

## Effect of Foliar Spray with Active Yeast Extract on Morphological, Anatomical and Yield Characteristics of Kidney Bean (*Phaseolus vulgaris* L.)

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**Abstract:** Field experiments were performed at the Agricultural Experiments and Researches Station, Faculty of Agriculture, Cairo University, Giza, Egypt during the two summer growing seasons of 2009 and 2010 to study the effect of foliar application with active yeast extract (AYE) at various concentrations of 25, 50, 100 and 150 ml/L on morphological, anatomical and yield characters as well as on seed quality of Kidney bean 'Giza 6'. Results revealed that foliar application with active yeast extract at the relatively low used concentration of 25 ml/L showed no significant effect on all studied morphological characters of vegetative growth, yield of green pods/plant, seed yield per plant and its related characters as well as on seed quality of Kidney bean 'Giza 6' in both studied seasons. On the other hand, foliar application with the relatively median used concentration of 50 ml AYE/L as well as with the relatively high used concentrations of 100 and 150 ml AYE/L induced significant promotive effects on all investigated morphological characters (plant height, number of branches/plant, number of leaves/plant, total leaf area/plant and shoot dry weight/plant), yield of green pods/plant, number of pods/plant, number of seeds/plant, seed yield/plant and the percentage of crude protein in seeds of Kidney bean 'Giza 6' in both studied seasons and the maximum promotion was detected at 100 ml AYE/L. It is clear that sprayed Kidney bean plants with active yeast extract at concentration of 100 ml /L showed maximum significant increase of 22.5 and 25.2% for yield of green pods/plant, 34.0 and 36.6% for yield of seeds/plant and 14.7 and 8.6% for seed protein more than the control in the first and second season; respectively. As to the effect of foliar application with the most effective concentration of active yeast extract (100 ml/L) on anatomical structure of vegetative growth of Kidney bean 'Giza 6', it could be stated that such treatment increased stem diameter due mainly to the increase in the thickness of epidermis, cortex, phloem tissue, xylem tissue and parenchymatous area of the pith more than those of the control although a slight reduction in diameter of hollow pith less than the control was observed. Likewise, such treatment increased thickness of both midvein and lamina of leaflet blades of Kidney bean 'Giza 6'. The increase in lamina thickness was accompanied with increments in thickness of palisade and spongy tissues. Also, the main vascular bundle of the midvein was increased in size as a result of spraying active yeast extract.

**Key words:** Kidney bean, Yeast extract, Morphology, Anatomy, Yield, Seed quality.

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### INTRODUCTION

*Phaseolus vulgaris* L. which commonly known in Egypt as Phasolia is a member of family Fabaceae (Papilionaceae). It is also known as Common, Snap, Kidney, French or Haricot beans (Singh, 1999 ; Pandey, 2003 and Bisby *et al.*, 2011). It is one of the most important food crops in Egypt and consumed as a cooked vegetable either as dry seeds or green pods. It plays an important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals.

The Kidney bean is a tender annual, cultivated as a food crop in many parts of the world including the temperate, sub-tropical and tropical zones (Purseglove, 1988). The bean plant is of two types; dwarf or bush type and pole or climbing type. Bush varieties have a short growing period and they are commonly grown in Egypt. Increasing yield of Kidney bean in Egypt is highly recommended to meet the demand of human needs. Plant growth and development is known to be under the control of extremely minute quantity of endogenous hormones produced within the plant. Recently, a great attention has been paid on the possibility of using natural and safety substances which are rich sources of phytohormones in order to improve plant growth, flowering and fruit setting.

