RESPONSE OF PAPAYA PLANTS TO SOME CHEMICAL SUBSTANCES AND YEAST EXTRACT TREATMENTS

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SUMMARY:

This study was carried out at experimental farm, faculty of Agriculture Moshtohor during 2002 /2003 and2003/ 2004 seasons. Seeds of papaya Solo cultivar were soaked for 12 hours in :

1- Tap water as control treatment.
2- Sodium benzoate at 0.1 and 0.2 g./L.
3- Citric acid at 1.0 and 2.0 g./L.
4- Glucose at 10 and 20 g./L.
5- Yeast extract at 250 and 500 ml./ L

Also, plants were sprayed with same solutions twice: after complete germination and after transplanted into orchard. Germination parameters, vegetative growth, flowering and fruiting were studied. Anatomical studies of flowers and fruits were conducted. Results obtained could be summarized as following:

The treatments with yeast extract and citric acid gave the highest values of germination parameters(germination percentage, germination rate and germination value).The vigorous vegetative growth was obtained with treatment of yeast extract followed by citric acid. The treatments with yeast extract or glucose improved leaves photosynthesis pigments content. The most important results of this study was that number of branches per plant, number of female flowers per plant and pollen grains fertility significantly increased and reduced time required attain blooming in case of yeast extract treatments. As for yield and physical and chemical fruit quality, treatments of yeast extract followed by glucose gave highest values for different quality characteristics.

As for the anatomical, several alternations were existed with different applied treatments.. All treatments gave the highest parameters of petiole flower (cross & longitudinal sections) and fruit anatomy compared with the control the best treatments was yeast extract followed by citric acid .

Key words: papaya plants, Sodium benzoate**,** Citric acid, Glucose**,** Yeast extract, pollen grain fertility and anatomical study.

INTRODUCTION:

Papaya or papaw plant (*Carica papaya* L.) family caricaceae is a dioecious, tropical plant and it is nearly tree in size. It can yield fruits all- around the year. Among several forms of sex in papaya staminate or pure pistilate forms predominates. There are fruiting male plants which bear staminate bunches ending with hermaphrodite flowers **(Chandler, 1959).** Papaya is commercially used for its fruits as well as some medical purposes, since the fruit contains a high level of papain enzyme and considerable quantities of vitamin A, B and C.

The various positive effects of applying reactivated dry yeast as a newly used biofertilizer were attributed to its own of different bioconstituents such as, higher percentage of protein, large amount of vitamin B and the natural plant growth hormone namely cytokinins. In addition, application of active dry yeast was very effective in releasing CO_2 which reflected on improving net photosynthesis (**Ferguson *et al*, 1995)**. The possibility of using the active dry yeast for improving growth and productivity of fruit crops was mentioned by (**Subba Rao, 1984 and Nijjar, 1985).** Active dry yeast at 0.1 % caused a striking improvement in growth, yield and quality of the berries for Red roomy grapes (**Ahmed *et al*, 1997**). In apple, dry yeast was very effective in improving leaf area, nutritional status of the trees, yield and quality (**Mansour, 1998**). In Valencia orange trees, spraying active dry yeast at 0.25 to 0.75% on March or / and August was favorable in improving growth, yield, fruit weight and volume (**Hegab *et al*, 1997**). In Washington navel orange, spraying yeast extract at 100 & 200ml/L and some growth regulators improved fruit set percentage and reducing June drop (**Atawia and EL-Desouky, 1997**).In tomato plants, spraying yeast extract and sodium benzoate improved yield and fruit quality **(Abdel- Naeem *et al*,2002)**

This work was designed to investigate the effect of some chemicals and yeast extract on germination, growth, flowering, yield and fruit quality in papaya under the Egyptian conditions. Beside, studying the effect of the applied treatments on anatomical changes in papaya.

MATERIALS AND METHODS:

This study was conducted during two consecutive seasons of 2002-2003 and 2003-2004 at the Experimental farm of Faculty of Agriculture at Moshtohor, Zagazig University to study the influence of seeds and plants treatment with some chemical substances and yeast extract on germination, growth, flowering and fruiting of Solo papaya cultivar. Mature papaya seeds cv. Solo were taken from the fruits in June 2001 and 2002 seasons and stored at room temperature up to the planting date.

Seeds were divided into nine groups then each group was subjected to one of the following treatments: -

1- Soaking in tap water for 12 hours as control treatment.
2- Soaking for 12 hours in sodium benzoate at 0.1 and 0.2 g./L.
3- Soaking for 12 hours in citric acid at 1.0 and 2.0 g./L.
4- Soaking for 12 hours in glucose at 10 and 20 g./L.
5- Soaking for 12 hours in yeast extract at 250 and 500 ml./ L.

Plants were sprayed with the same solutions after germination and after transplanting into the orchard.

Preparation of Yeast extract:

The dry pure yeast powder was activated by using sources of carbon and nitrogen with the ratio of 6:1 **(Barnett *et al*, 1990 and EL-Desouky *et al,* 1998).** This ratio is suitable to get the highest vegetative production of yeast (each ml yeast contained about 12000 of yeast cells). Then the media was frozen and thawed directly before usage. Tween- 20 was added as a spreading agent for all treatments.

The yeast extract used in the present study was analyzed for phytohormones, mineral elements "macro and micro", amino acid, total carbohydrates, reducing sugars as glucose, enzymes and Vitamins by **Mahmoud (2001)** as shown in **Table (1) and Fig. (1).**

Seeds were sown in March 5th in plastic bags (20 cm. in diameter) filled with a mixture of sandy and clay soil (1:1 by volume) and kept under greenhouse conditions.

These treatments were arranged in a completely randomized block design with twenty replicates for each treatment and plastic bags were sown with five seeds for each.

-Germination measurements:

Furthermore, from the beginning of seed germination, the number of emerged seedlings was counted at three days intervals until seed germination ceased. Seed germination was evaluated through the following germination parameters: germination percentages, rate and value according to the **Bartellet (1937).**

Ten weeks after seed germination, twenty plants for each treatment- healthy and nearly similar in growth vigor- were transplanted into the orchard and planted at 3X3m. apart on clay loamy soil. The treatments were arranged in a completely randomized block design with twenty replicates for each treatment and each replicate was represented by one plant. The plants received normal cultural practices that usually followed in the commercial fields and reached the blooming stage, the following data were recorded:

- Vegetative growth and flowering:

-Plant height (cm.), stem diameter (cm.) at 10cm. above the soil, number of leaves per plant, leaf area (cm.),petiole long (cm. of the 5th leaf from top), number of branches, time (days) required to attain blooming stage, number of female flowers per plant and number of male inflorescences per plant.

-Photosynthetic pigments content were determined in fresh leaves using the methods described by **Nornal (1982)**.

-Pollen grain fertility: -

Pollen fertility was estimated in two ways: the first was by the inspection and counting of fertile and non-fertile pollen grains mounted in dilute iodine solution and the second way was by the germination of pollen grains on a cultural media **(Shahine 1961).**

Germination of pollen grains took place on slides surrounded by water (to control humidity) at room temperature (about 23^{o}C) in Petri dishes in the laboratory on the media mentioned by **Darlington and**

La-Cour (1960). The culture media was made up of 100 ml.-distilled water,(6 gm. cane sugar, 2gm.agar and 2gm gelatin). Inspection and counts were carried out after 18 hours.

