. Stamens and the related perianth lobes form first among flower parts developing from common primordia. This process could be described using the abbreviations of the stages of flower development accepted for other bulbous species. In one inflorescence, flowers in the advanced and beginning stages have been observed at the same time.

Flower opening is related to the inflorescence structure. The oldest (first formed) flowers of the peripheral cymes open first. The strict sequence from oldest to youngest flowers was observed within each flower cluster. The central cymes begin to flower before the flowers of the peripheral cymes have all opened. As the flowers continue to open, all pedicels become almost equal in length, so that in the old inflorescence, the cymes can no longer be recognized. However, the regularity in the floral development continues into the flowering and seed maturation period.

In December, just before planting, certain morphological differences in intrabulb development, between control bulbs and bulbs vernalized at 4^0C for 16 weeks, were observed by both light stereoscopy and SEM (Table 1, Fig. 1c, d). At the time of observation, the differentiated inflorescence was more advanced in control than in vernalized bulbs.

Table 1. Effect of vernalization on the internal development of *A. aflatunense* at the end of storage (December), as observed by light stereoscope.

Organ/tissue	Vernalized bulbs	Control bulbs
Leaf primordia	5-6 leaf initials envelop the developing inflorescence	5-6 leaf initials envelop the developing inflorescence
Flower primordia	Flowers are differentiated in lower part of the inflorescence	Full differentiation of flowers in lower and upper parts of the inflorescence
Stalk	2 cm long	1 cm long
Inflorescence	Spherical. 3.3 cm in diameter	Spherical. 3.2 cm in diameter

3.1.2 Optimization of cold treatment during storage period.

Following warm storage, the bulbs of *Allium aflatunense* were treated by low temperatures (Scheme 1). After planting on December, the plants were cultivated under fully controlled conditions in a phytotron's growing chamber with temperature of $20/12^0$C, day and night, respectively. This range of temperatures was chosen to prevent additional vernalization of the plants during their growth. A photoperiod of 10 hours was applied during the *Allium* cultivation. The growth rate and length of the second leaf and flower stalk were measured for each plant once a week. Weight and number of daughter bulbs were measured after bulb harvest in April 1998.

Scheme 1. Combinations of cold treatments for leaf and floral stalk elongation

Temperature	2^0	4^0	9^0	$4+9^0$C	25^0C (control)
Duration					
12 weeks	+	+	+		+
16 weeks	+	+	+		+
8+8 weeks				+	

The physiological response of *A. aflatunense* plants to different storage conditions is presented in Fig. 2-5

Storage at temperature of 25°C (control) does not injure normal development of the leaves and inflorescence inside the bulb. However, in spite of the fact that after planting, these bulbs form root initials, no elongation of the leaves and floral stem was recorded.

Leaf development

1. The successful development of leaves was recorded after storage treatment at 2°C and 4°C (Figs.2 a, b; 5). The physiological response of the plants was influenced by the storage period: cold treatment for 12 weeks resulted in slow leaf elongation after planting, while the treatments for 16 weeks facilitated more intensive leaf growth. In both treatments, final leaf length reached 30-40 cm.

2. Storage at 9°C for 12 and 16 weeks delayed the normal development of the leaves. When planted after storage at 9°C, the bulbs developed leaves to a maximum length of 4-5 cm. However, additional chilling at 4°C for 8 weeks, after 8 weeks at 9°C, significantly improved leaf development, and final leaf length reached in this treatment 35-40 cm (Figs. 2 c; 5).

Floral stalk elongation

Successful elongation of the floral stalk of *A. aflatunense* was recorded only after cold treatment completion (Fig.3; 5). Vernalization at 4°C for 12 and 16 weeks resulted in stalk elongation (50-65 cm). Storage at 9°C for 8 weeks and then at 4°C for additional 8 weeks also resulted in successful stalk elongation (40-50 cm). As opposed to our preliminary hypothesis, lower temperature does not affect effective elongation of leaves and floral stalk. 2°C treatment for 12 and 16 weeks delayed and decreased floral development and stalk elongation.

Bulbing

Average weight of the bulbs of *A. aflatunense*, stored in different conditions, was measured before planting at December, 1997 and after harvest at April, 1998. All cold treatments affected formation of a renewal bulb and a few daughter bulbs. Total weight of the bulbs after harvest was significantly higher after storage at 9/4°C, while vernalization at 4°C, which affected better floral stalk elongation, decreased total weight of the renewal bulb (Fig.4).

3.1.3. Optimization of growth conditions

Cultivation conditions are of special importance for plant growth, flowering and bulbing. Following 16 weeks of warm treatment and cold treatment of 4°C for 16 weeks, plants were planted on December in phytotron and treated by different photo- and thermoperiods, as described in Scheme 2.

Scheme 2. Experimental layout to measure the effect of temperature and photoperiod on *Allium* cultivation

Photoperiod	16 hours LD	10 hours SD
Temperature °C, day / night		
17 / 9	X	X
20 / 12	X	X
23 / 15	X	X

LD- long day; SH - short day

Leaf and floral stalk elongation

1. Growth conditions, employed in our experiment, did not significantly affect leaf elongation (Fig. 6). In all growth chambers, length of the second (measured) leaf was 35-45 cm.

2. Maximum floral stalk elongation was recorded for the plants exposed to temperatures of 17/9°C, day and night respectively. This thermoperiod also promoted successful flowering. Photoperiod of 16 hours (LD) had no special effect on leaf and stalk elongation of *A. aflatunense* (Fig. 7). Normal leaf and floral stalk elongation was also recorded at temperatures of 20/12°C.

3. Growth temperatures of 23/15°C depress stalk elongation and cause flower malformations, while leaf development was only slightly depressed (Figs. 6,7).

Bulbing and vegetative propagation.

Growth conditions, employed in this experiment, did not affect significantly a formation of the renewal bulb (Fig.8). However, cultivation of *A. aflatunense* at higher temperatures slightly decreased a total weight of the renewal and daughter bulbs, measured after harvest.

Rate of vegetative propagation was similar in all growth conditions and varied between 2 and 7 daughter bulbs. Frequency of daughter bulbs' number per one mother bulb, is

shown in the Fig. 9. It is evident, that one bulb usually forms 3-5 daughter bulbs, while the formation of 2 or 6-7 bulbs is relatively sporadic.

3.1.4. Substitution of the cold treatment by exogenous gibberellin (GA_3) treatments.

Preplant immersion for 24 hours of the bulbs of *A. aflatunense* was performed in August-November, 1996 according to the Scheme 3.

Scheme 3. Experimental layout of the preplant treatments of *A. aflatunense* by GA_3.

Cold treatment by 4^0C.

Planting date/ cold treatment duration	August 15 0 weeks of cold treatment	September 15 4 weeks of cold treatment	October 15, 8 weeks of cold treatment	November 15, 12 weeks of cold treatment
100 ppm GA_3	10 bulbs	10 bulbs	10 bulbs	10 bulbs
500 ppm GA_3	10 bulbs	10 bulbs	10 bulbs	10 bulbs
control -water	10 bulbs	10 bulbs	10 bulbs	10 bulbs
control- no treatment	10 bulbs	10 bulbs	10 bulbs	10 bulbs

Following GA_3 treatment, bulbs were planted in phytotron at temperatures $20/12^0$C, day and night, respectively, day length 10 hours. No positive growth response of the bulbs, treated by different combinations of GA_3, was recorded in all the variants of the experiment. No treated bulbs nor the control ones, which did not receive at least 8 weeks of the cold treatment, did not sprout and did not formed normal leaves.