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In this connection, yeasts have been reported to be rich source of phytohormones (especially cytokinins), vitamins, enzymes, amino acids and minerals (Barnett *et al.*, 1990; Fathy and Farid, 1996; Khedr and Farid, 2000 and Mahmoud, 2001). It was reported about its stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation (Kraig and Haber, 1980 and Castelfranco and Beale, 1983). It participates in a beneficial role during stress due to its cytokinins content (Barnett *et al.*, 1990). Improving growth and productivity of vegetable crops by application of active yeast extract were recorded by Fathy and Farid (1996), Amer (2004) and El-Tohamy and El-Greadly (2007) on beans; Hewedy *et al.*, (1996) and El-Tohamy *et al.* (2008) on egg plant; El-Ghamriny *et al.* (1999) and Fathy *et al.* (2000) on tomatoes and Tartoura (2001) and El-Desuki and El-Greadly (2006) on pea. Likewise, such enhancement effect of active yeast extract on growth and fruiting of horticultural plants was recorded by Ahmed *et al.* (1997), El-Mogy *et al.* (1998), Abd El-Ghany *et al.* (2001) and Ismaeil *et al.* (2003) on vines as well as by Atawia and El-Desouky (1997) and Hegab *et al.* (1997) on citrus.

Therefore, the present investigation was designed to disclose the influence of different levels from active yeast extract on vegetative growth, anatomy and productivity of Kidney bean plant.

## MATERIALS AND METHODS

The present study was carried out at the Agricultural Experiments and Researches Station, Faculty of Agriculture, Cairo University, Giza, Egypt through the two successive growing summer seasons of 2009 and 2010 to study the effect of foliar spray with different concentrations of active yeast extract on morphological, anatomical and yield characters as well as on seed quality of Kidney bean plant.

Seeds of Kidney bean 'Giza 6' were secured from Department of Vegetable Researches, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt. Active yeast extract was sprayed at concentrations of 25, 50, 100 and 150 ml/L. The control plants were sprayed with tap water.

### **Preparation of Yeast Extract (YE):**

The pure dry yeast powder was activated by using sources of carbon and nitrogen with the ratio of 6 : 1. This ratio is suitable to get the highest vegetative production of yeast, each ml of activated yeast contained about 12000 yeast cells (Barnett *et al.*, 1990). Such technique allowed yeast cells to be grown and multiplied efficiently during conducive aerobic and nutritional conditions. To produce *de novo* beneficial bioconstituents; *i.e.*, phytohormones, carbohydrates, proteins, amino acids, fatty acids, vitamins, enzymes, minerals ...etc, hence allowed such constituents to release out of yeast cells in readily form. Such technique for yeast preparation based on: 1- Nutritional media of glucose and casein as favorable sources of C, N and other essential elements (P, K, Ca, Mg, Fe, Mn, Cu, B and Mo as well as Na and Cl) in suitable balance (Barnett *et al.*, 1990). 2- Air pumping and adjusting incubation temperature. The media then subjected to two cycles of freezing and thawing for disruption of yeast cells and releasing their bioconstituents directly before usage. Tween-20 was added as a spreading agent for tested treatments.

### **Field Work Procedure:**

Seeds of Kidney bean 'Giza 6' were sown on 12<sup>th</sup> May, 2009 in the first season and replicated on 4<sup>th</sup> May, 2010 in the second one to provide the experimental plant materials. The experiment was made in a randomized complete block design with four replicates. The four levels of active yeast extract beside the control required that the experimental land of each replicate be divided into five plots, each contained one treatment. The plot was five ridges, 3.5 meters long, 60 cms apart; *i.e.*, each plot comprised 1/400 of feddan. Seeds were sown in hills, spaced 25 cm, on the western side of the ridge. The plants were later thinned to two plants per hill. All field practices were carried out as recommended for the studied crop in the vicinity.

The tested concentrations of active yeast extract were applied twice by means of an atomizer sprayer. The first application was four weeks from sowing (the age of 4-compound leaf stage) and the second application was two weeks from the first one (at this age, opening of the flower buds started). Volume of spraying solution per plot was almost 1.5 and 3 liters for first and second application; respectively. This volume was adequate to wet plants of the plot thoroughly with excess of dripping solution.

### **Recording of Data:**

The present investigation involved studies pertaining to morphological, anatomical, yield and seed quality characters of Kidney bean 'Giza 6' as affected by different levels of active yeast extract in both studied seasons.