-Anatomical studies

The samples were taken from the 5^{th} internode from top of the stem at the flowering stage (blooming stage). The vegetative speciments were taken then killed and fixed in FAA (5ml. formalin, 5ml. glycial acetic acid and 90ml. ethyl alchohol 70%), washed in 50% ethyl alcohol, dehydrated in series of ethyl alchohol 70,90,95 and 100%, infiltrated in xylene, embedded in paraffin wax with a melting point of 60-63 ^{o}C, sectioned to 20 microns in thickness *(***Sass 1951),** stained with the double stain method (fast green and safranin), cleared in xylene and mounted in Canada balsam **(Johanson 1940***)*. Sections were read to detect histological manifestation of noticeable responses resulted from other treatments.

- yield indicators:

-Fruit set: -

Fruit set was recorded at 15 July, number of retained fruits was recorded at picking date at the start of appearance of yellow colour on part of the fruit and fruit drop Percentages were recorded as follows: -

$$\textbf{Fruit drop} = \frac{\text{Total No. of fruit set - No. of remained fruits}}{\text{Total No. of fruit set}} \times 100$$

- Fruit characters: -

Five mature fruits per each treatment were picked (start of appearance of yellow colour on part of the fruit), ripened and the following data were recorded: -

Fruit weight (Kg.), fruit length (cm.), fruit diameter (cm.), fruit shape index, pulp thickness (cm.), T.S.S. %, total acidity%, T.S.S. /Acidity and vitamin C mg/100gm**(A.O.A.C. 1975).**

All obtained data were subjected to analysis of variance according to **Snedecor and Cochran (1982).**The differences between means were differentiated by using Duncan's multiple range tests **Duncan (1980).**

RESULTS AND DISCUSSIONS:

1 -Germination parameters: -

-Germination percentage and rate: -

Data presented in **Table (2)** indicated that all test treatments caused significant increase in germination % and rate as compared with control in both seasons of study. The best results were obtained from yeast extract at 500 ml/L.

-Germination value: -

The presented data in **Table (2)** indicated that, the treatments with yeast extract and citric acid at two concentrations caused significant increase in germination value of papaya seeds compared with the control treatment which gave the lowest values during two seasons of study. These results are in agreement with the findings of **Ray Noggle and Fritz (1992) and Salama (1998).**

2- Vegetative growth: -

-Plant height (cm.): -

It is obvious from **Table (3)** that plants raised from yeast extract had the tallest stems at blooming date in both seasons. On the contrary, the treatment with water (control) produced the shortest plant when attained blooming stage in both seasons of study.

-Stem diameter (cm.): -

Table (3) shows that all treatments caused significant increase in stem diameter when the emerged plants attained blooming stage as compared with untreated seeds (control). Generally, sodium benzoate at 0.1g./L. and citric acid at 1.0g./L. produced plants with thickest stem in both seasons of study.

-Number of leaves per plant: -

Data in **Table (3)** clear that all treatments caused significant increase in number of leaves per plant attained blooming stage as compared with control except sodium benzoate at 0.2g. /L at the first season which was as the control, the highest number of leaves formed on papaya plants at blooming stage were obtained from citric acid at 1.0g./L. in both seasons of study.

-Leaf area (cm^2) and petiole long (cm): -

It is clear from **Table (3)** that generally leaf area and petiole long on papaya plants at blooming stage were increased by obtained sodium benzoate at 0.1g./L. and citric acid at 1.0g./L.. Meanwhile, lowest leaf area and petiole long on papaya plants at blooming stage were obtained from control in both seasons of study.

-Number of branches per plant: -

Table (3) shows that the highest numbers of branches per plant borne on papaya plants at blooming stage were obtained from yeast extract and citric acid.

These results are in agreement with the finding of **Luckey, (1980); Wally, (1981) and Salama, (1998).**

3- Leaves photosynthetic pigments content:

Data in **Table (4)** showed that the highest values of total leaves content of photosynthetic pigments (i.e., chlorophyll a & b and carotoniods) were obtained from yeast extract and glucose treatments in both seasons of study. On the other hand, sodium benzoate and control treatments gave lowest values in this respect during both seasons.

These results are in agreement with the findings of **Bakry and Wanas (2003)** on apricot trees .

4-Blooming parameters: -

-Time required for attaining blooming stage: -

Data present in **Table (5)** shows that untreated seeds (control) gave plants required longer time to attain blooming stage. On the contrary, the treatments with yeast extract succeeded in shortening that time needed to attain blooming stage in the first and second seasons.

-Number of female flowers per plant: -

Data in **Table (5)** clear that highest number of female flowers per plant was borne on plant raised from yeast extract at 500ml./L treatment as compared with untreated seeds (control) in both seasons.

- Number of male inflorescence per plant: -

Data in **Table (5)** obvious that no differences between all treatments in this respect. But, plants raised from treatment with glucose at 20g./l borne the highest number of male inflorescence per plant as compared with other treatments.

These results are in agreement with the finding of **Lucky (1980), Alamgir and Rahman (1991) and Salama, (1998).**

-Pollen fertility: -

Table (6) and **figure (2)** shows that all treatments increased pollen fertility percentage compared with the control. These values were 86.54,85.22,94.55,77.97,85.18,93.02,96.00,96.90 and 64.17 for sodium benzoate at 0.1g,0.2g/l,citric acid at 1.0g,2.0g/l ,glucose at10.0g,20.0g/l , yeast extract at 250.0ml,500.0ml/l and control, respectively.

The same result was noticed with the percentage of germinated pollens and length of pollen tube when compared with the control. These results could illustrate the increase or decrease of yield as the fertility of pollen grains could be an indication for egg fertility.

These obtained results are in agreement with those found by **Sayed (1970)** on tomato and **Bakry and Ismaeil (2002)** on papaya**.**

6- Anatomical study: -

Data in **Tables (7,8 and 9)** indicate the effect of treatments upon different estimated anatomical features in cross and longitudinal sections in the petiole of flowers and cross section of fruits of papaya plants.

-In cross section of petiole flower: -

As shown in **Table (7)** and **Figure (3)** different applied treatments increase the diameter of whole section. This increase reached maximum with yeast extract at 500ml/l and 250ml/l. which reached 8640 and 8532.20, respectively. Meanwhile, glucose at20.0 g/l gave the lowest increase in this respect.

Also, it could be noticed that increases of the whole diameter were reversed upon different layers comprises each section. Since, thickness of each of epidermis, cortex, phloem zone and xylem zone as well. In this respect, yeast extract at 500ml/l. followed by yeast extract at 250ml/l. gave the highest measurements of all these parameters.

In addition, the number of xylem rows in the vascular cylinder also increased with different applied treatments as well as the number vessels in each row. The same positive effect of applied treatment upon wall thickness of widest xylem vessel and pith diameter was also existed.

On the other hand, diameter of widest xylem vessel increased with sodium benzoate and citric acid . In general, the stimulatory effects of the applied treatments upon the anatomy features of treated plants could be attributed to the effect upon cambium activity. Increment of cambium activity could mainly attributed to the increase of endogenous hormones level especially cytokinin and auxin **(El Desouky, (1988) and Wanas, 1996).**

-In longitudinal section of petiole flower: -

As shown in **Table (8)** and **Fig.(4)** each of 0.1g/l sodium benzoate and 2.0g/l citric acid increased mean length of collenchyma cells and mean length of parenchyma cells.

Also, it could be noticed that each of sodium benzoate increased each of width of collenchyma and parenchyma cells.

As for the width of xylem vessel and the mean length of pith cells, it could be noticed that different applied treatments increased these two parameters.