3.1.5. Development of methods of vegetative propagation

Basal cuttage and bulb cutting were examined for 30 bulbs of *A. aflatunense* in 1996/97 and 1997/98 growing seasons. Bulbs were treated in August and placed in wet vermiculite until planting in December. In the second set of experiments, treated bulbs were directly planted in experimental plot in December. Growth analysis was performed throughout plant development, and at the end of the season the number and weight of daughter bulbs was estimated.

The results of the treatments are presented in Fig. 10. Basal cuttage seem to be more effective method for artificial vegetative propagation of *A. aflatunenese*: this treatment was resulted by an average of four bulbs per mother bulb, with total weight of 5.66±0.59 gr. In addition, more that 80% of bulbs survived after basal cuttage, while only 60% of the bulbs sprouted after bulb cutting.

Another promising method of rapid vegetative propagation of *A. aflatunense* is a development of daughter bulbs in the inflorescence (Fig. 11). This phenomena is characteristic for some species from the subgenus *Melanocrommyum*. Further research on the development of the inflorescence bulblets and regulation of this process is needed.

3.2. ALLIUM SPHAEROCEPHALON

3.2.1. Study of floral initiation and development.

Microscopic studies were executed at September 1; October 15; November 1, and November 15, 1996. Floral development of this species does not occur during storage period. Initiation of floral meristem was identified in growing plants, after formation of 6th leaf, during leaf elongation.

3.2.2. Optimization of growing conditions.

Storage of bulbs was performed in 9^{0}C from September 1, 1996 for 6 and 8 weeks. After cold storage, bulbs were planted in phytotron (Scheme 4)

Scheme 4. Experimental layout to measure the effect of storage duration, growth temperature and photoperiod on *A. sphaerocephalon*.

Planting:	17/9 ^{0}C		26/18 ^{0}C	
	ND	LD	ND	LD
October 15 Storage at 9^{0}C for 6 weeks	30 bulbs	30 bulbs	30 bulbs	30 bulbs
November 1 Storage at 9^{0}C for 8 weeks	30 bulbs	30 bulbs	30 bulbs	30 bulbs

Leaf and flower stalk elongation was measured every week. The results are presented in Figs.12-14.

1. Duration of the storage at 9^{0}C (6 or 8 weeks) did not affect leaf and floral stalk elongation of *A. sphaerocephalon.*

2. After planting, maximum leaf and floral stalk elongation was recorded for the plants exposed to temperatures of 17/9^{0}C, day and night respectively. This thermoperiod also promoted successful flowering. Extension of the day length slightly increased floral stalk elongation of *A. sphaerocephalon,* but at the same time, significantly reduced flowering percent.

3. High growth temperatures affected intensive leaf development and elongation (Fig. 12 and 13). Additional day length (16 hours) induced early leaf senescence and withering.

4. High growth temperatures depress stalk elongation and cause flower malformations or abortion (Fig. 14). Leaf development of *A. sphaerocephalon* was significantly depressed by temperature of 26/18^{0}C.

5. Growth temperatures affect floral stalk more than leaf elongation of the same plants.

3.3. TULBAGHIA FRAGANS

In March - October 1996 the plants of *Tulbaghia* were lifted in interval of two weeks and stored in 25^{o}C in order to examine their floral development. All these plants have been planted in December in experimental field for further observations.

Morphological analysis of the species have been performed during their storage and growth. Each plant contains one or two developing inflorescences in different stages of initiation and development. Intensive rhizome branching leads to the formation of additional buds and axillary daughter shoots. Rate of natural vegetative propagation is 4-10.

An effect of the storage temperatures and the growth conditions on *Tulbaghia* plants has been studied in 1996. The results of this study have been published in Hebrew (see Appendix).

In 1997, commercial cultivation of this species was reduced in Israel due to marketing reasons. Today, only three commercial flower growers maintain the small stocks of *Tulbaghia* plants, which cannot be used as a commercial crop.

4. Conclusions:

1. Light and Scanning Electron Microscopy (SEM) were used to study the monocarpic shoot development and florogenesis of *Allium* species, as relates to its annual life cycle. In *A. aflatunense*, which belong to the subgenus *Melanocrommyum*, the initiation of leaf primordia begins in the renewal bulb during the flowering stage of the mother plant. The meristem proceeds to florogenesis in August, during the "dormancy" stage of the mother plant. Since the inflorescences of the species studied consist of regularly arranged flower clusters, many stages of the floral development

can be observed simultaneously. Similar order of floral development is known for other members of the subgenus *Melanocrommyum* originated from Central Asia (Kamenetsky and Japarova, 1997).

In *A. sphaerocephalon*, which belongs to the subgenus *Rhyziridium*, floral development does not occur during storage period. Initiation of floral meristem was identified during plant growing, after formation of 6th leaf, as in other species of this taxonomic group (Krontal *et al*, 1998).

2. Cold storage treatment of *A. aflatunense* considerably affects the elongation of the floral stem. When grown in temperature of 20/12^{0}C (day and night, respectively) and photoperiod of 10 hours, the most effective stalk elongation was recorded after treatment of 4^{0}C for 16 weeks.

In *A. sphaerocephalon*, duration of *cold* treatment did not affect leaf and floral stalk elongation.

3. Growth temperatures affect leaf and floral stem elongation of both *Allium* species. Maximal stalk length was achieved at 17/9^{0}C (day and night, respectively). High growth temperatures depressed stalk elongation.

4. The effect of a photoperiod of 16 hours on leaf and flower stalk elongation was not remarkable for *A. aflatunense*. At the same time, long day in combination with relatively low growth temperatures, increased floral stalk length and reduced flower percent of *A. sphaerocephalon*.

5. Supplementary treatment of the bulbs of *A. aflatunense* by different concentrations of GA_3, can not be used as substitution of the cold treatment for this species

6. A serious limitation in the study of the physiology of *Allium* flowering in the 1996/97 and 1997/98 seasons was plant infection by *Fusarium*, *Penicillum* and viruses. This infection weakens the bulbous plant and could lead to an inadequate response to the environmental conditions.

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Figure legends

Fig. 1 Scanning electron photomicrographs of floral development of *A. aflatunense*

bar = 0.1 mm

a - initiation of spathe (SP) and floral meristem (FM) in March.

b - Differentiation of floral primordia (FP) in a reproductive meristem, in August, spathe removed.

c - developing inflorescence in December, after 4-months of storage at 4°C. Floral differentiation is visible in older flowers (F), while younger flowers still appear as meristematic domes (FP). Spathe removed.

d - developing inflorescence in December, after storage under ambient conditions. Floral primordia are fully differentiated, pedicel elongation is visible. In older flowers (F), perianth segments develop quickly and envelop the stamens. Younger flowers are differentiated.