***Morphological Characters of Vegetative Growth:***

A random sample of 16 plants for each tested treatment (4 plants from each replicate) was assigned for investigation. Vegetative characters were recorded after 8 weeks from sowing; *i.e.*, two weeks after the second application of active yeast extract. The following characters were studied in both growing seasons:

- Plant height; cm, measured from cotyledonary node up to the upper most point of the plant.
- Number of secondary branches per plant.
- Number of leaves per plant.
- Total leaf area per plant, cm<sup>2</sup>. Leaf area was measured by means of LI-3000 A portable area meter, LI-3050 A Transparent belt conveyer- of LI-Cor, Inc., Lincoln, Nebraska, U.S.A.
- Dry weight of shoot per plant, g.

***Yield of Green Pods:***

Yield of green pods (g) per plant was investigated, in each of the two growing seasons, using another four random plants assigned for this character in each plot (totaling 16 plants for each treatment) when pods were ripe, green and edible to determine the eventual yield of the edible fresh green pods per plant. This character was determined through the period from eight to ten weeks from sowing date.

***Anatomical Studies:***

A comparative microscopical examination was performed on plant material for treatments which showed remarkable response. In addition to the control, plants of Kidney bean 'Giza 6' sprayed with 100 ml/L active yeast extract were considered in details. Tested materials included the main stem at its median portion and lamina of the terminal leaflet of the third compound leaf developed toward the main stem apex. Specimens were taken throughout the first season of 2009 at the age of 10 weeks. Specimens were killed and fixed for at least 48 hrs. in F.A.A. (10 ml formalin, 5 ml glacial acetic acid and 85 ml ethyl alcohol 70%). The selected materials were washed in 50% ethyl alcohol, dehydrated in a normal butyl alcohol series, embedded in paraffin wax of melting point 56°C, sectioned to a thickness of 20 microns, double stained with crystal violet-erythrosin, cleared in xylene and mounted in Canada balsam (Nassar and El-Sahhar, 1998). Sections were read to detect histological manifestations of noticeable responses resulted from application of active yeast extract and photomicrographed.

***Yield of Seeds and its Components:***

A random sample of 20 plants for each tested treatment (5 plants from each replicate) was taken at harvest time, 12 weeks from sowing date, to investigate the following yield characters in each of the two growing seasons:

- Number of matured dry pods per plant.
- Number of seeds per pod.
- Number of seeds per plant.
- Yield of matured dry seeds (g) per plant.
- Specific weight of seeds (average weight of 100 seeds, g).

***Chemical Analysis of Seeds (Seed Quality):***

Percentages of total carbohydrates and crude protein were determined in mature dried seeds, at harvest time of Kidney bean 'Giza 6' as affected by spraying different levels of active yeast extract. Samples resembling various treatments beside the seeds of control plants were finely ground.

- Total carbohydrates was determined as glucose after acid hydrolysis and spectrophotometrically determined using phenol sulphuric acid reagent (Dubois *et al.*, 1960).
- For determination of crude protein, total nitrogen content was determined using the modified micro-Kjeldahl method described by Pregl (1945). Nitrogen content of seeds was multiplied by 6.25 to calculate the crude protein (Anon, 1990).

***Statistical Analysis:***

Data on morphological and yield characters as well as on seed quality characters were subjected to conventional methods of analysis of variance according to Snedecor and Cochran (1982). The least significant difference (L.S.D.) at 0.05 level of probability was calculated for each determined character under different assigned treatments.

## RESULTS AND DISCUSSION

### **I- Morphological Characters of Vegetative Growth:**

Morphological characters of vegetative growth of Kidney bean 'Giza 6' as affected by foliar spray with different concentrations of active yeast extract (AYE) in two growing seasons included data pertaining to plant height, number of branches/plant, number of leaves/plant, total leaf area / plant and dry weight of shoot/plant. Data on previous characters are presented in Table (1).

It is clear from Table (1) that all sprayed concentrations of active yeast extract increased significantly all investigated morphological characters of vegetative growth of Kidney bean 'Giza 6' in both studied seasons except that of plants which were sprayed with 25 ml AYE/L where the difference with the control plants proved insignificant in this respect. The maximum increase in any of the studied characters was achieved when plants were sprayed with 100 ml AYE/L, which statistically being indifferent with that recorded by plants treated with 150 ml AYE/L. The maximum increases in morphological characters due to spraying with 100 ml AYE/L were 17.6 and 23.4% for plant height, 16.7 and 19.4% for number of branches / plant, 23.7 and 25.3% for number of leaves/plant, 24.8 and 26.1% for total leaf area / plant and 23.7 and 24.9% for dry weight of shoot / plant more than those of the control plants in the first and second season; respectively.