-Fruit anatomy: -

As for the diameter of pericarp it could be noticed that yeast extract at 500ml/l gave the highest increase value of the pericarp diameter that reached 4396.50 micron followed by yeast extract at 250ml/l (4329.00 micron), citric acid at1.0g/l. (4140.00 micron) comparing with control value that only was 3051.00 micron **(Table, 9** and **Fig.,5)** . With regard to the thickness of exocarp and number of pericarp layers, it could be noticed that all treatments increased this thickness. In this respect, citric acid and yeast extract gave the highest value of this thickness.

In addition, length and widest of ovule were increased with different applied treatments. Also, it could be noticed that each of yeast extract at 500ml/l and 250 ml/l gave the highest values of ovule length and width, respectively. Moreover, applied treatments increased each of length and width of ovule bundle. Also, it could be noticed that effects of different treatments upon length and width of ovule bundle similar was prolonged to the diameter of widest xylem vessel in ovule.

In general, the obtained results of the anatomy study are of great important. Since, increases of most histological features with different applied treatments when compared with control ones were completely reversed upon yielded fruits as well as improving their quality.

7-Yield indicator:

- Fruit set %: -

Data presented in **Table (10**) showed that highest fruit set percentage was recorded by 500 ml/l yeast extract treatment followed by 250 ml/l yeast extract and 2.0g/l citric acid treatments, respectively. The lowest fruit set percentage was recorded by the control and rest of treatments was intermediate during two seasons of this study.

-Fruit drop percentage: -

Results in **Table (10)** show that in the first season, the highest fruit drop percentage was recorded by control, followed by sodium benzoate at 0.1 and 0.2g/l treatments. The lowest fruit drop percentage was recorded by yeast extract at 500 and 250 ml/l treatments. The second season gave the similar results in this respect.

-Number of retained fruits (being harvested): -

Data in **Table (10)** indicated that 500 and 250 ml/l yeast extract treatments recorded the highest number of retained fruits. The lowest number of retained fruits was obtained by control treatment. The rest of treatments were intermediate during both seasons of this study.

These results agree with the findings of **Thomas *et al* (1973)** on oil palm and **Wally (1981)** on papaya and **Abdel-Naeem *et al* (2002)** on tomato plants

8-Physical properties: -

-Fruit weight: -

Data in **Table (11)** showed that all treatments caused significant increase in fruit weight as compared with control. The heaviest fruit weight was obtained from yeast extract treatments followed by glucose and citric acid treatments in both seasons of study.

-Fruit length: -

Data in **Table (11)** indicated that yeast extract treatments caused significant increase in fruit length of papaya followed by glucose and citric acid treatments. On the other hand, the control treatment

gave the lowest values in this respect. However, the other treatments gave intermediate values in both seasons of study.

-Fruit diameter: -

Table (11) shows that, all treatments caused different fruit diameter of papaya. Yeast extract and glucose treatments gave highest values in this respect. On the contrary, the control treatment gave the lowest values in this respect. However, the other treatments gave intermediate values in both seasons of study.

-Fruit shape index: -

Data in **Table (11)** show that the highest values in the first season was recorded by yeast extract and control treatments. Meanwhile, the highest values in the second season was recorded by citric acid and control treatments

- pulp thickness: -

Table (11) clear that, all treatments caused significant increase in pulp thickness as compared with control. Best pulp thickness was obtained from plants raised from treatment with yeast extract in both seasons of study.

9-Chemical properties: -

-Total soluble solids percentage (T.S.S. %): -

Data in **Table (12)** clear that all treatments caused significant increase in T.S.S. % as compared with control. The best result was obtained from yeast extract treatments at 250 or 500 ml/l during two seasons.

-Total acidity %: -

Table (12) shows that, all treatments reduced total acidity as compared with control in both seasons of study. Citric acid and glucose treatments gave smallest value in this respect.

-T.S.S./Acidity: -

Table (12) clear that all treatments caused significant increase in T.S.S./ acidity as compared with control. The highest values were obtained from yeast extract and glucose treatments in both seasons of study.

-Vitamin C: -

Data presented in **Table (12)** shows that the highest values of vitamin C were obtained from yeast extract and glucose treatments in both seasons of study. On the other hand, citric acid ,sodium benzoate and control treatments gave lowest values in this respect during both seasons.

These results are in agreement with the findings of **Alamgir and Rahman (1991), Ghanta et al (1995) and Bakry and Wanas (2003)** on apricot trees .

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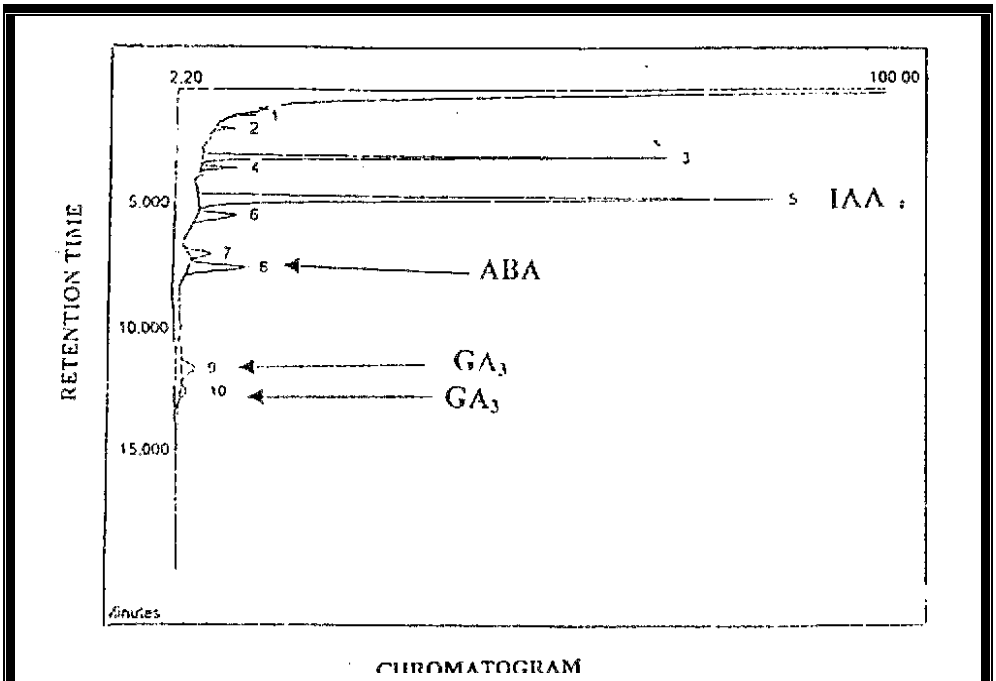


Fig (1): Chromatograms of endogenous IAA, GA3 and ABA at 100% level as determined by GLC.

Table (1): Chemical analysis of yeast extract.