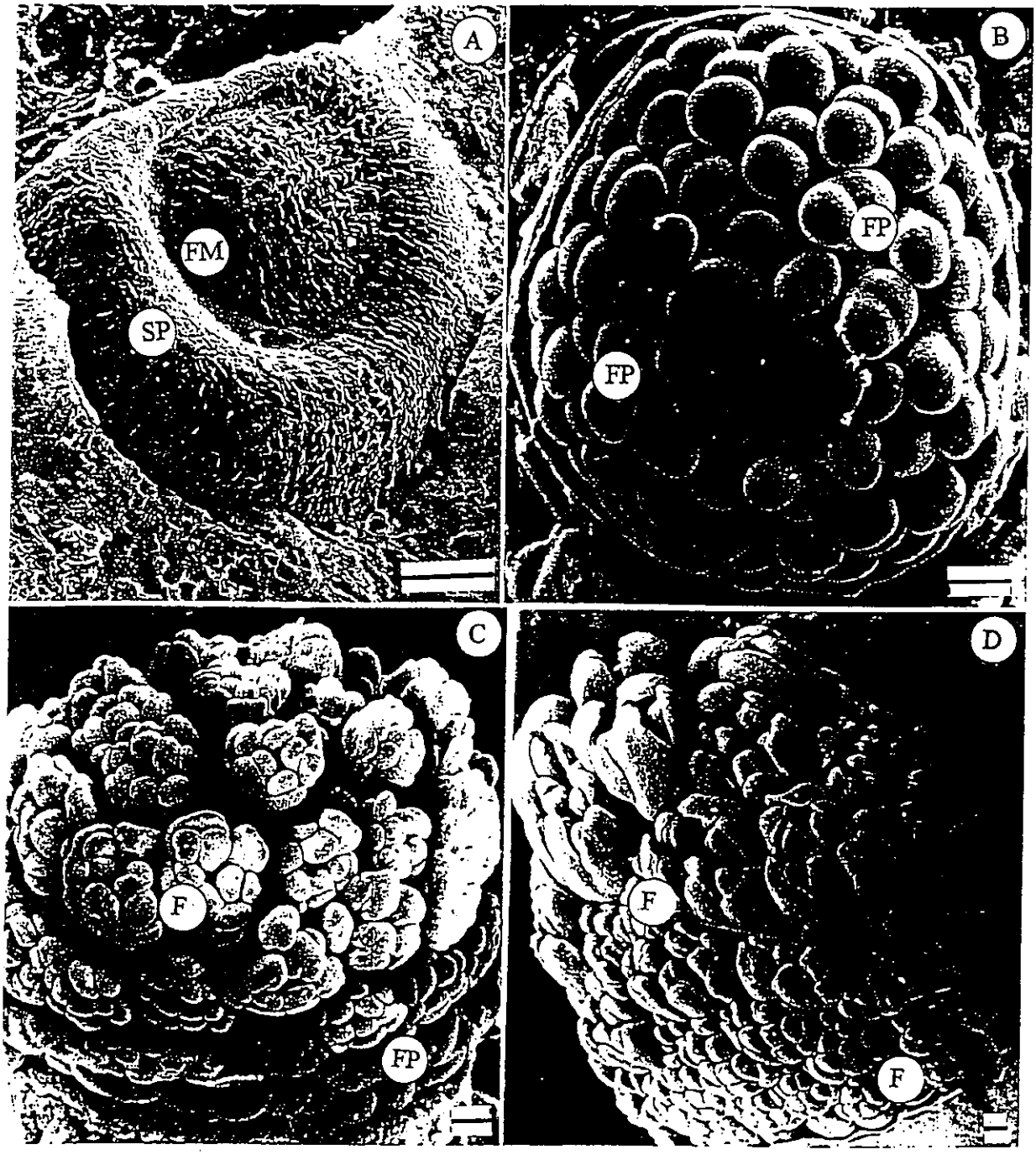


Fig. 1

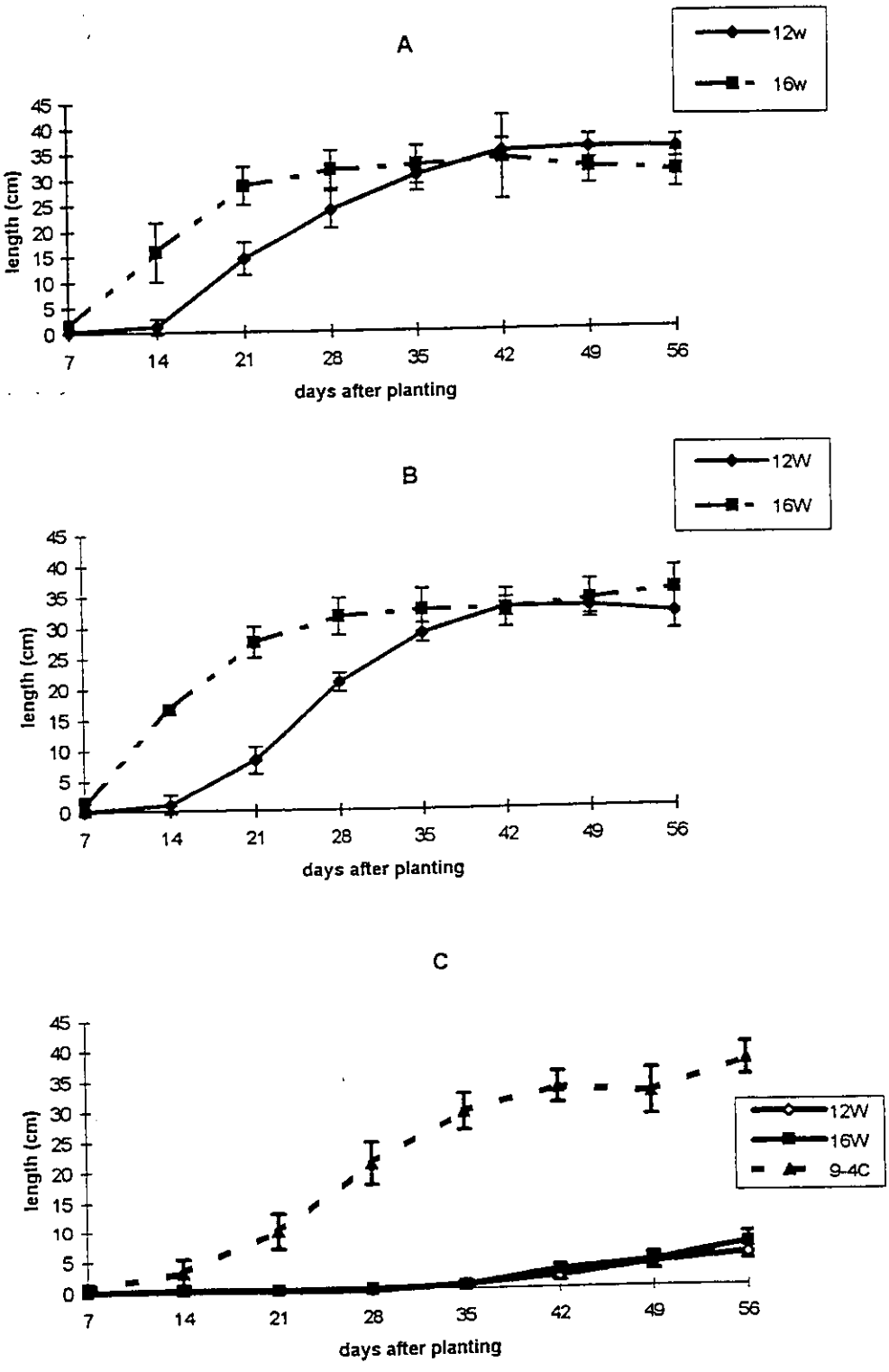


Fig. 2. Dynamics of *A. aflatunense* leaf elongation . Planting after bulb storage at 2^0C (A), 4^0C (B) for 12 and 16 weeks, and combination of 9^0C for 8 weeks and 4^0C for 8 weeks(C). Plants were grown at $20/12^0$C, day and night, respectively, photoperiod 10 h.