In this connection, improving vegetative growth characters of certain vegetable crops by application of active yeast extract were previously recorded by Fathy and Farid (1996), Amer (2004) and El-Tohamy and El-Greadly (2007) on beans; Hewedy *et al.* (1996) and El-Tohamy *et al.* (2008) on egg plant, El-Ghamriny *et al.* (1999) and Fathy *et al.* (2000) on tomatoes and Tartoura (2001) and El-Desuki and El-Greadly (2006) on pea. All, being in agreement with the present findings.

### **II- Yield of Green Pods / Plant:**

Data on yield of green pods / plant of Kidney bean 'Giza 6' as affected by spraying with various concentrations of active yeast extract in two growing seasons and the results of their statistical analysis are given in Table (1).

Results in Table (1) clearly show that the relatively low used concentration of 25 ml AYE/L had no significant effect on yield of green pods per plant in both studied seasons. Whereas, spraying active yeast extract at the relatively median concentration of 50 ml/L or at the relatively high used concentrations of 100 and 150 ml/L induced significant increase in yield of green pods/plant of Kidney bean 'Giza 6' in both studied seasons and the difference between 100 ml AYE/L and 150 ml AYE/L proved insignificant. The maximum significant increase in yield of green pods was detected at 100 ml AYE/L, being 22.5 and 25.2% more than the yield of green pods/untreated plant (control) in the first and second season; respectively.

The present results are in accordance with those reported by Fathy and Farid (1996), Amer (2004) and El-Tohamy and El-Greadly (2007) on beans. Likewise, Tartoura (2001) and El-Desuki and El-Greadly (2006) recorded significant increase in yield of green pods of pea plant by yeast application, being in agreement with the present findings.

### **III- Anatomical Studies:**

#### **1- Anatomy of the Main Stem:**

Microscopical measurements of certain histological characters in transverse sections through the median portion of the main stem of Kidney bean 'Giza 6' sprayed with 100 ml AYE/L and those of control are presented in Table (2). Also, microphotographs depict these treatments are shown in Figure (1).

It is realized from Table (2) and Figure (1) that foliar application with active yeast extract at concentration of 100 ml/L increased the diameter of the main stem by 25.8% more than that of the control. It is obvious that the increase in stem diameter, due to foliar application with 100 ml AYE/L, could be attributed mainly to the prominent increase in thickness of stem wall by 32.7% more than that of the control although a decrement of 8.1% in diameter of hollow pith was observed less than that of the control. It is clear that the increase in the stem wall thickness could be attributed mainly to the prominent increase in all included tissues. The thickness of epidermis, cortex, phloem tissue, xylem tissue and parenchymatous area of the pith were, 7.7, 49.8, 54.3, 30.5 and 25.1 % more than those of the control, respectively.

#### **2- Anatomy of the Leaf:**

Microscopical counts and measurements of certain histological characters in transverse sections through the blade of the terminal leaflet of the third compound leaf developed toward the main stem apex of control plants of Kidney bean 'Giza 6' and of those sprayed with 100 ml AYE/L are given in Table (3).

Likewise, microphotographs illustrating these treatments are shown in Figure (2). It is noted from Table (3) and Figure (2) that spraying active yeast extract at concentration of 100 ml/L increased thickness of both midvein and lamina of leaflet blades of Kidney bean 'Giza 6' by 11.8 and 32.4% more than the control; respectively. It is clear that the increase in lamina thickness was accompanied with 28.5 and 29.9% increments in thickness of palisade and spongy tissues compared with the control; respectively. Likewise, the main vascular bundle of the midvein was increased in size as a result of spraying active yeast extract. The increment was mainly due to the increase in length by 19.1% and in width by 22.8% more than the control. Also, average number of vessels per midvein bundle was increased by 13.8% over the control. Moreover, xylem vessels increased in diameter, being 23.4% more than the control, which amounted to more total active conducting area to cope with vigorous growth resulting from treatment with 100 ml AYE/L. As far as the authors are aware, previous information about the effect of spraying active yeast extract on anatomical structure of vegetative organs of Kidney bean plant or other related species are not available in the literature.

