

## **MORPHOLOGICAL AND ANATOMICAL STUDIES ON THE STEM OF SOME SOLANACEAE GENERA.**

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### **ABSTRACT**

This study aimed to find out the morphological and anatomical differences in the stem among three genera of Solanaceae, namely; *Solanum tuberosum* L. (potato), *Capsicum annuum* L. (pepper) and *Datura stramonium* L. (datura).

Results revealed that *Datura stramonium* plants gave the highest measurements in plant height, stem diameter, and fresh and dry weights of leafless shoots, followed by *Capsicum annuum*, while *Solanum tuberosum* gave the lowest measurements in these characters, except in plant height where *Capsicum* was the lowest. Although *Datura* plants were the highest in plant height, it was the lowest in number of internodes. On the contrary *Solanum* recorded low measurements for plant height but was the highest in number of internodes.

The structure of the stem indicated that, *Solanum* had the thickest second, median and basal internodes due to the thickness of vascular cylinder and pith, while *Capsicum* gave the most thin second and median internodes, and *Datura* was the most thin in the basal one.

**Keywords:** Morphology, Anatomy, Solanaceae, *Solanum*, *Capsicum*, *Datura*.

### **INTRODUCTION**

Family Solanaceae is one of the most important economic families of the flowering plants, with about 90 genera and 2000 species. Plants are distributed in the tropical and temperate regions mainly in Central and South America. The family includes several important genera, e.g. *Solanum*, *Capsicum* and *Datura*. Plants are mostly herbaceous, though some are soft wooded shrubs or small trees, with alternate, simple or compound leaves which are often softly hairy; without stipules, (Cobley, 1976) and (Pritishakla and Misra, 1979). Three genera were chosen for this work, to disclose their different morphological and anatomical characteristics in the stem. The three genera are:

*Solanum tuberosum* L. (potato), is an annual, herbaceous and succulent plant, with branched stem, arising laterally and extending along the stem. The leaf is compound with netted venation. The plant has two types of stems; aerial stems (herbaceous and erect) and subterranean ones (stolons and tubers). The aerial stems are green or purplish, and are round to more or less triangular, with prominent wing-like growths along its two sides. The tubers originate from the tip of stolons and contain all characters of normal stems, including dormant vegetative buds found inside eyes at the base of a leaf with detectable leaf scars. The buds are found in a spiral pattern on the tuber. The corky epidermis and periderm together comprise the skin of the mature tuber, which contains some pigments and gives a colour for the tuber. Tubers are rich in starch and vitamins B and C and used for human food and livestock feed, (Cutter, 1992).

*Capsicum annuum* L. (pepper), is an annual to biennial herb, with erect multiple dichasium branched glabrous stem, bearing simple leaves with netted venation. It is one of the most important and widely distributed vegetable crops in Egypt, especially under tunnels nowadays. Fruits of hot pepper contain Capsaicin (2%), therefore it is used as a condiment and for rheumatism treatment by external application as it irritates and reddens the skin, (Bailey, 1958).

*Datura stramonium* L. (datura), is an annual or perennial shrub. The stem is erect, multiple dichasium branched bearing simple leaves with netted venation and it is a stout plant. It is rerepresented as an important medicinal plant, where the leaves are rich in alkaloids: Hyosyamin, Hyosin and Atropine, which are used for medical treatments of respiration, digestive and nervous systems and as eye drops. The fruit, is often called thorn-apple or mad-apple. (Robins *et al.*, 1992).

## MATERIALS AND METHODS

The current investigation was carried out at the Agricultural Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt, during two successive seasons; (2002 and 2003), to compare the morphological and anatomical differences, among three genera of family Solanaceae; *Solanum tuberosum* L. *Capsicum annuum* L. and *Datura stramonium* L.

Tuber seeds of potato, cv. Spunta, were obtained from the Co-operative Society of Potato Growers, Egypt. While seeds of pepper, cv. Anahiam, were secured from the Vegetable Research Department, Agricultural Research Center. Seeds of datura cv. Stramonium were procured from the Experimental Station of Medicinal Plants, Faculty of Pharmacy, Cairo University. Giza.

The layout of the experiment was a randomized complete block design, in three replicates per genus. The type of soil of the experimental field was a loamy clay soil.

Tuber seeds of potato were sown on the first of February, 2002 and 2003 in three plots, each consisted of 8 rows, 4 meters long and 70 cm in width. Whole potato tubers, weighing 45-60 g, were sown in hills and covered with soil.

Pepper seeds were sown on the first of February, 2002 and 2003 in warm seed beds in lines and were transplanted to the field on the first of April in replicates comprised 6 rows, 4.5 meters long and 65 cm in width.

Datura seeds were cultivated on the first of April, 2002 and 2003, in plots 2 × 3 meters with 6 rows each and 50 cm. apart. Seeds were disseminated in hills spaced 50 cm, 3-4 seeds per hill. Plants were thinned to one plant per hill after one month.

### Studied morphological characters:

Fifteen plants per genus, 5 plants from each of the 3 replicates, were assigned for the following morphological characters, at 15 days intervals in both seasons, starting from the age of 30 days until the end of the growing season.

- 1- Average plant height (cm.): at the same ages, was measured from the soil surface to the unpermost point of the plant.
- 2-Average diameter of the median internode of the main stem (cm.): was measured at the same ages, by using a Clipper.
- 3-Average number of internodes of the main stem/ plant at the same ages was calculated.
- 4-Average fresh and dry weights (g.), of leafless shoots / plant at the same ages, except the first age (30 days) as the seedlings were very small.  
Samples were dried in an electric oven at 70°C till constant weight, (almost 48 hours).

#### **Anatomical studies:**

Specimens, 1 cm. long, were taken from plants of the second season at two ages, 45 and 60 days, and were taken from the main stem represented by the second internode below the shoot apex, the median internode and the basal one, from the middle region of each internode. Transverse sections of stolons, 1 cm. long samples were taken at 2 cm. apart from the tip, while tubers specimens, 1cm<sup>2</sup>. and 0.5 cm. thick were taken from the middle of mature tubers at the age of 90 days. Specimens were killed and fixed for at least 48 hours in F.A.A. ( 10 ml formalin, 5 ml glacial acetic acid, 85 ml ethyl alcohol 70% ). Materials were washed in 50% ethyl alcohol and dehydrated in a normal butyl alcohol series, embedded in paraffin wax (55°C m.p.) ( Sass, 1958). Transverse sections, 20  $\mu$  thick, were cut using a rotary microtome and stained with crystal violet / erythrosine combination, and mounted in Canada balsam, (Willey, 1971). Counts and measurements ( $\mu$ ) of the different tissues were taken, and averages of ten readings from five slides were calculated.