Minerals				**Amino acids** (mg/100g fresh weight)		**Total carbohydrates** (mg/100g dry weight)		**Enzymes** (mg/100g fresh weight)		**Vitamins** (mg/100g fresh weight)	
Macro (g/100g dry weight)		**Micro** (mg/100g dry weight)									
Total N	6.23	Al	200.2	Arginine	1.99	Carbohydrates	13.2	Cytochrome oxidase	0.35	Vitamin B1	1.23
P_2O_4	45.68	Ba	105.6	Histidine	1.63	Glucose	11.3	Cytochrome peroxidase	0.29	Vitamin B2	1.31
K_2O	34.39	Co	47.8	Isoleiucine	1.31			Catalase	0.063	Riboflavin	2.96
NaO	0.35	Pb	238.6	Leucine	2.09					Nicotinic acid	25.89
MgO	3.76	Mn	61.3	Lysine	1.95					Panthothenic acid	13.56
CaO	2.05	Sn	123.9	Methionine	0.72					Biotin	0.09
SiO_2	1.55	Zn	235.6	Pheylalanine	1.01					P-amino benzoic acid	6.23
SO_2	0.49			Threonine	1.09					Vitamin B6	1.25
CI	0.06			Tryptophan	0.45					Folic acid	2.36
FeO	0.92			Valine	1.19					Thiamin	2.71
NaCl	0.30			Glutamic acid	1.00					Pyridoxine	2.90
				Serine	1.59					Vitamin B12	1.53 (µg/100g
				Aspartic acid	1.33					Inositol	202.1 (µg/100g)
				Cystine	0.23						
				Proline	1.53						
				Tyrosine	1.49						

Table (2): Effect of seeds chemical soaking and yeast extract on germination parameters of Solo papaya Cultivar during 2002-2003 and 2003-2004 seasons.

Characters / Treatments	Germination %		Germination rate		Germination value	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	60.00 C	58.33 B	13.33 C	13.00 D	0.31 C	0.34 C
Sodium benzoate at 0.1g./L.	90.00 AB	85.00 A	13.43 C	13.30 D	0.36 BC	0.36 BC
Sodium benzoate at 0.2g./L.	80.00 B	80.00 A	14.06 BC	14.00 CD	0.32 BC	0.36 BC
Citric acid at 1.0g./L.	96.00 A	90.00 A	15.73 ABC	14.73 BCD	0.41 A	0.45 A
Citric acid at 2.0g./L.	97.67 A	95.00 A	17.38 AB	15.38 ABC	0.42 A	0.46 A
Glucose at 10g./L.	96.67 A	95.00 A	16.77 AB	15.00 ABCD	0.41 A	0.44 A
Glucose at 20g./L.	97.67 A	96.00 A	17.34 AB	17.00 A	0.39 AB	0.40 AB
Yeast extract at 250ml/L.	98.33 A	9500 A	16.86 AB	16.50 AB	0.42 A	0.44 A
Yeast extract at 500ml/L.	90.00 AB	90.00 A	17.67 A	16.67 AB	0.43 A	0.46 A

Table (3): Effect of seeds soaking and plants spraying with some chemicals and yeast extract on vegetative growth of Solo papaya cultivar during 2002-2003 and 2003-2004 seasons.

Characters / Treatments	Plant height (cm)		Stem diameter (cm)		No. of leaves/plant		Leaf area (cm2)		Petiole long (cm)			No. of branches per plant
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003004	2002-03	2003-04
Control	125.00 B	120.00 B	7.00 ABC	7.06 ABC	17.67 C	19.67 CD	1115.33 E	1114.3 CD	20.67 AB	20.00 B	2.00 C	1.67 BD
Sodium benzoate at 0.1g./L.	130.00 AB	127.33 AB	8.16 AB	8.33 A	23.23 ABC	24.00 CD	1157.0 C	1165.00 A	23.00 A	23.67 A	2.00 C	2.33 AB
Sodium benzoate at 0.2g./L.	130.00 AB	125.00 AB	8.16 AB	8.23 A	17.67 C	18.67 D	1190.00 A	1162.0 AB	17.67 ABC	18.67 BC	3.00 B C	2.67 AB
Citric acid at 1.0g./L.	140.00 AB	135.00 AB	8.33 A	7.56 AB	26.00 A	25.67 A	1165.67 AB	1164.7 A	17.33 BC	17.67 BC	3.00 BC	2.67 AB
Citric acid at 2.0g./L.	130.00 AB	130.00 AB	7.30 ABC	7.50 AB	23.67 ABC	24.00 AB	1150.3 BCD	1152.3 ABC	16.00 BC	16.67 C	3.00 BC	3.33 A
Glucose at 10g./L.	131.67 AB	130.00 AB	5.96 CD	6.23 BC	24.33 A	23.67 AB	1084.00 F	1081.33 D	13.33 C	12.67 D	2.33 C	2.67 AB
Glucose at 20g./L.	140.00 AB	137.00 AB	5.10 D	5.63 C	19.00 BC	21.00B CD	1131.67 CDE	1132.3 ABC	20.67 AB	20.33 B	2.33 C	2.00 AB
Yeast extract at 250ml/L.	142.67 A	140.00 A	6.80 ABC	6.73 ABC	23.67A BC	22.67A BC	1119.33 DE	1120.3 BCD	17.00 BC	19.67 B	4.33 A	3.00 AB
Yeast extract at 500ml/L.	143.33 A	140.00 A	6.73 BC	6.73 ABC	24.67 AB	20.00 CD	1142.33 BCDE	1141.A BC	15.00 BC	16.33 C	4.00 A B	3.33 A

Table(4): Effect of plants spraying with some chemicals and yeast extract on leaves photosynthesis pigments content of Solo papaya cultivar which grown from soaking seeds during 2002-2003 and 2003-2004 seasons.

Characters / Treatments	Chlorophyll (a)		Chlorophyll (b)		Carotenoids	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	1.34 E	1.40 F	0.62 G	0.65 G	1.08 F	1.11
Sodium benzoate at 0.1g./L.	1.36 E	1.46 F	0.69 G	0.74 G	1.16 F	1.18
Sodium benzoate at 0.2g./L.	2.18 D	2.25 E	1.26 F	1.30 F	1.64 E	1.66
Citric acid at 1.0g./L.	2.35 C	2.40 D	1.40 E	1.43 E	1.70 D	1.73
Citric acid at 2.0g./L.	2.51 B	2.55 C	1.73 D	1.75 D	1.96 C	1.95
Glucose at 10g./L.	2.55 B	2.62 B	1.86 C	1.87 C	2.42 B	2.50
Glucose at 20g./L.	2.54 B	2.60 B	1.84 C	1.88 C	2.43 B	2.49
Yeast extract at 250ml/L.	2.47 B	2.49 C	2.25 B	2.30 B	2.46 B	2.52
Yeast extract at 500ml/L.	3.75 A	2.77 A	2.79 A	2.80 A	2.99 A	2.95

Table (5): Effect of plants spraying with some chemicals and yeast extract on blooming of Solo papaya cultivar which grown from soaking seeds during 2002-2003 and 2003-2004 seasons.

Treatments	Time required to attain blooming		No. of female flowers/plant		No. of male inflorescence/plant	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	370.67 A	379.67 A	13.00 D	14.00 B	17.67 A	18.00 A
Sodium benzoate at 0.1g./L.	317.67 CD	320.00 C	15.33 BCD	15.00 AB	17.67 A	17.33 A
Sodium benzoate at 0.2g./L.	339.33 BC	345.00 B	14.67 CD	16.00 AB	18.00 A	19.33 A
Citric acid at 1.0g./L.	341.67 B	346.33 B	14.33 CD	15.33 AB	18.33 A	20.00 A
Citric acid at 2.0g./L.	317.67 CD	320.00 C	18.00 AB	17.00 AB	15.33 A	16.67 A
Glucose at 10g./L.	321.00 BCD	323.00 C	14.67 CD	14.33 B	17.00 A	18.00 A
Glucose at 20g./L.	316.67 CD	320.00 C	16.00 ABC	15.00 AB	20.00 A	20.00 A
Yeast extract at 250ml/L.	313.33 D	320.00 C	18.00 AB	17.33 AB	19.67 A	19.00 A
Yeast extract at 500ml/L.	314.33 D	318.00 C	18.67 A	18.00 A	17.33 A	18.00 A

Table (6): Effect of plants spraying with some chemicals and yeast extract on fertility % and germination of pollen grains in Solo papaya cultivar which grown from soaking seeds.