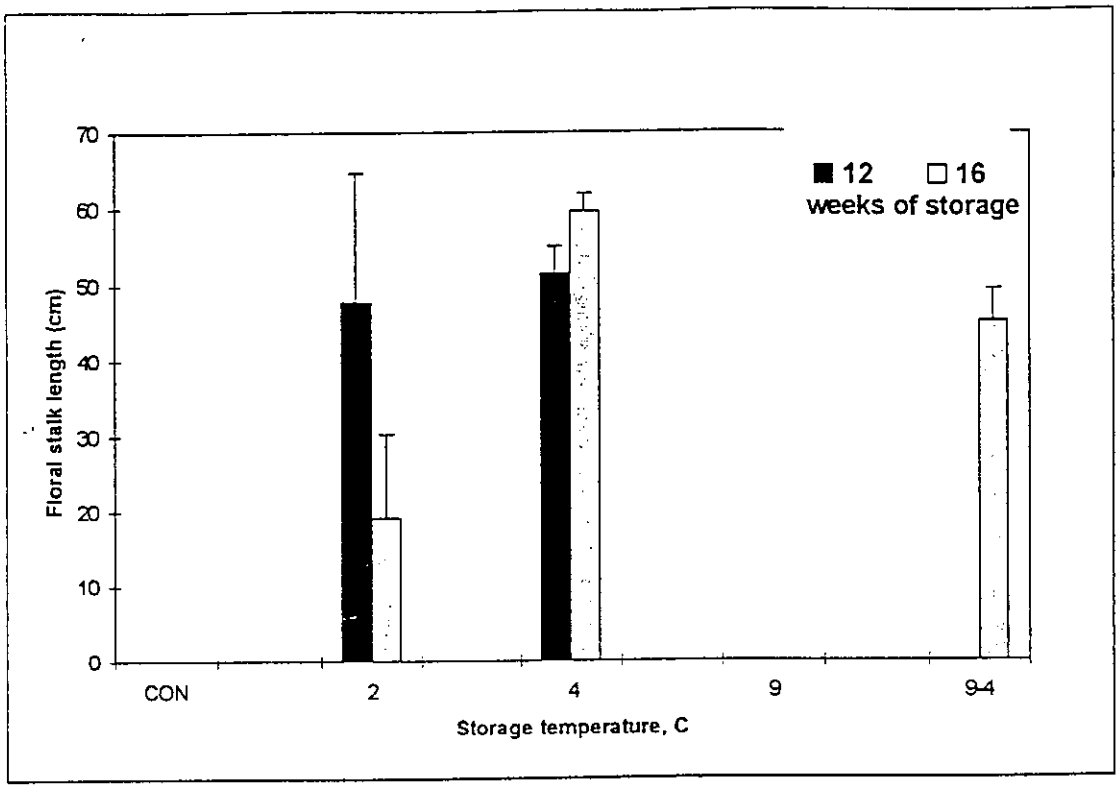


Fig. 3. Final length of floral stalk of *A. aflatunense* as response to different storage temperatures. Plants were grown at 20/12^{0}C, day and night, respectively, photoperiod 10 h.

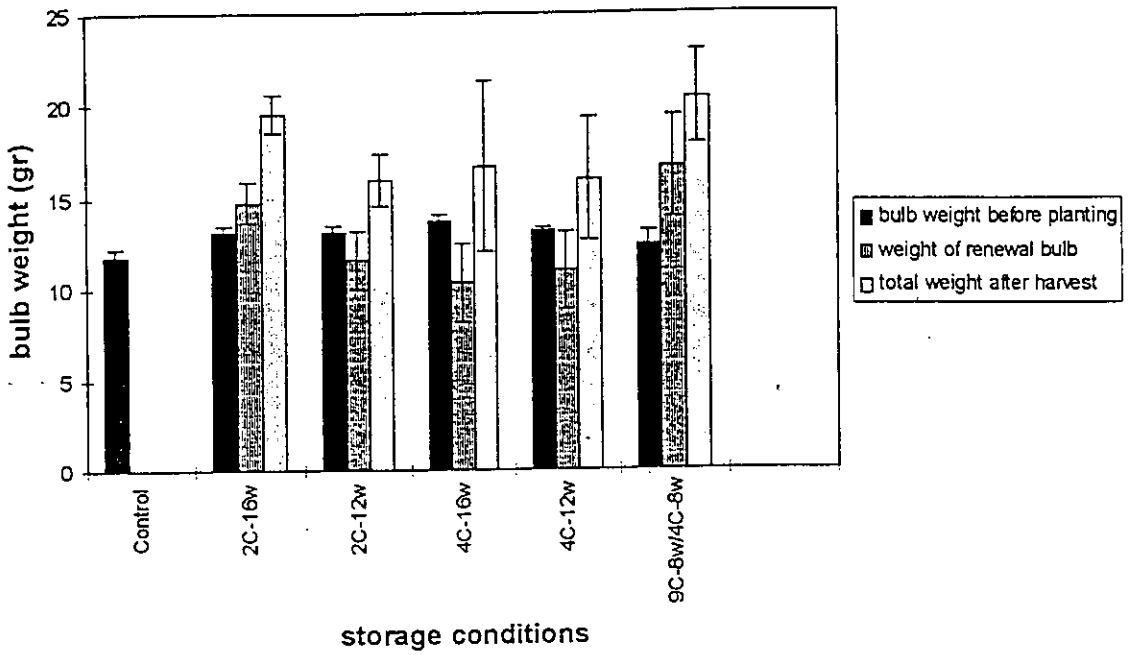


Fig. 4. Bulb weight after storage in different conditions and growing at $20/12^0$C, day and night, respectively, photoperiod 10 h.