#### **Statistical analysis:**

Morphological data were subjected to different methods of statistical analysis according to computer software designed for statistical analysis (MSTAT, 1986).

## **RESULTS AND DISCUSSION**

#### **Morphological studies:**

##### **1. *Solanum tuberosum* L. (potato)**

Table (1) indicates the values of the studied morphological characters of the stem of *Solanum tuberosum* during 2 seasons; plant height, stem diameter, number of internodes of the main stem and fresh and dry weights of leafless shoots.

##### **a. Plant height:**

Results indicated that significant increases in plant height were attained during the consecutive periods in both seasons up to the age of 105 days, where the plants reached an average height of 69.9 and 65.7 cm.; respectively. Thereafter insignificant increases were recorded between the ages of 105-120 days in both seasons. The maximum heights were reached at the end of the growing season (120 days), being 73.7 and 71.6 cm. in two

seasons; respectively. The highest increase in plant height occurred between the age 45-60 days in both seasons.

**b. Stem diameter:**

Data showed that diameter of median internode achieved significant increases up to age 75 days in both seasons, where average diameters were 1.2 and 1.1 cm. in two seasons; respectively. The average stem diameter was significantly decreased in the following periods (90-120 days), in both seasons being 0.8 and 0.7 cm. at the end of the growing season (120 days). This decrease in diameter might be a result to the normal dryness causing shrinkage associated with senescence. The highest increase in diameter of median internodes of the main stem was achieved during the stage between 30-45 days in the first season and between 30-45 and 45-60 days in the second one.

**Table (1): Morphological characters of the stem of *Solanum tuberosum* L. during two successive seasons, 2002 and 2003. (Averages of 5 plants).**

Plant age (days)	Plant height (cm.)		Diameter of main stem (cm.)		No. of internodes of the main stem		Fresh weight of leafless shoots (g.)		Dry weight of leafless shoots (g.)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
30	5.2	4.5	0.4	0.3	5.8	5.0	-	-	-	-
45	22.3	19.3	0.8	0.6	10.4	9.8	8.8	8.5	1.8	1.6
60	41.4	37.7	1.0	0.9	13.2	12.0	18.7	16.8	3.4	2.7
75	52.6	47.3	1.2	1.1	15.2	14.6	30.2	27.4	5.5	4.8
90	60.8	58.5	1.1	0.9	16.2	15.0	64.9	60.2	11.6	10.4
105	69.9	65.7	1.0	0.8	16.4	16.0	84.3	82.1	15.4	14.7
120	73.7	71.6	0.8	0.7	16.6	16.5	61.4	57.8	11.3	9.7
L.S.D. at 0.05	5.0	6.9	0.1	0.1	1.5	1.3	22.1	11.9	1.8	2.1

**c. Number of internodes of the main stem:**

Results showed significant increases in number of internodes with plant age in the two successive seasons till the age of 75 days, being 15.2 and 14.6 internodes/ plant in both seasons; respectively. Afterwards, insignificant increases were achieved during the two seasons reaching its maximum at 120 days, being 16.6 and 16.5 internodes/ plant in both seasons; respectively. The highest increase was achieved during the stage 30-45 days in both seasons.

**d. Fresh weight of leafless shoots:**

It is evident from the values that average fresh weights of the leafless shoots recorded gradual insignificant increases till the age of 105 days in the first season, except the stage between 75- 90 days, while in the second season significant increases were recorded among the stages 75-90 and 90-105 days. The maximum weights were 84.3 and 82.1 g. at 105 days, in both seasons; respectively. At final stage (105-120 days), significant decreases were found in both seasons. The highest increase in fresh weight of leafless shoots was recorded at 75- 90 days in both seasons.

**e. Dry weight of leafless shoots:**

It is clear from data that, there were significant increases in dry weight in both seasons, except at the stage of 45-60 days, and reached its maximum at 105 days, being 15.4 and 14.7 g. in both seasons; respectively. At final stage (105- 120 days), significant decreases were achieved in both seasons; respectively, being 11.3 and 9.7 g. The highest increase was achieved during the stage between 75-90 days in both seasons. The dry weight was corresponding with that of the fresh weight.

**2. *Capsicum annuum* L. (pepper)**

Table (2) indicates the values of the studied morphological characters of the stem of *Capsicum annuum* during 2 seasons; plant height, stem diameter, number of internodes of the main stem and fresh and dry weights of leafless shoots.

**a. Plant height:**

It is evident that significant increases were detected in both seasons during all consecutive stages up to the end of the growing season, where the plant reached an average height of 83.8 and 82.7cm. in both seasons; respectively. The highest increase in plant height was achieved during stages 90- 105 days in both seasons.

**b. Stem diameter:**

It is obvious that there were significant increases during all stages in both seasons, except at the stages 30-45 and 75-90 days in the second one. A maximum diameter was recorded at the end of the growing season (150 days), being 1.8 and 1.7 cm. in both seasons; respectively.

**Table (2): Morphological characters of the stem of *capsicum annuum* L. during two successive seasons, 2002 and 2003. (Averages of 5 plants).**

Plant age (days)	Plant height (cm.)		Diameter of main stem (cm.)		No. of internodes of the main stem		Fresh weight of leafless shoots (g.)		Dry weight of leafless shoots (g.)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
30	13.3	12.7	0.4	0.3	8.8	7.8	-	-	-	-
45	21.2	17.0	0.5	0.4	10.2	10.0	1.7	1.5	0.3	0.2
60	29.9	24.3	0.8	0.6	11.2	11.0	4.0	2.7	0.6	0.4
75	37.6	33.7	0.9	0.8	12.0	12.2	11.9	10.5	1.9	1.6
90	47.8	39.9	1.0	0.9	13.4	13.6	57.4	52.6	9.3	8.2
105	60.3	54.6	1.2	1.1	14.4	13.8	92.2	90.6	14.8	13.6
120	68.8	66.0	1.4	1.3	14.5	14.4	165.5	162.1	26.6	25.5
135	78.5	74.7	1.6	1.5	14.6	14.8	232.5	226.4	36.4	34.4
150	83.8	82.7	1.8	1.7	14.8	15.0	314.4	309.7	48.8	45.9
L.S.D. at 0.05	3.0	4.3	0.1	0.2	1.1	1.0	21.9	18.4	5.4	4.4

**c. Number of internodes of the main stem:**

It is evident that there were significant increases in number of internodes during the stages 30-45 and 75-90 days in the first season, and from 30 to 90 days in the second one. The numbers reached 14.8 and 15.0 internodes at the end of the growing stages (150 days), in both seasons;

respectively. Insignificant increases were recorded in number of internodes during the stages from 90 days till the end of the growing season, in both seasons. The highest increase in number of internodes occurred between 30-45 days in both seasons.