Treatments	Iodine treatments				Germination of pollens		
	Fertility %	Sterile		Sterility %	Germinated pollens %	ungerminated pollens %	Length of tube (micron)
		Morphology Normal %	Aborted				
Control	64.17	33.33	2.5	35.83	62.22	62.22	62.22
Sodium benzoate at 0.1g./L.	86.54	13.46	0.00	13.46	84.28	84.28	84.28
Sodium benzoate at 0.2g./L.	85.22	14.78	0.00	14.78	85.09	85.09	85.09
Citric acid at 1.0g./L.	94.55	5.45	0.00	5.45	93.73	93.73	93.73
Citric acid at 2.0g./L.	77.97	22.03	0.00	22.03	77.28	77.28	77.28
Glucose at 10g./L.	85.18	14.82	0.00	14.82	84.43	84.43	84.43
Glucose at 20g./L.	93.02	6.98	0.00	6.98	92.20	92.20	92.20
Yeast extract at 250ml/L.	96.00	4.00	0.00	4.00	93.54	93.54	93.54
Yeast extract at 500ml/L.	96.90	3.10	0.00	3.10	96.05	96.05	96.05

Table (7): Effect of plants spraying with some chemicals and yeast extract on mean count and measurements of certain anatomical feature cross section of petiole flower of Solo papaya cultivar which grown from soaking seeds.

Characters / Treatments	Diameter of Whole Section	Thickness of Epidermis	Thickness of Cortex	Thickness of fiber zone	Thickness of phloem zone	Thickness of xylem zone	No. of xylen Rows in the vascular cylinder	No .of xylem vessels in the row	Diameter of widest xylem vessel	Wall thickness of Widest xylem Vessel	Diameter of pith
Control	5301.00	18.00	727.20	200.70	180.00	378.00	58.00	7.34	40.50	11.25	1704.60
Sodium benzoate at 0.1g./L.	5886.00	21.60	789.30	261.00	189.00	393.00	57.00	8.34	58.50	15.30	1723.50
Sodium benzoate at 0.2g./L.	5446.80	21.60	807.80	370.00	226.00	450.00	59.00	10.75	53.55	15.60	1890.00
Citric acid at 1.0g./L.	6255.90	18.90	711.00	373.50	256.00	457.00	55.00	10.00	53.10	16.70	1822.50
Citric acid at 2.0g./L.	7195.50	20.70	1426.50	288.90	274.00	479.00	78.00	11.00	56.70	18.90	1731.50
Glucose at 10g./L.	5439.60	19.80	783.00	331.20	237.00	466.00	59.00	8.67	41.40	18.10	1480.50
Glucose at 20g./L.	5370.40	17.10	1018.80	339.90	265.00	464.00	58.00	7.00	42.40	18.80	1561.50
Yeast extract at 250ml/L.	8532.20	18.90	1464.30	348.75	303.30	482.00	64.00	11.00	47.40	18.80	1223.90
Yeast extract at 500ml/L.	8640.00	22.50	1489.86	385.20	312.30	469.00	80.00	12.00	40.40	18.70	1475.00

Table (8): Effect of plants spraying with some chemicals and yeast extract on mean count and measurements of certain anatomical feature in longitudinal section of petiole flower of Solo papaya cultivar which grown from soaking seeds during.

Characters / Treatments	Mean length of collenchyma cells	Mean length of parenchyma cells	Mean widest of collenchyma cells	Mean widest of parenchyma cells	Mean widest of xylem vessel	Mean length of pith cells
Control	96.30	79.20	48.16	39.61	49.50	45.00
Sodium benzoate at 0.1g./L.	134.10	116.10	67.06	59.94	40.50	65.70
Sodium benzoate at 0.2g./L.	117.00	90.00	85.51	46.47	54.90	72.00
Citric acid at 1.0g./L.	117.00	105.30	57.32	54.37	49.50	63.00
Citric acid at 2.0g./L.	128.70	101.70	64.01	52.51	27.90	67.50
Glucose at 10g./L.	115.20	91.80	57.61	47.40	42.30	46.80
Glucose at 20g./L.	117.00	98.10	58.62	50.65	36.90	69.30
Yeast extract at 250ml/L.	117.00	87.30	58.11	45.07	32.40	51.30
Yeast extract at 500ml/L.	118.00	90.00	59.01	46.46	35.10	52.20

Table (9): Effect of plants spraying with some chemicals and yeast extract on mean count and measurements of certain anatomical feature in cross section of fruit of Solo papaya cultivar which grown from soaking seeds during.

Characters / Treatments	Diameter of Pericarp	Thickness of Exocarp	No. Of pricarp layers	Length of ovule	Widest of ovule	Length of ovule bundle	Widest of ovule bundle	No. of xylem vessel in ovule	Diameter of widest xylem vessel in ovule
Control	3051.00	15.80	77.80	540.00	612.00	304.20	270.00	43.00	29.70
Sodium benzoate at 0.1g./L.	3478.85	18.90	110.43	540.00	630.00	360.00	304.20	50.00	30.60
Sodium benzoate at 0.2g./L.	3406.50	18.00	102.30	585.00	747.00	377.10	333.00	37.00	29.70
Citric acid at 1.0g./L.	4140.00	19.80	117.95	616.00	913.00	378.00	378.00	22.00	30.60
Citric acid at 2.0g./L.	3355.20	21.60	95.59	643.00	931.00	488.70	425.00	46.00	28.80
Glucose at 10g./L.	3358.80	19.80	74.64	567.00	713.00	360.00	388.00	20.00	29.70
Glucose at 20g./L.	3922.20	18.90	80.70	585.00	786.00	423.00	333.00	21.00	25.20
Yeast extract at 250ml/L.	4329.00	20.70	123.33	855.00	927.00	549.00	370.00	40.00	31.50
Yeast extract at 500ml/L.	4396.50	20.70	162.84	895.00	1089.00	450.00	450.00	35.00	27.00

Table (10): Effect of plants spraying with some chemicals and yeast extract on yield indicators of Solo papaya cultivar which grown from soaking seeds during 2002-2003 and 2003-2004 seasons.