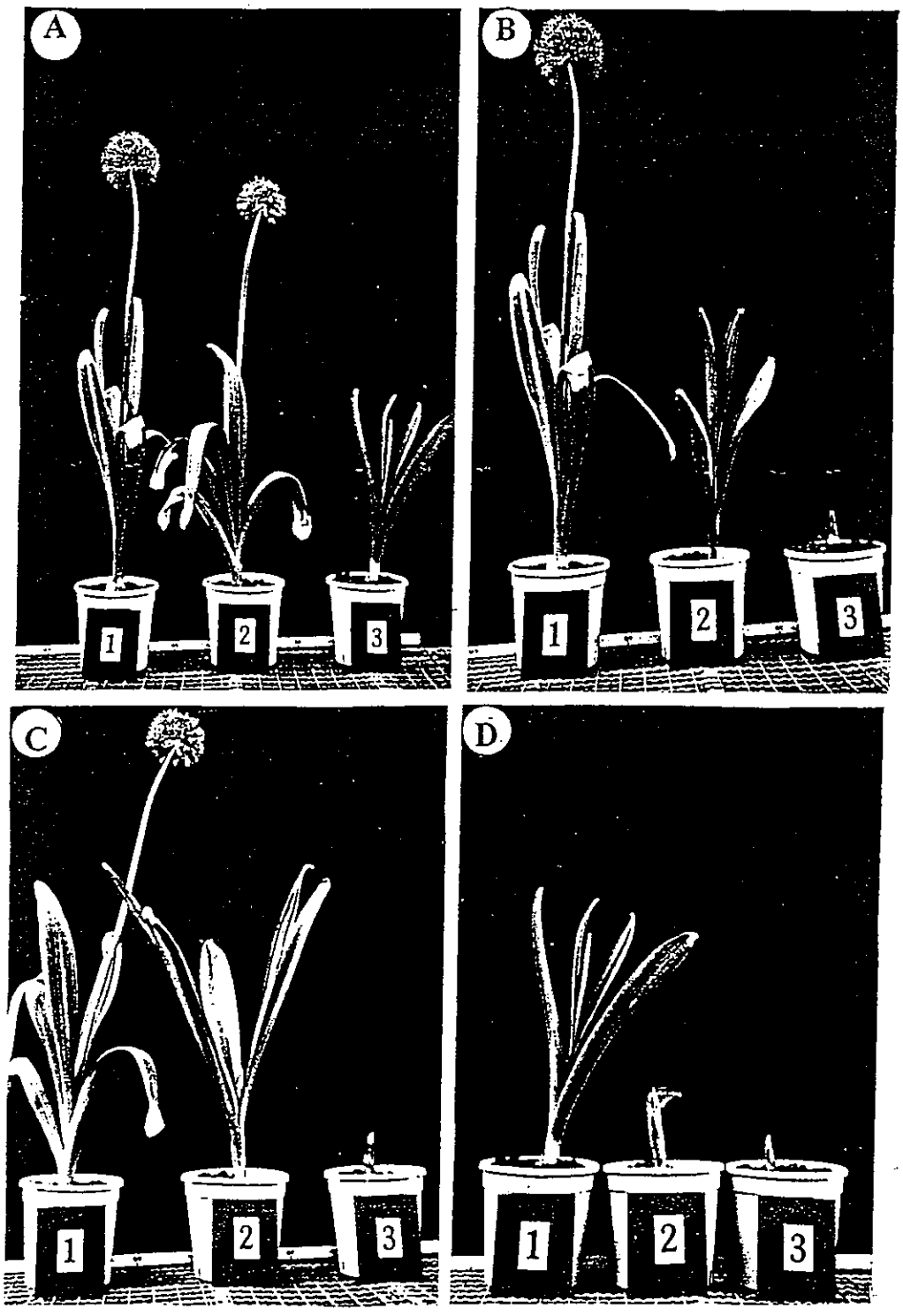


Fig.5. Effects of bulb storage on subsequent development of *A. aflatunense.*

Planting on December 15, 1997 after storage at:

A - 2^0C (1); 4^0C (2) and 9^0C (3) for 12 weeks

B - 2^0C for 12 (1); 8 (2) and 4 (3) weeks

C - 4^0C for 12 (1); 8 (2) and 4 (3) weeks

D - 9^0C for 12 (1); 8 (2) and 4 (3) weeks

Growth temperature $20/12^0$C, day and night, respectively, photoperiod 10 h.

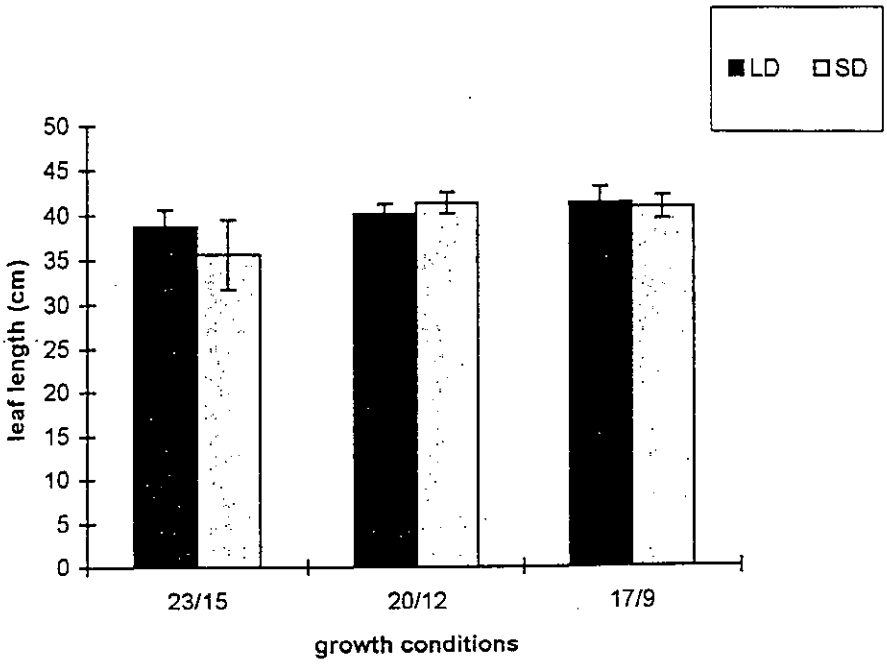


Fig. 6. Final length of second leaf of *A. aflatunense* under forcing at different conditions. Planting in December, 1997 after cold treatment of 4^0C for 16 weeks.

LD – long day (16 h), SD – short day (10 h).