**d.Fresh weight of leafless shoots:**

It is obvious that, there were insignificant increases in fresh weight of the leafless shoots until the age of 75 days in both seasons. However, from the age of 75 days significant increases were recorded in this concern until the end of the growing season, where the fresh weight of leafless shoots reached a maximum of 314.4 and 309.7 g. in the two successive seasons; respectively. The highest increase in fresh weight was found during the stage 135-150 days in both seasons.

**e.Dry weight of leafless shoots:**

Results indicated that, there were insignificant increases in dry weight of the leafless shoots were gained up to the age of 75 days in both seasons. Thereafter, significant increases were recorded in this concern and dry weight of the leafless shoots reached a maximum of 48.8 and 45.9 g. in the first and second seasons; respectively. The highest increase in dry weight was detected during the stage 135-150 days in the first season and between 105-120 days in the second one.

**3. *Datura stramonium* L. (*Datura*)**

Table (3) indicates the values of the studied morphological characters of the stem of *Datura stramonium* during 2 seasons; plant height, stem diameter, number of internodes of the main stem and fresh and dry weights of leafless shoots.

**a.Plant height:**

Significant increases in plant height were detected up to the age of 120 days in both seasons, being 159.6 and 157.0 cm.; respectively. Thereafter insignificant increases were recorded till the end of growing season (150 days). The maximum plant height was reached at the age of 150 days in both seasons, being 163.1 and 162.7 cm.; respectively. The highest increase in plant height occurred between the age of 75-90 days in both seasons.

**b.Stem diameter:**

Results indicated that, there were significant increases starting from the age of 30 to 120 days in both seasons; except at the stage of 90 to 105 days in the first season. At final two sampling dates (120-150 days), the diameter of median internode of the main stem decreased insignificantly and recorded 1.7 and 1.6 cm. in the two experimental seasons; respectively. This decrease could be a result of normal dryness and shrinkage associated with senescence. The highest increase in diameter was achieved during the stage 30-45 days in the first season, and between 30-45 and 75-90 days in the second one.

**c.Number of internodes of the main stem:**

It is evident from the values that significant increases in number of internodes were recorded at the age of 30 to 60 days in the first season, and from 30- 45 days in the second one. No further significant increases were

observed in number of internodes of the main stem till the end of the growing season. The highest increase in number of internodes occurred during the first period of growth; 30 to 45 days in both seasons.

**d. Fresh weight of leafless shoots:**

It is clear that, there were insignificant increases among the stages of 45 to 75 days in both seasons, followed by significant increases from the stage of 75 to 135 days in both seasons; thereafter, significant decreases occurred. The highest increase in fresh weight was achieved during the stage 75-90 days in both seasons.

**Table (3): Morphological characters of the stem of *Datura stramonium* L. during two successive seasons, 2002 and 2003. (Averages of 5 plants).**

Plant age (days)	Plant height (cm.)		Diameter of main stem (cm.)		No. of internodes of the main stem		Fresh weight of leafless shoots (g.)		Dry weight of leafless shoots (g.)	
	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>
	season	season	season	season	season	season	season	season	season	season
30	12.3	13.5	0.4	0.4	3.2	3.5	-	-	-	-
45	28.9	30.1	0.8	0.7	4.4	4.5	4.0	4.3	0.7	0.8
60	48.4	42.4	1.0	0.9	4.9	4.8	16.9	12.9	2.9	2.3
75	78.6	65.6	1.3	1.1	5.0	5.0	62.7	60.2	10.8	9.8
90	117.9	113.1	1.5	1.4	5.0	5.0	373.7	340.2	63.5	58.4
105	146.5	144.6	1.6	1.6	5.0	5.0	496.9	474.7	82.5	78.3
120	159.6	157.0	1.9	1.8	5.0	5.0	690.9	671.9	113.4	109.6
135	162.9	161.9	1.8	1.7	5.2	5.0	847.6	797.4	136.8	129.5
150	163.1	162.7	1.7	1.6	5.4	5.0	534.2	518.1	54.8	51.6
L.S.D. at 0.05	7.3	8.7	0.2	0.2	0.4	0.4	108.5	84.1	6.8	7.0

**e. Dry weight of leafless shoots:**

It is clear from Table (3) that, at the early stages, from 45 to 60 days, there were insignificant increases in both seasons. Thereafter, significant increases were recorded till the age of 135 days in both seasons, being 136.8 and 129.5 g.; respectively. At the age of 135-150 days, dry weight significantly decreased in both seasons. The highest increases in dry weight were achieved during stage 75-90 days in both seasons.

**Anatomical studies :**

**a) Stem structure of the second and median internodes:**

Table (4) and Fig. 1 (a, b and c ) and 2 (a, b and c) give the details of the anatomical structure of the second and median internodes of the stem. The cross sections of the second internode below the shoot apex in all studied genera indicate that the shape was quadrangular with five furrows and five ridges in both *Solanum* and *Capsicum*, while in *Datura* it was nearly round in outline.

The epidermal cells were almost square in shape in *Solanum*, elongated in *Capsicum*, barrel shaped in *Datura*, and they were covered with a thin cuticle.