#### ***IV- Yield of Seeds and its Components:***

The mean values of yield characters of Kidney bean 'Giza 6' as affected by foliar application with different concentrations of active yeast extract in two growing seasons are presented in Table (4).

It is realized from Table (4) that foliar application with active yeast extract at any of the four assigned concentrations (25, 50, 100 and 150 ml/L.) had no significant effect on average number of seeds per pod and weight of 100 seeds of Kidney bean 'Giza 6' in both studied seasons. In this respect, Fathy and Farid (1996) as well as Amer (2004) found that foliar application with active yeast increased weight of 100 seeds of bean plants. Also, Tartoura (2001) stated that foliar application with active yeast extract induced significant increase in number of seeds per pod and weight of 100 green seeds of pea plants. All, being in contradiction with the present findings.

At the same time, it was found that the relatively low sprayed concentration of 25 ml AYE/L had no significant effect on number of pods / plant, number of seeds/plant and seed yield / plant of Kidney bean 'Giza 6' in both studied seasons. On the other hand, sprayed active yeast extract at the relatively median concentration of 50 ml/L or at the relatively high used concentrations of 100 and 150 ml/L increased significantly number of pods / plant, number of seeds / plant and seed yield / plant of Kidney bean 'Giza 6' in both studied seasons. Worthy to note that the difference between 100 ml AYE/L and 150 ml AYE/L proved insignificant. The maximum increase in the previous mentioned characters was detected at 100 ml AYE/L, being 29.0 and 32.02% for number of pods/plant, 32.04 and 35.19% for number of seeds / plant and 34.02 and 36.61% for seed yield / plant more than the control in the first and second season; respectively.

The present results are generally in agreement with those recorded by Fathy and Farid (1996), Amer (2004) and El-Tohamy and El-Greadly (2007) on beans as well as by Tartoura (2001) and El-Desuki and El-Greadly (2006) on peas.

#### ***V- Seed Quality:***

Chemical analysis was performed on mature dried seeds, at harvest time of each of the two studied seasons, of Kidney bean 'Giza 6' as affected by different treatments of active yeast extract. For each treatment, chemical analysis was done to determine the percentage of total carbohydrates and crude protein. The percentages of these fractions in seeds of treated and untreated plants of Kidney bean 'Giza 6' are given in Table (4).

It is clear from Table (4) that all tested concentrations of active yeast extract showed no significant effect on total carbohydrates percentage in seeds of Kidney bean 'Giza 6'. At the same time, it was found that foliar application of active yeast extract at the relatively median concentration of 50 ml/L or at the relatively high used concentrations of 100 and 150 ml/L increased significantly the percentage of crude protein in seeds of Kidney bean 'Giza 6' in both studied seasons. Worthy to note that the percentage of crude protein in seeds of untreated plants was 22.4% in the first season and it was 23.2 % in the second one. The highest percentage of crude protein (25.7% in the first season and 25.2% in the second one) was recorded in seeds of plants which were sprayed with 100 ml AYE/L. The maximum increase in seed protein due to application of active yeast extract was 14.7 and 8.6% more than seed protein of control plants in the first and second season; respectively.

In this respect, El-Tohamy and El-Greadly (2007) stated that foliar application of yeast, especially at high used concentration of 10 g/L., induced significant increase in the percentages of total carbohydrates and protein in fresh pods of snap beans compared to the control, being partially in accordance with the present findings.