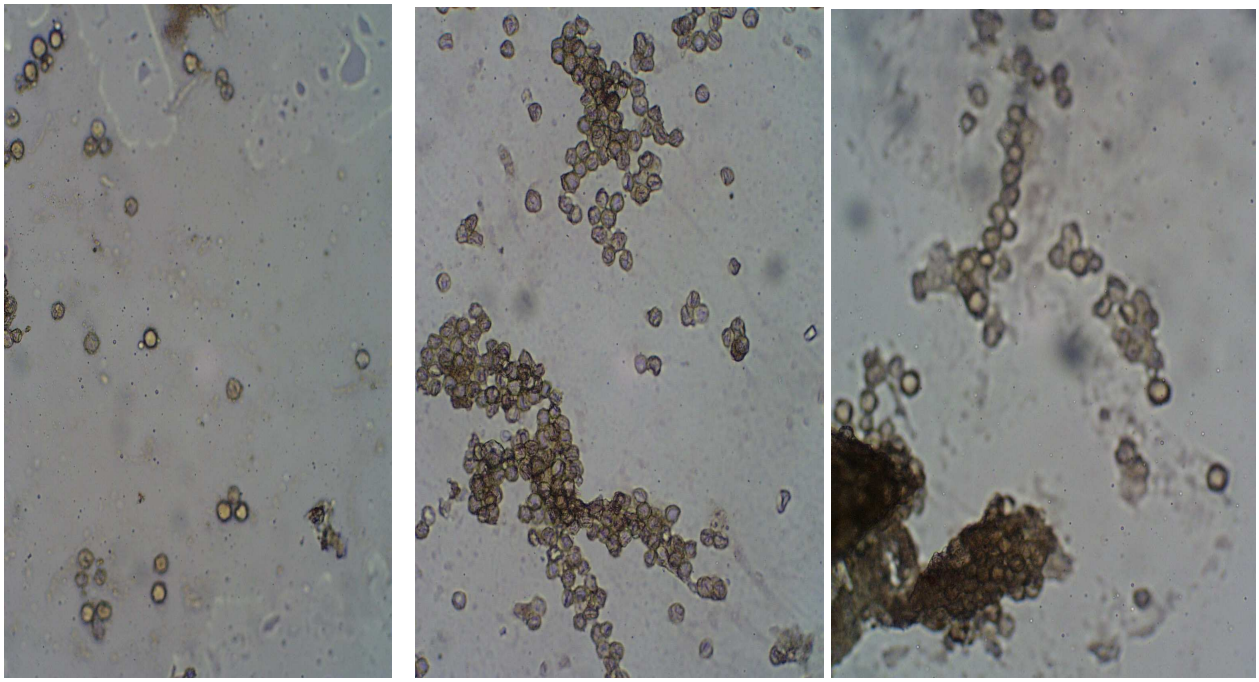
Characters / Treatments	Fruit set %		Fruit drop %		No. of retained fruits (being harvested)	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	45.00 E	41.67 E	61.53 A	64.28 A	5.00 C	5.00 D
Sodium benzoate at 0.1g./L.	60.01 D	53.84 D	46.67 B	53.33 B	8.00 BC	7.00 CD
Sodium benzoate at 0.2g./L.	63.14 CD	57.14 D	42.85 BC	50.00 B	8.00 BC	8.00 C
Citric acid at 1.0g./L.	72.99 B	67.51 C	35.71 DE	39.13 C	9.00 A	9.00 BC
Citric acid at 2.0g./L.	75.00 AB	73.33 AB	33.33 E	35.29 CD	12.00 A	11.00 AB
Glucose at 10g./L.	68.55 BC	72.99 AB	40.89 CD	34.89 CD	8.00 BC	9.00 BC
Glucose at 20g./L.	71.42 B	69.23 BC	37.50 CDE	40.00 C	10.00 AB	9.00 BC
Yeast extract at 250ml/L.	75.00 AB	71.75 ABC	33.33 E	35.20 CD	12.00 A	11.00 AB
Yeast extract at 500ml/L.	80.00 A	75.00 A	32.13 E	33.39 D	12.00 A	12.00A

Table (11): Effect of plants spraying with some chemicals and yeast extract on fruit physical characteristics of Solo papaya cultivar which grown from soaking seeds during 2002-2003 and 2003-2004 seasons.

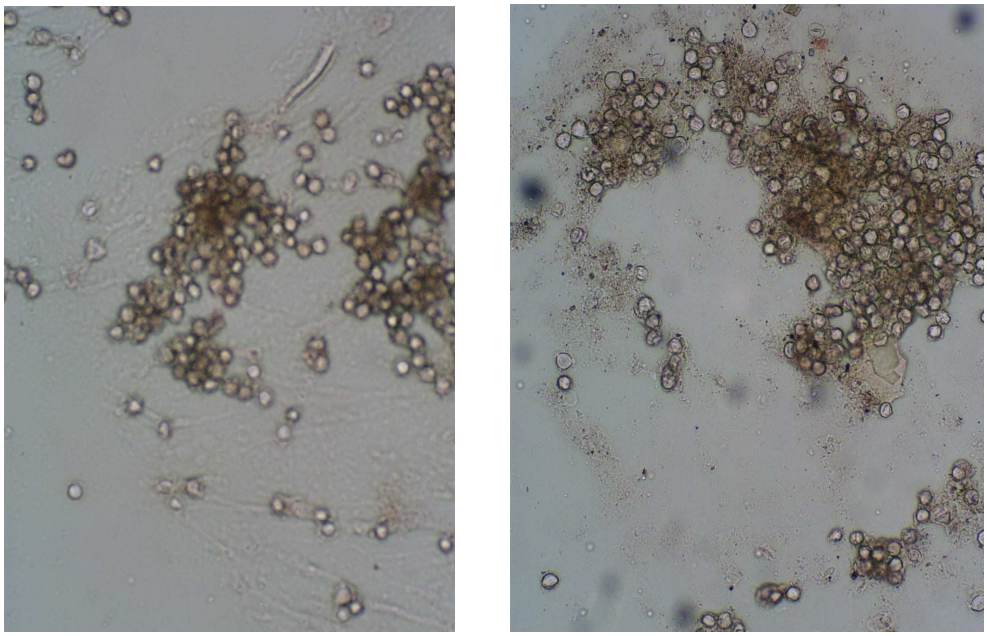
Characters / Treatments	Fruit weight (Kg)		Fruit length(cm.)		Fruit diameter(cm.)		Fruit shape index		Pulp thickness(cm)	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	0.68 F	0.72 F	15.00E	16.00 E	10.00 D	11.00E	1.50 AB	1.45 AB	2.10 F	2.00 F
Sodium benzoate at 0.1g./L.	0.71 F	0.74 F	17.00 DE	17.00 E	12.00D	12.00DE	1.42ABC	1.42 AB	2.30 EF	2.10 EF
Sodium benzoate at 0.2g./L.	0.76 E	0.81 E	20.00 CD	19.00 DE	15.00 C	14.00 CDE	1.33 C	1.36 CD	2.60 DE	2.40 DEF
Citric acid at 1.0g./L.	0.77DE	0.83 DE	22.00 BC	22.00 CD	16.00 AB	15.00 CD	1.38 BC	1.47 A	2.80 CD	2.50 DE
Citric acid at 2.0g./L.	0.83 BC	0.88BCD	23.00 BC	22.00 CD	17.00 BC	17.00 BC	1.35 C	1.29 EF	3.00 BC	2.60 CD
Glucose at 10g./L.	0.80 CD	0.86CDE	26.00 AB	24.00 BC	18.00 AB	19.00 AB	1.44 ABC	1.26 F	3.30 AB	2.80 CD
Glucose at 20g./L.	0.86 B	0.90ABC	28.00 A	25.00 ABC	19.00 AB	19.00 AB	1.47 AB	1.31 DEF	3.50 A	3.00 BC
Yeast extract at 250ml/L.	0.88 B	0.93 AB	29.00A	27.00 AB	19.00 AB	20.00 AB	1.53 A	1.35 BC	3.55 A	3.30 AB
Yeast extract at 500ml/L.	0.93 A	00.96 A	30.00 A	28.00 A	20.00 A	21.00 A	1.50 AB	1.31 DE	3.60 A	3.50 A

Table (12): Effect of plants spraying with some chemicals and yeast extract on pulp chemical characteristics of Solo papaya cultivar which grown from soaking seeds during 2002-2003 and 2003-2004 seasons.