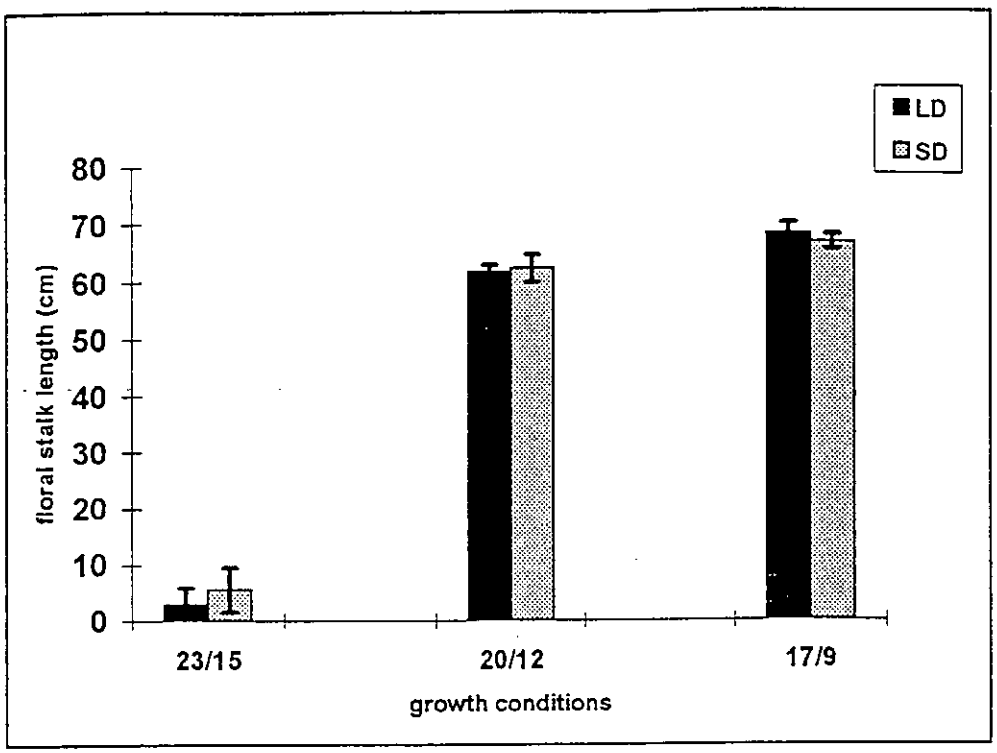


Fig.7. Final length of floral stalk of *A. aflatunense* under forcing at different conditions. Planting in December, 1997 after cold treatment of 4^{0}C for 16 weeks. LD- long day (16 h), SD- short day (10h).

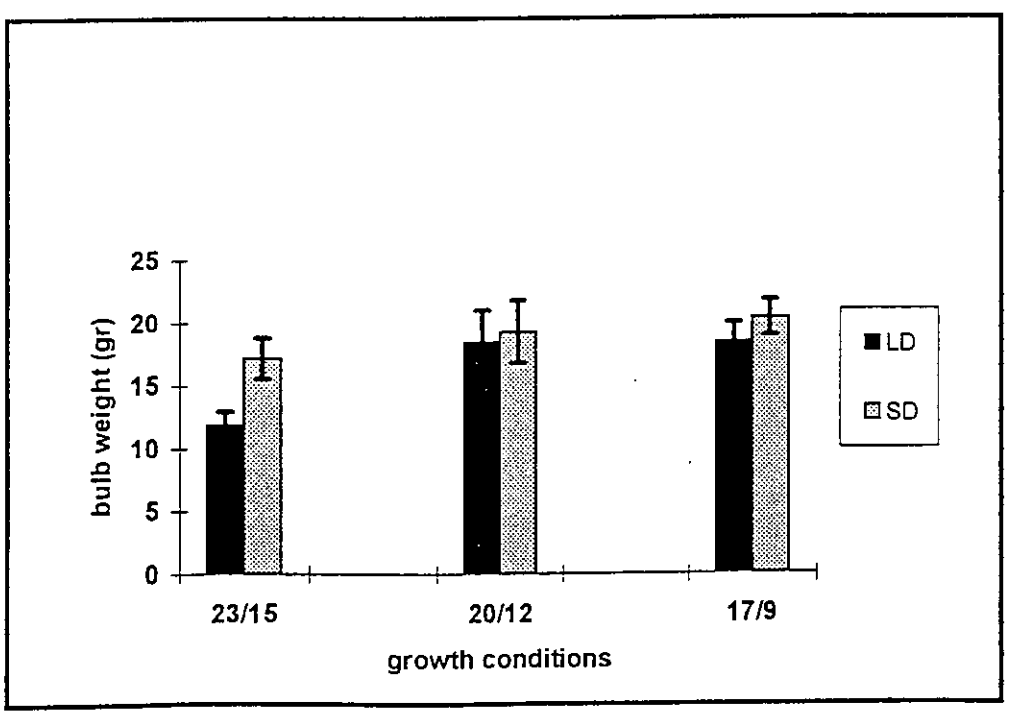


Fig. 8. Bulbs weight of *A. aflatunense* after growing under different temperature conditions. Planting in December, 1997 after cold treatment at 4^{0}C for 16 weeks. Weight measurements after bulb harvest, in April, 1998. LD- long day (16 h), SD- short day (10h).

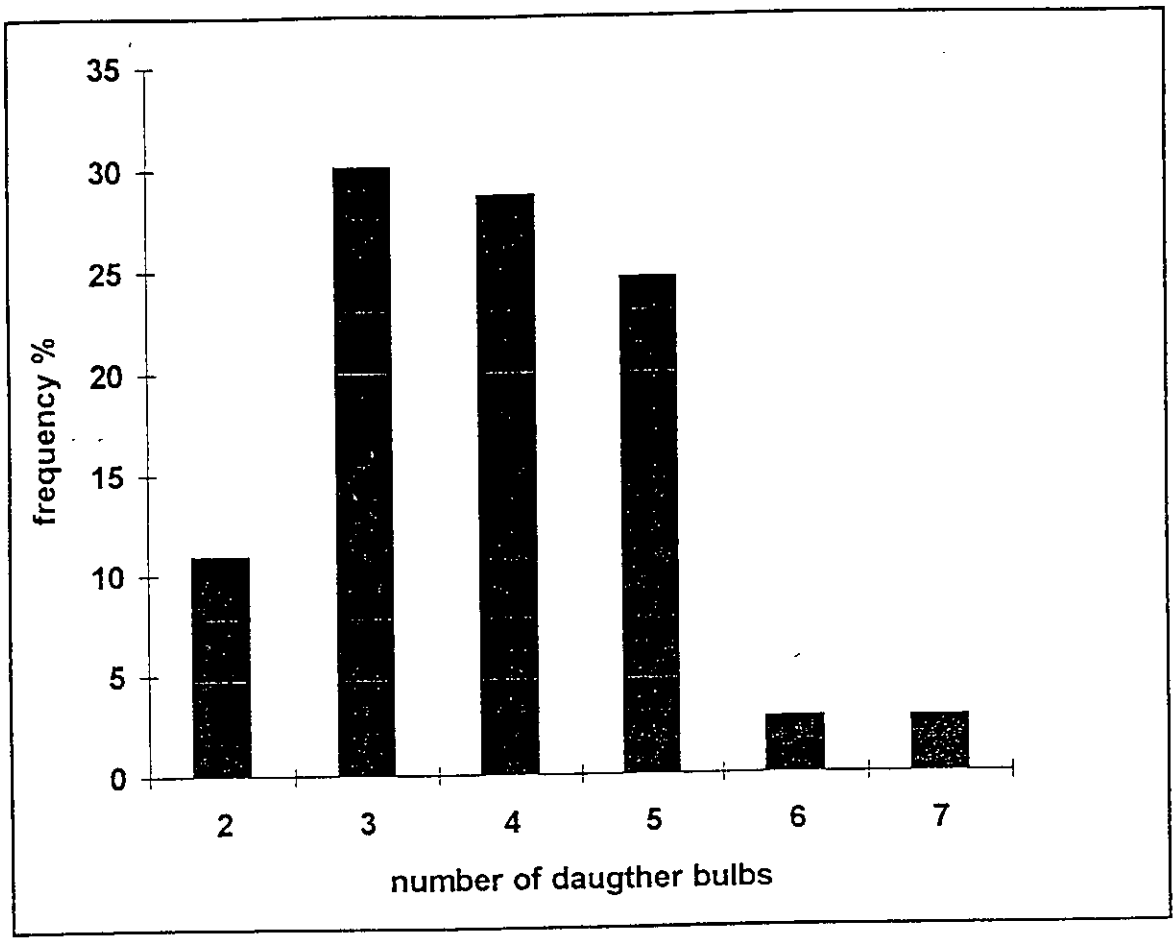


Fig. 9. Frequency of number of daughter bulbs (per one mother bulb), formed by *A. aflatunense* during one vegetative season 1997/1998. Measured after harvest, April, 1998