**Table (4): Means of measurements ( $\mu$ ) and counts of different tissues of the second internode, below the shoot apex and the median internode of *Solanum*, *Capsicum* and *Datura* (Averages of 10 readings).**

Characters	Second internode			Median internode		
	Genera			Genera		
	<i>Solanum</i>	<i>Capsicum</i>	<i>Datura</i>	<i>Solanum</i>	<i>Capsicum</i>	<i>Datura</i>
Epidermis thickness ( $\mu$ )	17.1	22.9	23.5	24.6	27.6	24.9
Total cortex thickness ( $\mu$ )	342.0	338.1	469.2	568.6	524.4	673.7
- No. of collenchyma layers	6	5	6	5	6	6
- No. of parenchyma layers	5	6	7	6	7	8
Vascular cylinder thickness ( $\mu$ )	265.7	258.7	276.5	667.5	581.6	648.9
External phloem thickness ( $\mu$ )	32.6	55.2	34.5	52.4	49.7	69.0
Internal phloem thickness ( $\mu$ )	38.8	41.4	44.2	64.9	55.2	121.4
Xylem thickness ( $\mu$ )	186.3	151.8	182.2	539.6	463.7	437.5
Pith diameter ( $\mu$ )	1317.4	1333.8	2284.6	46395.4	3310.6	4343.4
Stem diameter ( $\mu$ )	2577.5	2610.2	3845.5	6970.2	5710.3	7084.7

Averages of epidermis thickness were 17.1, 22.9 and 23.5 $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. Cortex thickness was 342.0, 338.1 and 469.2  $\mu$  in the same order. The numbers of collenchyma layers were 6 layers in both *Solanum* and *Datura*, while in *Capsicum* they were 5 layers, and parenchyma layers were 5, 6 and 7 layers in the same sequence. Measurements of thickness of vascular cylinder were 265.7, 258.7 and 276.5  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively.

Averages of thickness of both external and internal phloem thickness were 32.6 and 38.8, 55.2 and 41.4, and 34.5 and 44.2  $\mu$  in the same order. Measurements of thickness of xylem were 186.3, 151.8 and 182.2  $\mu$  in the same sequence. The average diameters of pith were 1317.4, 1333.8 and 2284.6  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. The whole diameters of the stem were 2577.5, 2610.2 and 3845.5  $\mu$  in the same order.

The above results on the structure of stem of potato are in harmony with Hayward (1938), and El-Said (2001) and Salib (1992) on pepper, while results on the structure of datura stem are in harmony with Khattab *et al.* (2002).

As to the median internode, it is clear that, the shape was similar to that of the second internode in the three genera being quadrangular at this stage with five furrows and five ridges in *Solanum* and *Capsicum*, while it was round in *Datura*.

Averages of epidermis thickness were 24.6, 27.6 and 24.9  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. Measurements of cortex thickness were 568.6, 524.4 and 673.7  $\mu$  in the same order. The numbers of collenchyma layers were 5 in *Solanum* and 6 in both *Capsicum* and *Datura*, while the numbers of parenchyma layers were 6, 7 and 8 layers in the same sequence. The average measurements of vascular cylinder thickness were 667.5, 581.6 and 648.9  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. Both external and internal phloem thickness were 52.4 and 64.9, 49.7 and 55.2 and 69.0 and 121.4  $\mu$  in the same order. Measurements of xylem thickness were 539.6, 463.7 and 437.5  $\mu$  in the same sequence.



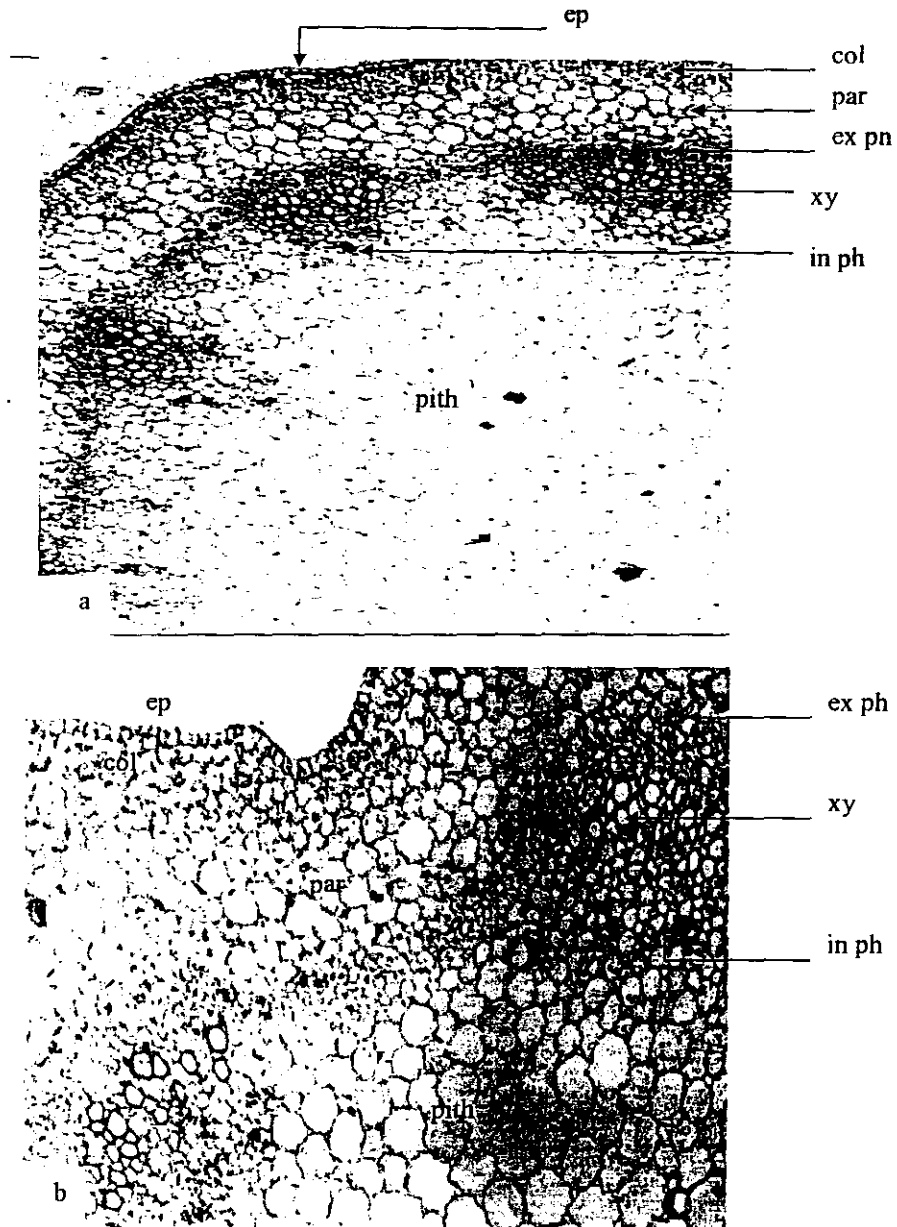


Fig. (1): Transverse sections of the second internode below the shoot apex

a) *Solanum* (X 40 )

b) *Capsicum* (X 100 )