Characters / Treatments	T.SS.		Total acidity (%)		TSS /Acidity		Vitamin C(mg/ 100g)	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
Control	9.50 E	9.30 D	0.15 A	0.16 A	63.33 E	62.00 F	5.80 E	6.10 D
Sodium benzoate at 0.1g./L.	9.52 E	9.50 D	0.14 B	0.14 B	68.00 D	67.85 E	5.82 E	6.30 CD
Sodium benzoate at 0.2g./L.	9.60 E	9.50 D	0.14 B	0.13 BC	68.57 D	67.85 E	5.90 E	6.35 CD
Citric acid at 1.0g./L	10.00 DE	10.30 C	0.13 C	0.13 BC	76.92 C	73.57 D	5.97 E	6.50 BCD
Citric acid at 2.0g./L.	10.30 D	10.50 C	0.12 D	0.12 C	85.83 B	87.50 C	6.50 D	6.70 BC
Glucose at 10g./L.	10.90 C	10.70 BC	0.12 D	0.12 C	90.83 A	89.16 BC	6.80 CD	6.90 B
Glucose at 20g./L.	11.40 B	11.00 BC	0.13 C	0.12 C	87.69 B	91.66 B	6.95 BC	6.96 B
Yeast extract at 250ml/L.	11.90 A	11.40 AB	0.13 C	0.12 C	91.54 A	95.00 A	7.40 B	7.50 A
Yeast extract at 500ml/L.	12.10 A	11.80 A	0.13 C	0.12 C	93.08 A	90.76 BC	7.80 A	7.75 A



(a) (b) (c)



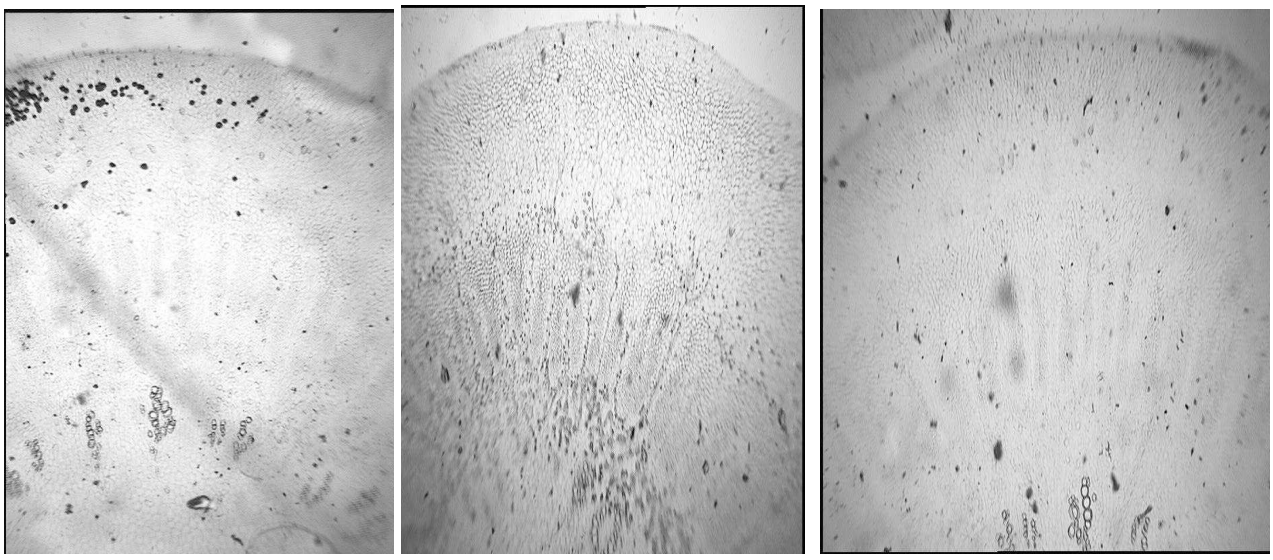
(d) (e)

Fig.(2): Shows the effect of seeds chemical soaking and yeast extract on pollen fertility of Solo papaya cultivar(100 x) .

a-control b- sodium benzoate at 0.2 g/L.

c- citric acid at 2.0 g/ L. d- yeast extract at 250 ppm.

e- yeast extract at 500 ppm.



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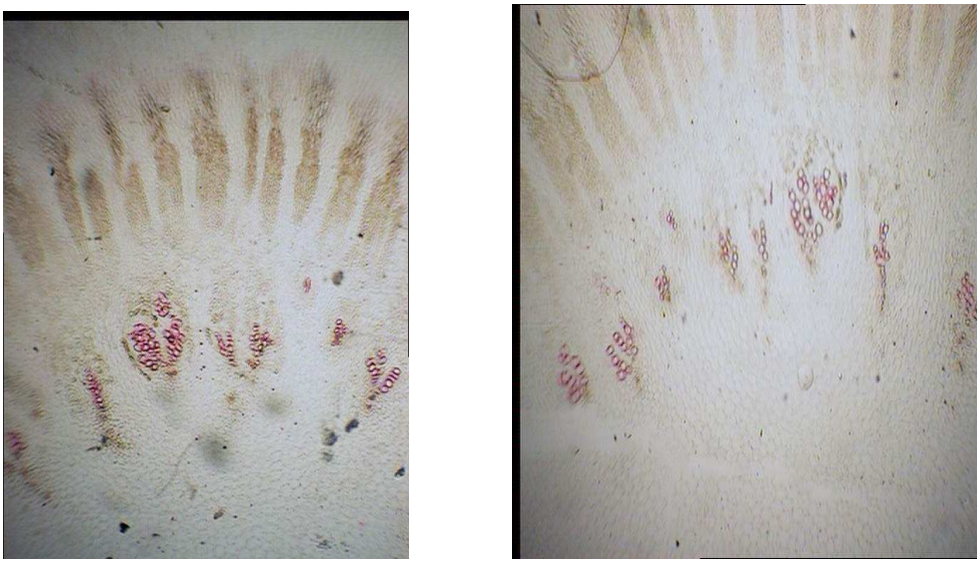


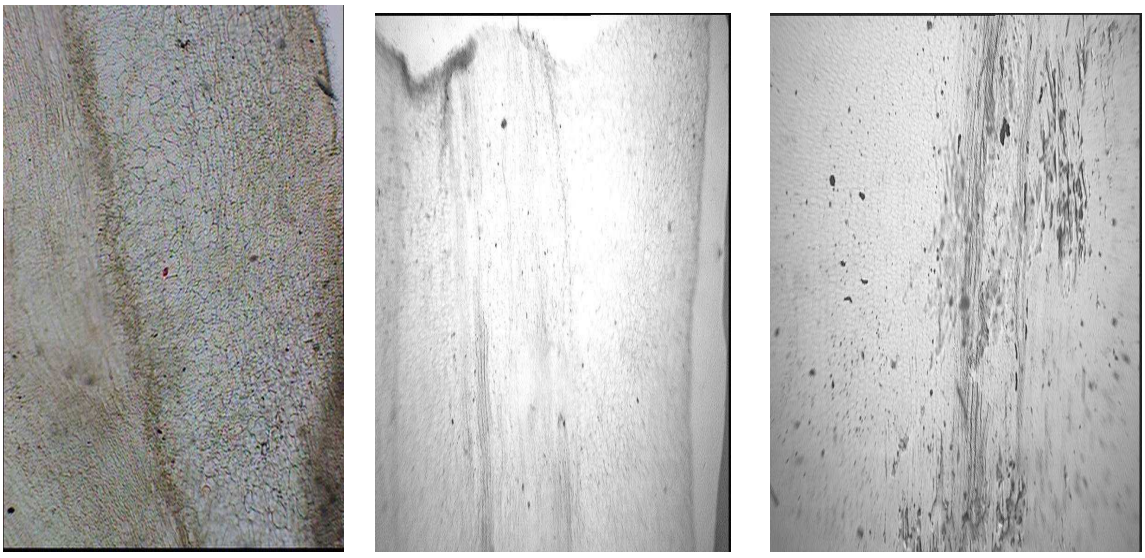
(d) (e)

Fig.(3): Shows the effect of seeds chemical soaking and yeast extract on certain anatomical feature in cross section of petiole flower of Solo papaya cultivar(100 x) .

a-control b- sodium benzoate at 0.2 g/L.

c- citric acid at 2.0 g/ L. d- yeast extract at 250 ppm.

e- yeast extract at 500 ppm.