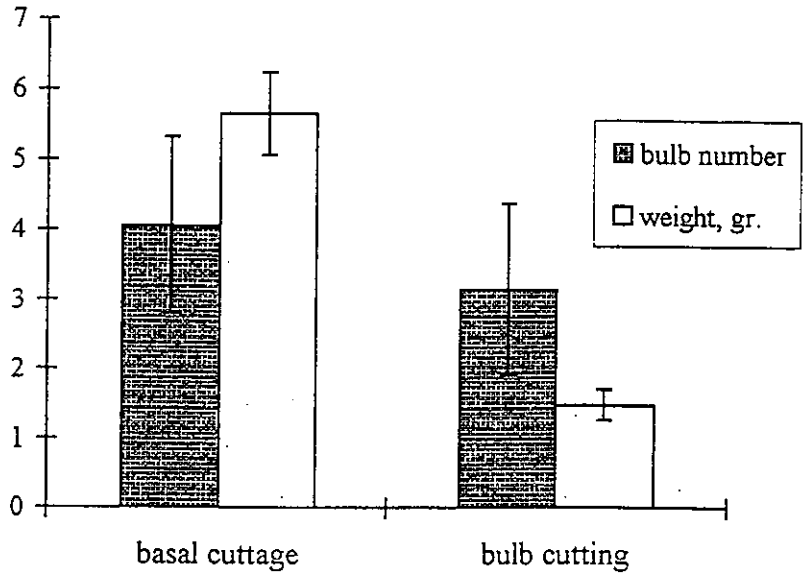
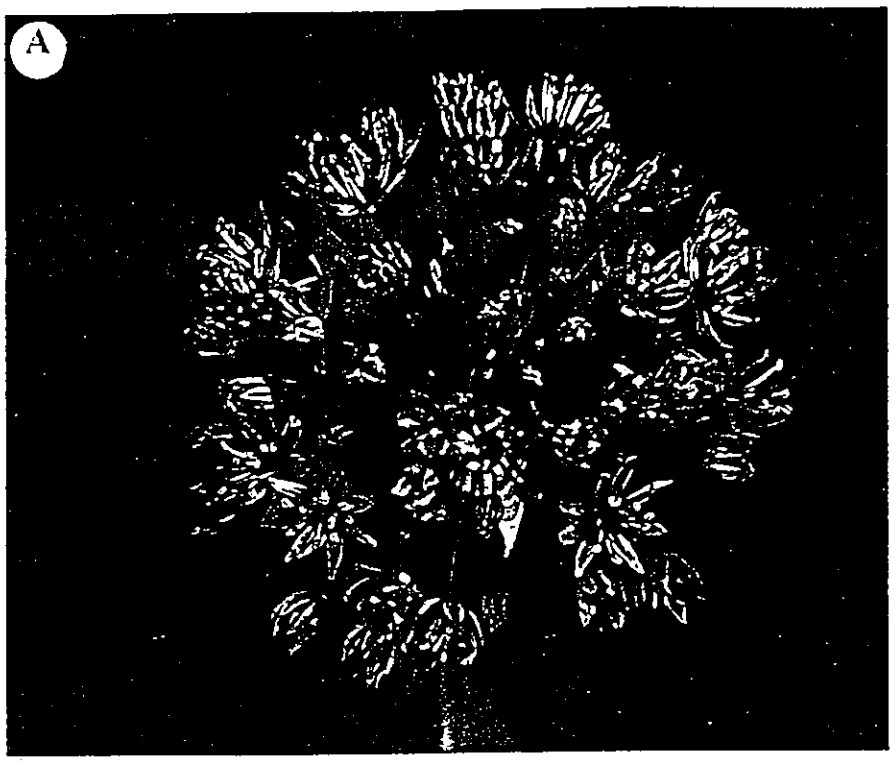


Fig.10. Effect of basal cuttage and bulb cutting of *A. aflatunenese* on number and weight of daughter bulbs. 30 bulbs were treated in August 1997 and placed in wet vermiculite until planting in December.



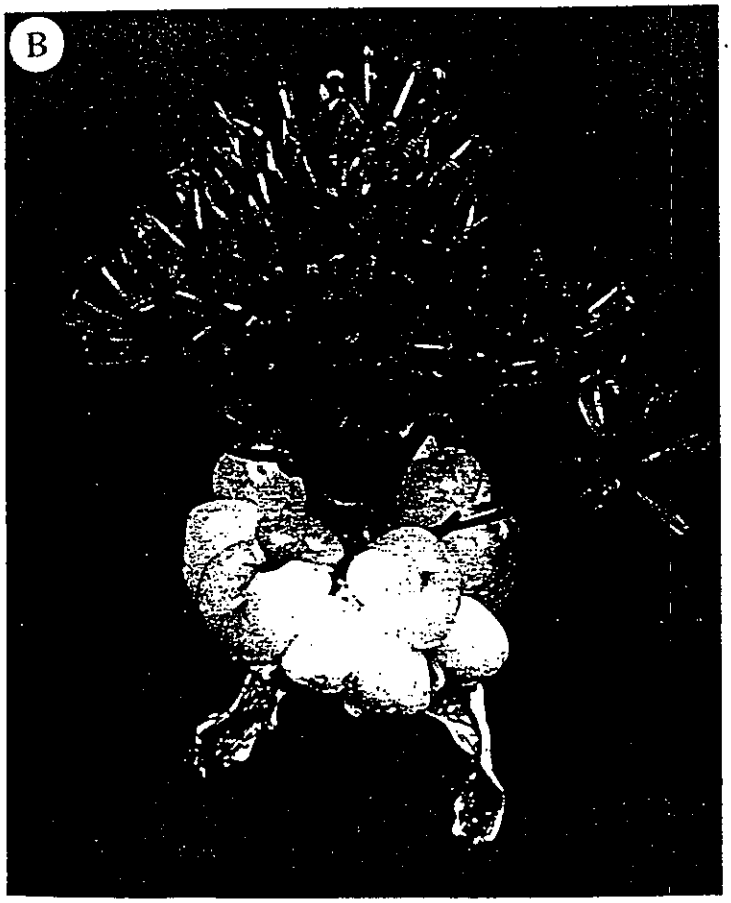


Fig. 11. Development of bulblets in the inflorescence of *Allium aflatunense*:

A-normal inflorescence; B - normal flowers and bulblets; C- bulblets

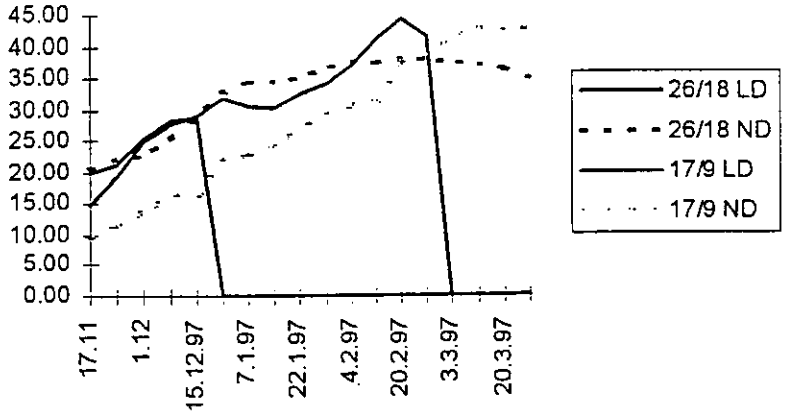


Fig. 12. Dynamics of *A. sphaerocephalon* leaf elongation in fully controlled conditions of temperature 17/9^{0}C and 26/18^{0}C, day and night, respectively, and photoperiod of 10 (ND, normal day) and 16 (LD, long day) hours. Planting at October 15, 1996, after cold treatment at 9^{0}C for 6 weeks.

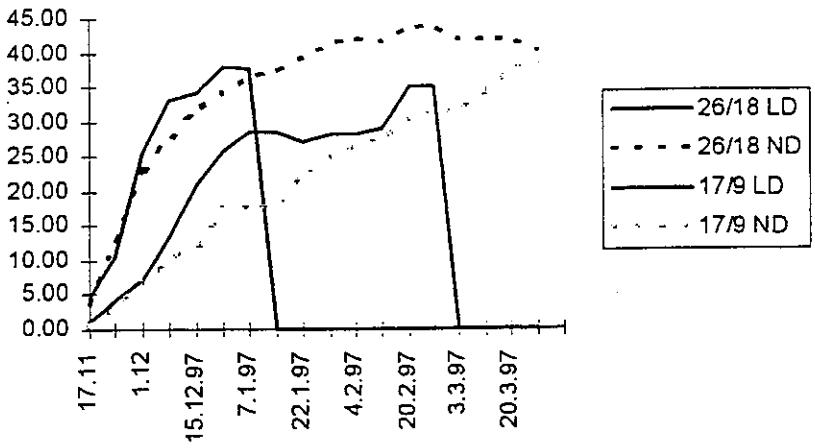


Fig. 13. Dynamics of *A. sphaerocephalon* leaf elongation in fully controlled conditions of temperature 17/9^{0}C and 26/18^{0}C, day and night, respectively, and photoperiod of 10 (ND, normal day) and 16 (LD, long day) hours. Planting at November 1, 1996, after cold treatment at 9^{0}C for 8 weeks.

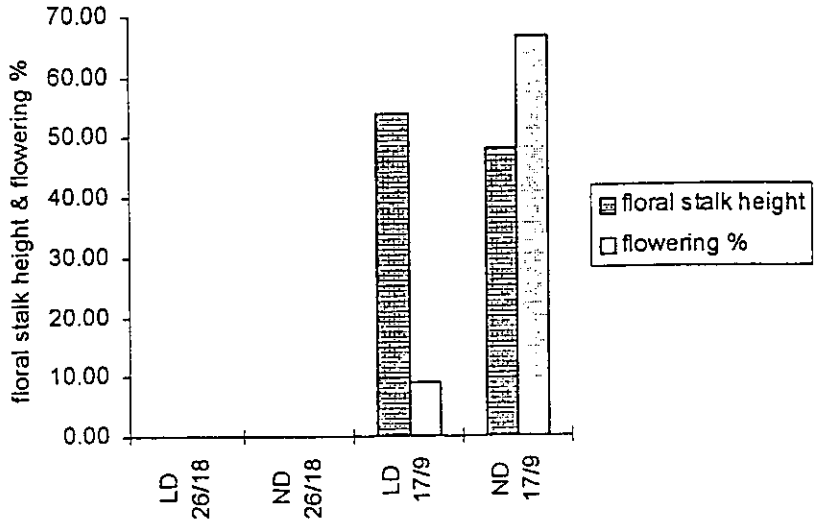


Fig.14. Final length of floral stalk and flowering percent of *A. sphaerocephalon* under forcing in different growth conditions. Planting at October 15, 1996 after cold treatment of 9^0C for 6 weeks.

1. <u>מטרות המחקר לתקופת הדו"ח תוך התייחסות לתוכנית העבודה.</u>

-לימוד שלבי האיניציאציה והתפתחות תפרחות של שלושה מינים ממשפחת השומיים בתנאים מבוקרים (באמצעות מיקרוסקופ אור ומיקרוסקופ אלקטרוני סורק SEM).

-לימוד תגובת הצמחים לתנאי סביבה במהלך האחסון והגידול בתנאים מבוקרים.

2. <u>עיקרי הניסויים והתוצאות שהושגו בתקופה אליה מתייחס הדו"ח.</u>

- איניציאציה של תפרחת בכל שלושת המינים מתחילה לאחר התפתחות של 5-6 עלים. אך בכל מין תהליך זה מתרחש בשלב שונה במחזור החיים.

- תנאי האחסון והגידול משפיעים על תהליכים מורפולוגיים של התפתחות הפרח.

-לכל אחד משלושת המינים נמצאו התנאים האופטימליים לאחסון וגידול , ב-*A. aflatunense* ו- *A. sphaerocephalon* נמצא משך הזמן האופטימלי לאחסון בטמפ' נמוכות.

3 . <u>המסקנות המדעיות וההשלכות לגבי יישום המחקר והמשכו.</u>

- טמפ' נמוכות ואורך יום קצר מעודדים פריחה מוקדמת של כל המינים שנלמדו. עובדה זו מלמדת על אפשרות להפרחתם בתנאי החורף בישראל.

-בשני מינים נמצא שהאחסון בטמפ' נמוכות לפני השתילה הוא תנאי הכרחי לקבלת פריחה.

4. <u>הבעיות שנותרו לפתרון ו/או השינויים שחלו במהלך העבודה (טכנולוגיים, שיווקיים ואחרים); התייחסות המחקר לגביהן.</u>

- החומר הצמחי בו השתמשנו בניסויים היה נגוע במחלות וירוסים.

- *Tulbaghia fragans* ירדה מסדר העדיפויות של החקלאים מסיבות שיווקיות ולכן לא ניתן ליישם את תוצאות המחקר בצמח הזה.

5. <u>האם הוחל כבר בהפצת ידע הידע שנוצר בתקופת הדו"ח- יש לפרט: פרסומים - כמקובל בביבליוגרפיה , פטנטים- יש לציין מס' פטנט, וימי עיון- יש לפרט מקום ותאריך.</u>

התוצאות דווחו בשני ימי עיון למגדלים . שני מאמרים באנגלית נמצאים בהכנה. מאמר בעברית העוסק ב- *Tulbaghia fragans* התפרסם ב- 'דפי-מידע' ביוני 1996.

ביום עיון בנושא: "פרחים ובתי צמיחה" הוצגו התוצאות והמסקנות מן הדו"ח הסופי.