Details: col, collenchyma; ep, epidermis; ex ph, external phloem; in ph, internal phloem; par, parenchyma; pi, pith; and xy, xylem

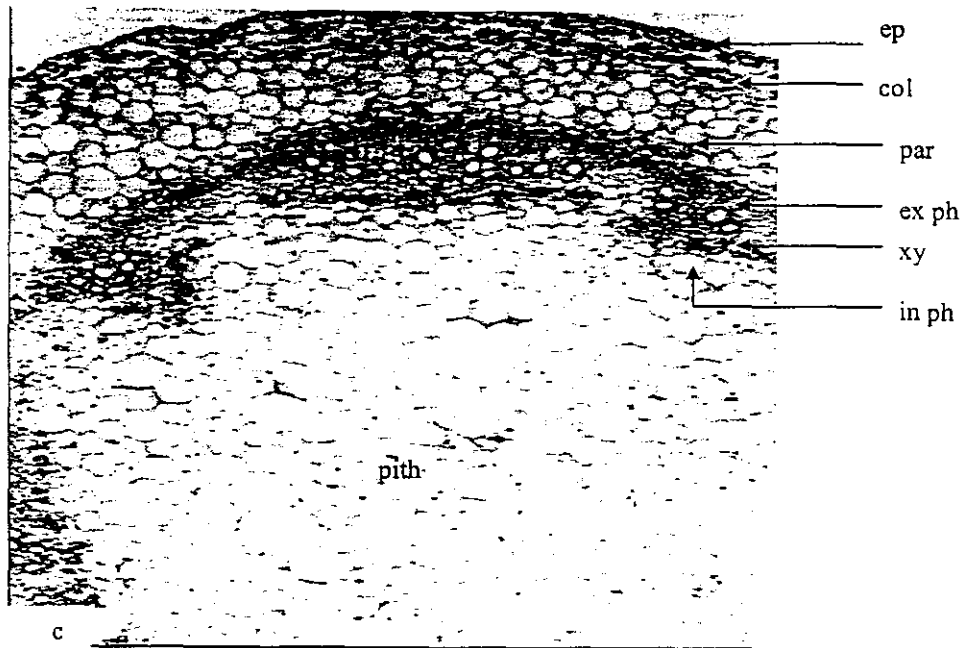


Fig. (1) cont.

c) *Datura* (X 40 )

Details: col, collenchyma; ep, epidermis; ex ph, external phloem; in ph, internal phloem; par, parenchyma; pi, pith; and xy, xylem

The average diameters of pith were 4395.4, 3310.6 and 4343.4  $\mu$  in the same order; respectively.

The whole stem diameter recorded 6970.2, 5710.3 and 7084.7  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively.

These results on the structure of *datura* stem are in accordance with those obtained by El-Sayed (1978) and Anaza and Lwu (1989), while El-Said (2001) obtained different results on the structure of pepper stem.

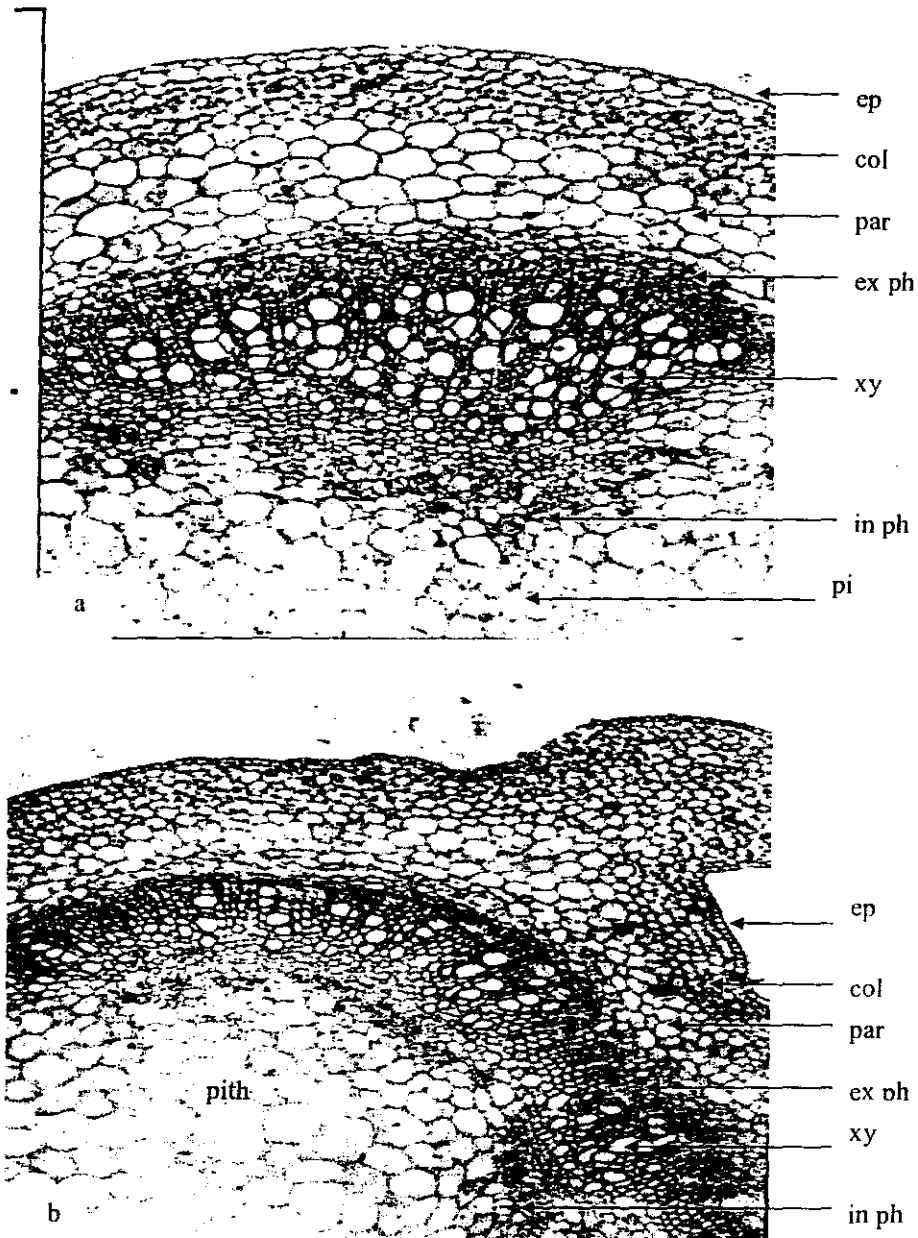


Fig. (2): Transverse sections in the median internode of the main stem (X 40 )

a) *Solanum*

b) *Capsicum*

Details: col, collenchyma; ep, epidermis; ex ph, external phloem; in ph, internal phloem; par, parenchyma; pi, pith; and xy, xylem