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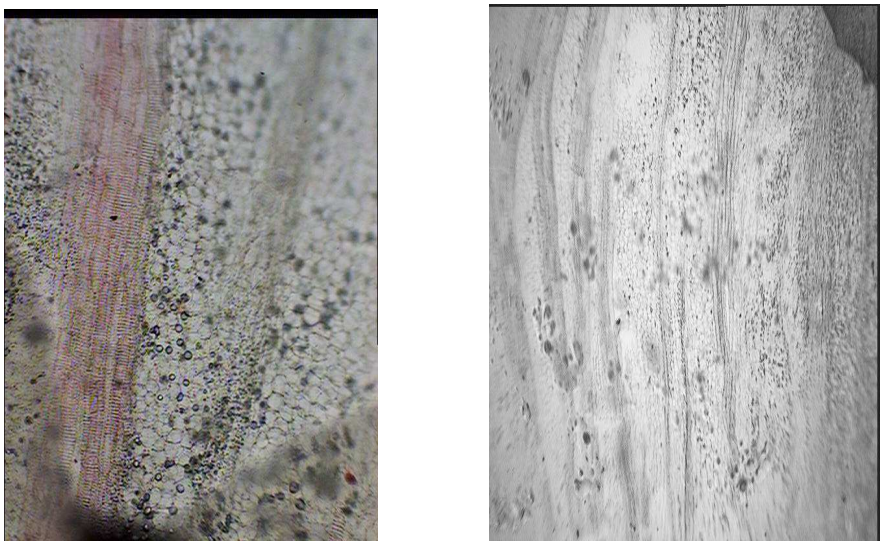


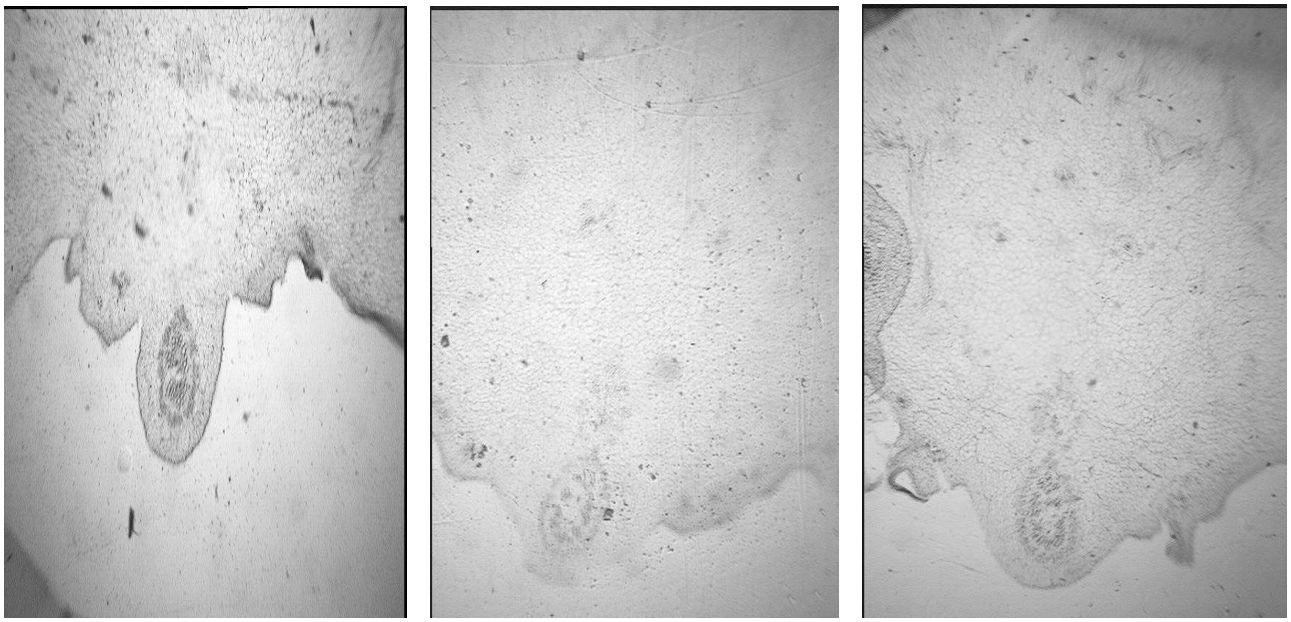
(d) (e)

Fig.(4): Shows the effect of seeds chemical soaking and yeast extract on certain anatomical feature in longitudinal section of petiole flower of Solo papaya cultivar(100 x).

a-control b- sodium benzoate at 0.2 g/L.

c- citric acid at 2.0 g/ L. d- yeast extract at 250 ppm.

e- yeast extract at 500 ppm.



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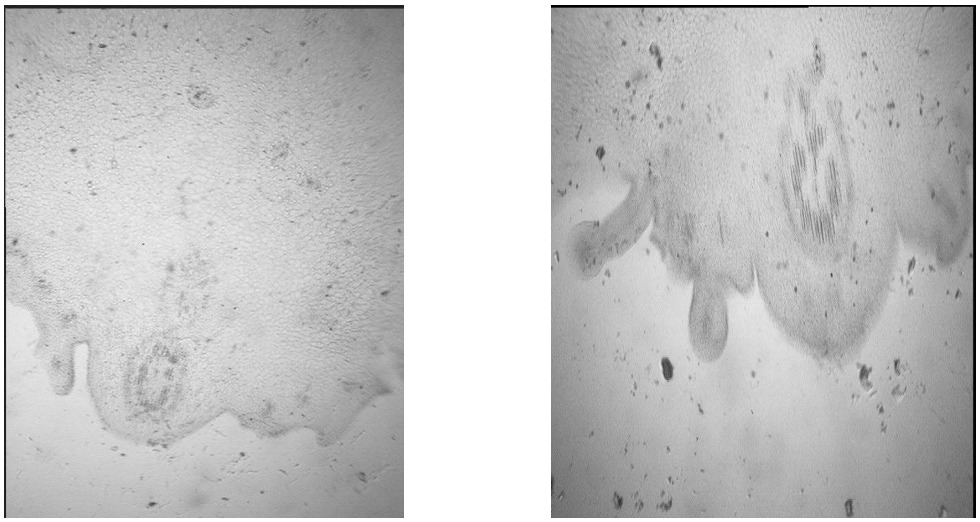

(d) (e)

Fig.(5): Shows the effect of seeds chemical soaking and yeast extract on certain anatomical feature in cross section of fruit of Solo papaya cultivar(100 x).
a-control b- sodium benzoate at 0.2 g/L.
c- citric acid at 2.0 g/ L. d- yeast extract at 250 ppm.
e-yeast extract at 500 ppm.

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