**Table 1:** Morphological characters of vegetative growth and yield of green pods per plant of Kidney bean 'Giza 6' as affected by foliar application with different concentrations of active yeast extract in two summer growing seasons (2009 and 2010)

Treatments	Conc. (ml/L.)	Morphological characters					Yield of green pods (g) per plant	
		Plant height (cm)	No. of branches per plant	No. of leaves per plant	Total leaf area (cm <sup>2</sup> ) per plant	Shoot dry weight (g) per plant		
First season								
Control	0	54.7 B	7.2 C	27.9 C	2899 C	57.3 C	105.8 C	
Active yeast extract	25	56.2 B	7.3 C	28.6 C	2986 C	58.6 C	107.9 C	
	50	61.8 A	7.8 B	31.7 B	3311 B	64.7 B	118.2 B	
	100	64.3 A	8.4 A	34.5 A	3617 A	70.9 A	129.6 A	
	150	62.5 A	8.3 A	34.5 A	3592 A	70.2 A	128.4 A	
L.S.D. (0.05)		5.17 cm	0.44 branch	2.33 leaves	246.9 cm <sup>2</sup>	5.09 g	9.12 g	
Second season								
Control	0	49.2 B	6.7 C	24.5 C	2527 C	49.4 C	92.6 C	
Active yeast extract	25	51.4 B	6.9 C	25.7 C	2665 C	51.2 C	93.7 C	
	50	57.5 A	7.6 B	28.2 B	2924 B	56.1 B	104.2 B	
	100	60.7 A	8.0 A	30.7 A	3186 A	61.7 A	115.9 A	
	150	59.1 A	8.0 A	30.3 A	3142 A	60.9 A	114.2 A	
L.S.D. (0.05)		4.83 cm	0.37 branch	1.94 leaves	201.7 cm <sup>2</sup>	4.62 g	7.59 g	

Means having the same letter are not significantly different at 0.05 level.

**Table 2:** Measurements in microns of certain histological features in transverse sections through the median portion of the main stem of Kidney bean 'Giza 6', at the age of 10 weeks, as affected by foliar application with active yeast extract (Means of three sections from three specimens)

Histological characters	Treatments		
	Control	Active yeast extract (100 ml / L.)	± % to control
Main stem diameter	6038.0	7594.0	+25.8
Stem wall thickness	2476.0	3286.0	+32.7
Epidermis thickness	27.4	29.5	+7.7
Cortex thickness	121.6	182.1	+49.8
Phloem tissue thickness	272.1	419.8	+54.3
Xylem tissue thickness	1656.9	2162.6	+30.5
Parenchymatous pith thickness	389.5	487.4	+25.1
Hollow pith diameter	1102.4	1013.3	- 8.1

**Table 3:** Counts and measurements in microns of certain histological features in transverse sections through the blade of the terminal leaflet of the third compound leaf developed toward the main stem apex of Kidney bean 'Giza 6' at the age of 10 weeks as affected by foliar application with active yeast extract (Means of three sections from three specimens).

Histological characters	Treatments		
	Control	Active yeast extract (100 ml / L.)	± % to control
Midvein thickness	1685.8	1884.2	+11.8
Lamina thickness	297.5	393.9	+32.4
Palisade tissue thickness	138.9	178.5	+28.5
Spongy tissue thickness	119.1	154.7	+29.9
Dimensions of the main vascular bundle of midvein			
Length	493.7	588.1	+19.1
Width	396.5	486.9	+22.8
Number of vessels / midvein bundle	29.0	33.0	+13.8
Vessel diameter	30.4	37.5	+23.4

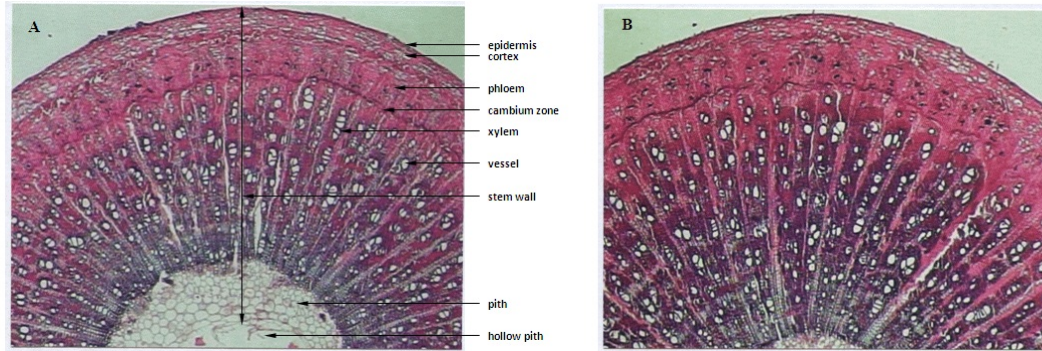
**Table 4:** Yield characters and seed quality of Kidney bean 'Giza 6' at harvest time as affected by foliar application with different concentrations of active yeast extract in two summer growing seasons (2009 and 2010).