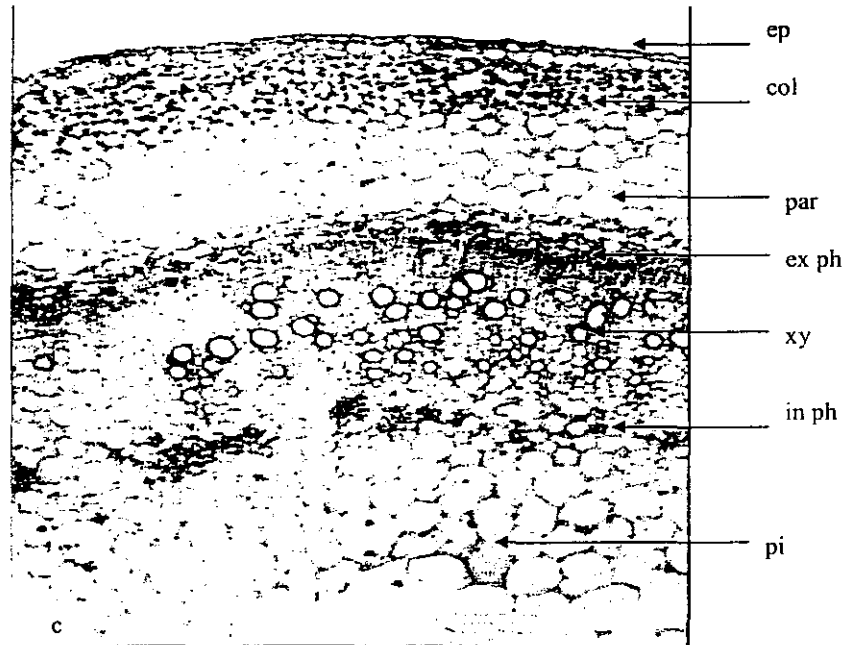


Fig. (2): cont.

c) *Datura* (X 40 )

Details: ep: epidermis, col: collenchyma, par: parenchyma, ex ph: external phloem, in ph: internal phloem, xy: xylem and pi: pith

#### b) Structure of the basal internode:

Table ( 5 A ) and Fig. 3 ( a, b and c ) show the average measurements of different tissues of the basal internode at the age of 60 days for the studied genera. The shape of this internode was pentagon in *Solanum* and rounded in both *Capsicum* and *Datura*. The results indicate that the averages of epidermis thickness were 28.5, 34.2 and 23.5  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively, while those of cortex thickness were 707.9, 487.4 and 560.9  $\mu$  in the same order. The average numbers of collenchyma layers were 7, 6 and 5 in *Solanum*, *Capsicum* and *Datura*; respectively, while the numbers of parenchyma layers were 7, 5 and 5 in the same order.

Averages of thickness of the vascular cylinder recorded 838.5, 1240.3 and 772.8  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. Both external and internal phloem thickness were 71.8 and 73.1, 200.1 and 85.6 and 124.2 and 73.1  $\mu$  in the same order. Measurements of thickness of xylem were 676.2, 933.7 and 558.9  $\mu$  in the same sequence stated before . The average diameter of pith reached 4976.1, 3495.2 and 3796.2  $\mu$  in the same order. The whole diameters of the stem were 8150.6, 7040.2 and 6515.7  $\mu$  in *Solanum*, *Capsicum* and *Datura*, respectively. The mentioned results are in harmony with those of Cutter (1992) on the structure of stem of potato.

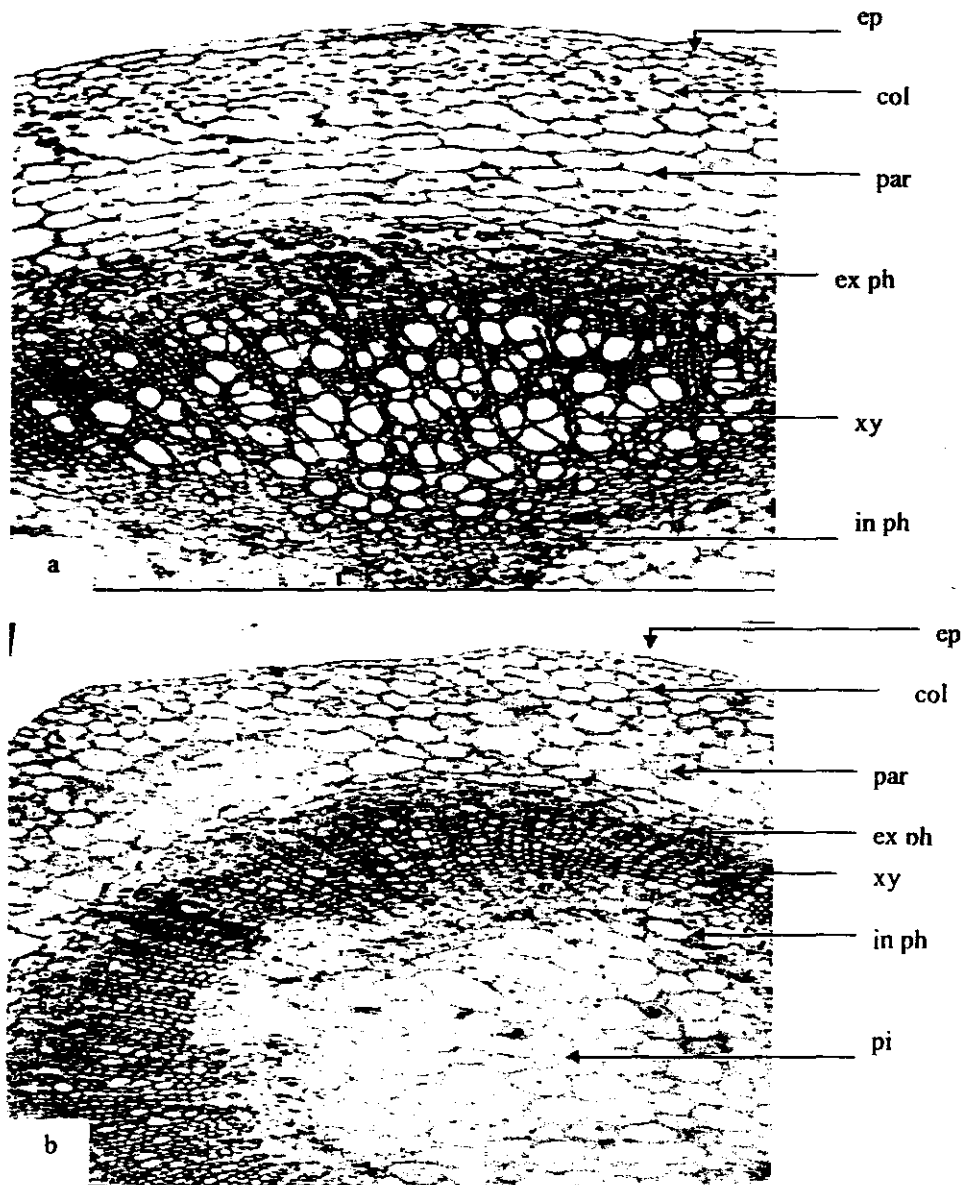


Fig. ( 3): Transverse section in the basal internode of the main stem (X 40)

a) *Solanum*

b) *Capsicum*

Details col, collenchyma; ep, epidermis; ex ph, external phloem; in ph, internal phloem; par, parenchyma; pi, pith; and xy, xylem

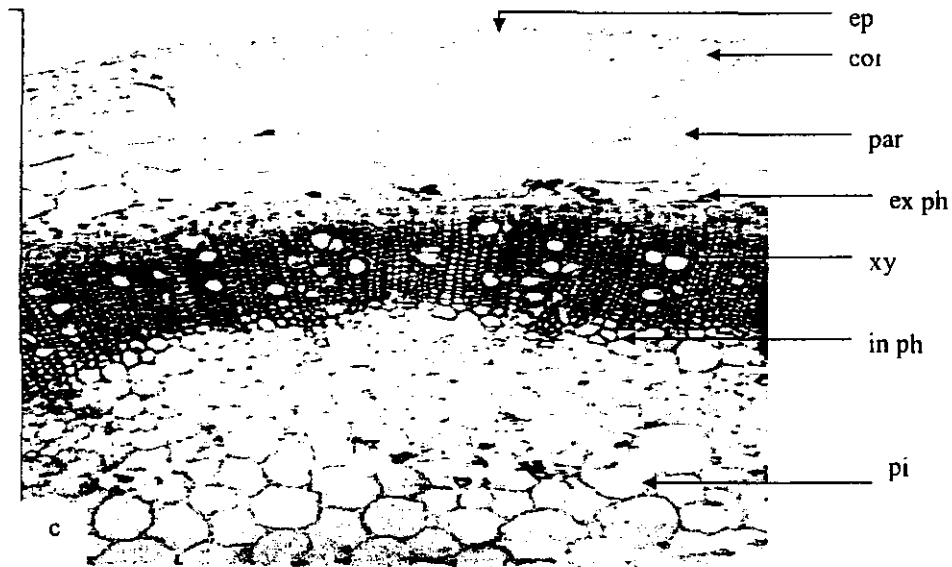


Fig.( 3) Cont.

c) *Datura* (X 40 )

Details: col, collenchyma; ep, epidermis; ex ph, external phloem; in ph, internal phloem; par, parenchyma; pi, pith; and xy, xylem

**Table (5 A): Means of measurements ( $\mu$ ) and counts of different tissues of the basal internode of the main stem of *Solanum*, *Capsicum* and *Datura*, ; and (B) the measurements ( $\mu$ ) and counts of the potato stolon and tuber, , (Averages of 10 readings).**

Characters	(A)			(B)	
	Basal internode			<i>Solanum</i>	
	Genera			Stolon 90 days old:	
	<i>Solanum</i>	<i>Capsicum</i>	<i>Datura</i>	Epidermis thickness ( $\mu$ )	32.3
Epidermis thickness ( $\mu$ )	28.5	34.2	23.5	Cortex thickness	417.5
Total cortex thickness ( $\mu$ )	707.9	487.4	560.9	External phloem	75.0
- No. of collenchyma layers	7	6	5	Internal phloem	43.7
- No. of parenchyma layers	7	5	5		
Vascular cylinder thickness ( $\mu$ )	838.5	1240.3	772.8	Xylem thickness	165.0
				Vascular cylinder diameter	295.7
External phloem thickness ( $\mu$ )	71.8	200.1	124.2	Pith diameter	1372.5
Internal phloem thickness ( $\mu$ )	73.1	85.6	73.1	Stolon diameter	2894.3
Xylem thickness ( $\mu$ )	676.2	933.7	558.9	<b>Tuber 90 days old:</b>	
Pith diameter ( $\mu$ )	4976.1	3495.2	3796.2	No. of phellem layers	10-12
Stem diameter ( $\mu$ )	8150.6	7040.2	6515.7	Thickness of phellem ( $\mu$ )	187.5

**Structure of the stolon and tuber of potato:**

Table (5 B) and Fig. (4) show the microscopical measurements ( $\mu$ ) and counts of different tissues of stolon.