Treatments	Conc. (ml/L.)	Yield characters				Seed quality		
		No. of pods per plant	No. of seeds per plant	No. of seeds per plant	Weight of 100 seeds (g)	Yield of seeds (g) per plant	Total carbohydrates (%)	Crude protein (%)
First season								
Control	0	26.9 C	4.2	113.0 C	33.74	38.13 C	57.8	22.4 C
Active yeast extract	25	28.4 C	4.3	122.1 C	33.25	40.60 C	58.2	22.2 C
	50	31.6 B	4.2	132.7 B	33.81	44.87 B	56.9	23.9 B
	100	34.7 A	4.3	149.2 A	34.25	51.10 A	58.4	25.7 A
	150	34.6 A	4.3	148.8 A	34.19	50.88 A	58.5	25.7 A
L.S.D. (0.05)		2.78 pods	N.S.	9.82 seeds	N.S.	3.69 g	N.S.	1.36 %

**Table 4:** Continued.

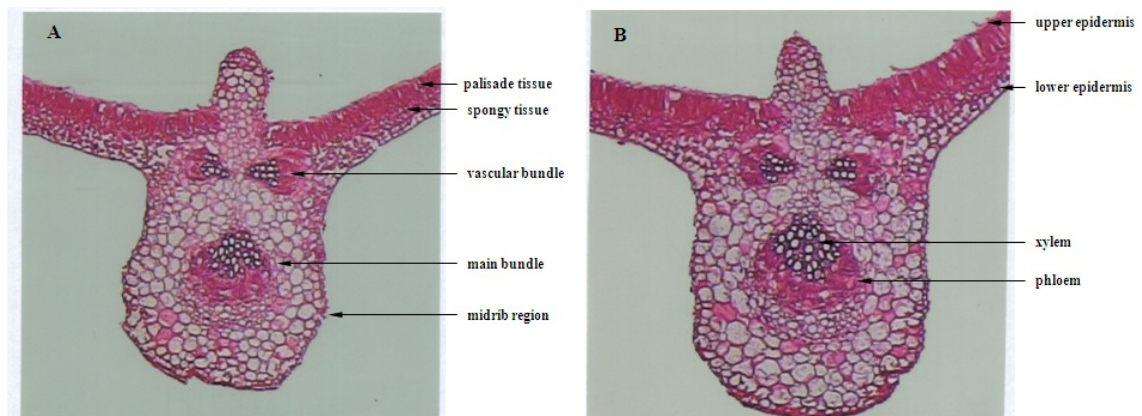
		Second season						
Control	0	22.8 C	4.1	93.5 C	33.91	31.71 C	56.5	23.2 B
Active yeast extract	25	23.2 C	4.0	92.8 C	34.16	31.70 C	56.1	23.5 B
	50	26.5 B	4.3	114.0 B	33.82	38.56 B	57.3	24.8 A
	100	30.1 A	4.2	126.4 A	34.27	43.32 A	56.8	25.2 A
	150	29.4 A	4.2	123.5 A	34.31	42.37 A	55.9	24.9 A
L.S.D. (0.05)		2.53 pods	N.S.	8.74 seeds	N.S.	3.28 g	N.S.	1.21 %

Means having the same letter are not significantly different at 0.05 level. N.S. = Not significant.



**Fig. 1:** Transverse sections through median portion of the main stem of Kidney bean 'Giza 6' at the age of ten weeks as affected by foliar application with active yeast extract. (X 52)

- A- From untreated plant (control).
- B- From plant sprayed with 100 ml AYE/L.



**Fig. 2:** Transverse sections through the blade of terminal leaflet of the third compound leaf developed toward the main stem apex of Kidney bean 'Giza 6' at the age of ten weeks as affected by foliar application with active yeast extract. (X 52)

- A- From untreated plant (control).
- B- From plant sprayed with 100 ml AYE/L.

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