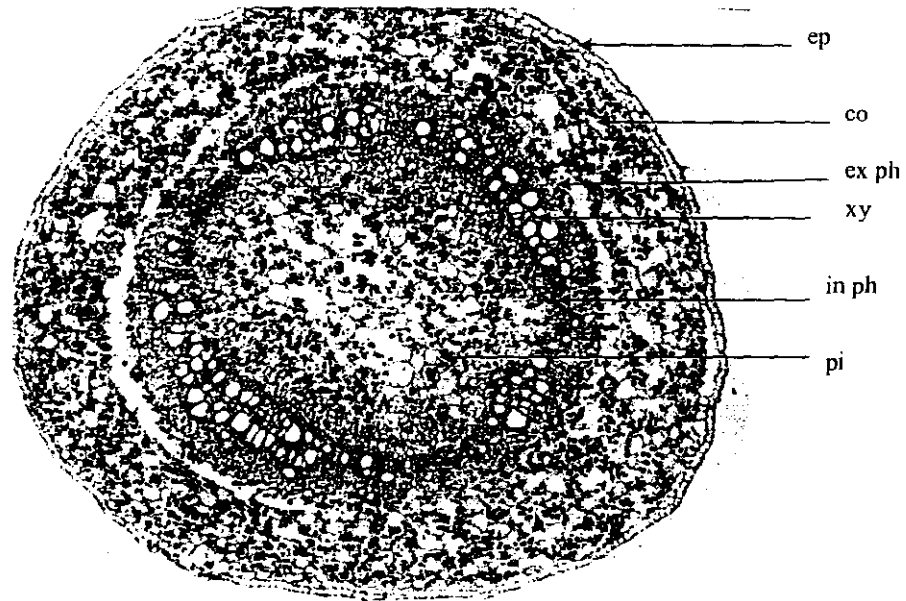


Fig. (4): Transverse section of the stolon of potato ( X 40 ).  
Details: co, cortex; ep, epidermis; ex ph, external phloem; in ph, internal phloem; pi, pith; and xy, xylem



Fig. (5): Transverse section of the mature tuber of potato (X 40 ).

It is clear that, the stolon shape was round and the epidermal cells were round or slightly elongated towards the cortex tissue and was covered with a thin cuticle layer. Cortex thickness was  $417.5 \mu$ , and the parenchyma cells had thin walls, and small intercellular spaces. Cells had many starch grains. Vascular cylinder type was bicollateral, where xylem elements occur between the outer and inner phloem. Measurements of outer and inner phloem were  $75.0$  and  $43.7 \mu$ ; respectively, while xylem thickness recorded  $165.0 \mu$ . It is noted from measurements, that the thickness of outer phloem exceeds that of the inner one, and the total of both is approximately two-thirds of the xylem thickness. This does not agree with that given by Hayward (1938). Vascular cylinder thickness reached  $295.7 \mu$ . Concerning pith diameter it was  $1372.5 \mu$ , while the whole diameter of the stolon reached  $2894.3 \mu$ .

It is obvious from Table (5 B) that parenchymatous tissues of pith and cortex comprise nearly three-fifths of the total diameter.

Fig. (5) shows the structure of a sector of mature tuber. The principal zones in the mature tuber from the periphery inward are the periderm, cortex, vascular cylinder, perimedullary zone and central pith. The periderm acts as a protective zone over the entire tuber and consists of 10-12 of pressed layers of cork cells, where the thickness of phellem reached  $187.5 \mu$ . Cortex zone consists of storage tissue below the periderm, the peripheral layers are arranged in rows due to the tangential division of phellogen cambium. These layers have a limited amount of starch grains. The cells of the innermost layers of cortex are rounded or slightly elongated with small intercellular spaces in between, and the cells are filled with many starch grains.

The present results on the structure of the tuber disagree with those of Hayward (1938).

## CONCLUSION

From the previous results, the following could be concluded:

- 1-*Datura stramonium* was the highest measurement in plant height, followed by *Solanum tuberosum* while *Capsicum annuum* was the lowest.
- 2-Increase in stem diameter of *Datura stramonium* was accompanied with a decrease in number of internodes as it gave the highest measurements for stem diameter and the lowest number of internodes / plant, while the reverse occurred in *Solanum tuberosum* as it gave the lowest value in stem diameter with the highest number of internodes / plant.
- 3-Concerning fresh and dry weights of leafless shoots, *Datura stramonium* plants gave the highest values in both characters, while *Solanum tuberosum* was the lowest in fresh weight and *Capsicum annuum* recorded the lowest value in dry weight.
- 4-Epidermis cells of the second internode below the shoot apex were nearly square in shape in both *Solanum* and *Datura* and slightly elongated towards the cortex in *Capsicum*.
- 5-The structure of the second internode showed that, *Datura stramonium* had the widest cortex and pith and the highest in thickness of internal phloem,



- while *Capsicum annuum* gave the thickest external phloem. On the other hand *Solanum tuberosum* had the largest xylem thickness .
- 6-In the median internode measurements, *Solanum tuberosum* had the widest pith and thickest vascular cylinder, while *Datura stramonium* had the widest cortex with the highest numbers of parenchyma layers.
- 7-Basal internode in *Solanum tuberosum* was the thickest, with the widest cortex and pith, while *Capsicum annuum* had the thickest vascular cylinder with the thickest external and internal phloem and thickest xylem. On the other hand *Datura stramonium* had the lowest measurements and counts for the basal internode in some characters.
- 8-Stolon measurements revealed that, thickness of outer phloem exceeded that of the inner one and the two together gave nearly two thirds of the xylem thickness, whereas the pith diameter and cortex thickness comprise approximately three-fifths of the total diameter of the stolon.
- 9-Periderm of mature tuber, with 10-12 phellem pressed layers, recorded a thickness of 187.5  $\mu$ .

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دراسات مورفولوجية وتشريحية مقارنة في الساق لسبع أصناف الفصيلة الباذنجانية  
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تهدف الدراسة إلى بحث الاختلافات المورفولوجية والتشريحية للساق بين الأصناف الثلاثة موضع الدراسة من الفصيلة الباذنجانية وهم: السولانم (*Solanum tuberosum*) - الكابسيك (*Capsicum annuum*) و الداتوره (*Datura stramonium*).  
أشارت النتائج أن نباتات الداتورا أعطت القياسات الأعلى في ارتفاع النبات وسمك الساق والوزن الطازج والجاف للمجموع الخضري بدون الأوراق، يليه نباتات الفلفل، بينما أعطت نباتات البطاطس القياسات الأدنى بالنسبة للصفات السابقة فيما عدا ارتفاع النبات حيث كانت نباتات الفلفل هي الأدنى. ومع أن نباتات الداتورا كانت الأعلى في قياس ارتفاع النبات لكنها كانت الأقل في عدد السلاميات وعلي العكس فإن نباتات البطاطس سجلت قياس أقل في ارتفاع النبات ولكنها كانت الأعلى في عدد السلاميات.  
أظهر التركيب التشريحي للساق أن نباتات البطاطس كانت ذات سلاميات أسمك سواء في السلامة الثانية أو الوسطية أو القاعدية ويرجع ذلك لسمك الأسطوانة الوعائية والنخاع، بينما نباتات الفلفل كانت الأقل سمكا بالنسبة للسلاميتين الثانية والوسطية وكانت نباتات الداتورا هي الأقل سمكا بالنسبة للسلامية القاعدية.