Effects of Some Natural Extracts and Their Application Methods on The Growth of *Pentas lanceolata* L. plants.

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ABSTRACT: This study was carried out during the two successive seasons of 2014 and 2015 at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt . The experiment was carried out to investigate the effects of yeast, garlic , onion, ginger and liquorice root extracts and their application methods on the growth and flowering of *Pentas lanceolata* L. plants.The results showed that the used extracts caused a positive effect on the growth and flowering of Pentas plants. Five grams per liter of yeast extract caused a significant increase in most of the studied characteristics (vegetative ,flowering and chemical composition) while liquorice root extract led to the highest increase in volume and dry weight of roots. Leaves area, leaves dry weight, stem dry weight and inflorescences. Dry weight per plant were significantly increased by the addition of yeast extract to the soil by drench .
Key wards : *Pentas lanceolata* , yeast extract , garlic extract , onion extract , ginger extract , liquorice root extract.

INTRODUCTION

Natural extracts are used to promote the vegetative growth and the yield of many crops through its influences in different physiological activities in the plants. Yeast is a natural source of cytokinins (Kraig and Haber, 1980; Spencer *et al* 1983; Castelfranco and Beale, 1983 and Fathy and Farid, 1996). Hewedy *et al.* (1996) found that spraying eggplant with the solution of soft bread yeast gave higher yield and marketable fruits than control plants.

Yeast extract is the common name for various forms of processed yeast products made by extracting the cell contents (removing the cell walls). When a yeast cell is inactivated, a natural digestion process called "autolysis" starts. During this process the yeast's own enzymes break down proteins and other parts of the cell. This causes the release of peptides, amino acids like glutamic acid , vitamins and other yeast cell components. Food processors use yeast extract to create savoury flavours and umami taste sensations (Bekatorou *et al.,* 2006).

Use of botanicals instead of chemical fungicides is one of the recent approaches for plant disease control. Some research works on the use of eco-friendly plant extracts as fungi control and found that beside its effect on plant disease control it has a positive effect on the plant growth. Islam and Faruq (2012) found that using garlic , onion and ginger extracts caused a positive increase in the growth parameters of tomato and chilli , also Ridha (2015) studied the effect of foliar application of garlic extract and liquorice root extract on vegetative growth and flowering and flower set of tomato and found that garlic extract significantly increased the number of leaves and foliar spray with liquorice root extract at the rate of 2.5 $g.L^{-1}$ and caused a significant increase in the plant height , number of leaves ,leaf area , number of flower and the number of flower punches.

Pentas lanceolata L. is a common plant, originating from tropical East Africa. It belongs to the family Rubiaceae. The most widely used names are "Egyptian Star Cluster" or "Pentas". It is used as a decorative plant and has been spread all over the tropics and subtropics area. The inflorescences have many several colours (white, pink, purple, or red). (Mongrand *et al.,* 2005)

The aim of this work was to study the effects of yeast, garlic, onion, ginger and liquorice root extracts and their application methods on the growth and flowering of *Pentas lanceolata* L. plants.

MATERIALS AND METHODS

The present study was carried out during the two successive seasons of 2014 and 2015 at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria.

The cuttings of *Pentas lanceolata* plants were planted in plastic pots of 10 cm diameter using a mixture of sandy and clay soils at the ratio of (1:1) by volume (Table 1) on November 15th, in both seasons. The rooted cuttings were transplanted to plastic pots of 25 cm diameter using the same soil mixture mentioned before on March 8th, 2014 and March 16th 2015 (in the first and second seasons, respectively). One pinching treatment was done on all plants at the length of 10-12 cm on the 1st of April, 2014 and the 9th of April, 2015 (in the first and second seasons, respectively) to encourage them to branch and homogenize the experimental units.

Table (1). Chemical analysis of the used mixture soil for the two growing seasons (2014 & 2015) .

Season	pH	EC ds/m	Cations (meq/l)				Anions (meq/l)		
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
2014	8.08	1.80	1.40	0.60	1.40	0.53	1.00	1.13	0.98
2015	8.24	1.61	1.70	0.90	1.90	0.65	1.13	1.38	0.98

Five natural extracts were used in this study i.e. yeast, ginger, liquoric*e*, onion and garlic extracts. The different extracts were applied by two methods either as soil drench or as foliar spray. The treatments were started after one week from pinching on April 8th,2014 and April 16th, 2015 during the two seasons, respectively. The treatments were repeated three times at two weeks intervals.

Extracts of yeast, ginger, liquorice, onion and garlic were prepared as follows:

Yeast extract: 5 g of yeast extract were mixed in 1 liter of water.

Ginger extract: 5 g of well dried grinded ginger (*Zingiber officinale* L.) rhizomes were dissolved in 1 liter warm water one hour before being used, after which contents were filtered on a sieve

Liquorice extract: 5g of the pulverized roots of liquorice (*Glycyrrhiza glabra* L.) were weighed and put in a 1 liter measuring flask, which was left to soak for 24 hours, after which contents were filtered on a sieve and the final volume of the extract was restored to 1 liter (Noor *et al.,* 2014)

Onion and garlic extracts: 250 g of onion bulbs (*Allium cepa L*) or garlic cloves (*Allium sativum*) were mixed with 250 ml of tap water. The mixtures were put in a freezer for one day, after which, frozen mixtures were left to thaw. Freezing and thawing were repeated three times. Water was added to a final volume of 1 liter before filtering. Final size of the filtrate was adjusted to 1:1, before being used (Hanafy *et al.,* 2012) .

The requirements of plants for fertilization were covered by the addition of NPK chemical fertilization (20-20-20) at the rate of 3g per liter each fertilization dose was repeated 15 days intervals.

The experiment layout was designed to provide complete randomized block design in factorial experiment, which contained three replicates, each replicate contained twelve treatments. Three pots were used as an experimental unit for each treatment in each replicate. The means of the individual factors and their interactions were compared by L.S.D test at 5% level of probability according to Snedecor and Cochran (1989).

The following data were measured in both of the two growing seasons:

Vegetative growth: Plant height (cm), stem diameter (cm), number of main branches, number of leaves, leaf area (cm^2), leaves and stems dry weight (g).

Flowering characteristics: flowering date (days), flowers full opening (days), flower longevity (days), number of inflorescences/plant and inflorescence dry weight (g) .

Root characteristics: volume of roots (cm^3) and root dry weight (g).

Chemical analysis of leaves: Chlorophyll a and b content (mg/g fresh weight) was determined according to Moran (1982) and Total carbohydrate content (%) according to Dubios *et al.*(1956).

RESULTS AND DISCUSSION

Vegetative growth characteristics:

Data presented in Table (2) showed that all natural extract treatments have a positive effect on *Pentas lanceolata* plant height, number of leaves per plant, stem diameter and number of branches in both seasons. Generally, data in the two experimental seasons cleared that, there was a significant increase in plant height by using either yeast or liquorice extracts. Applying of yeast, onion or garlic extracts resulted in significant increase in the number of leaves per plant .Yeast, liquorice, or onion extracts caused significant increase in stem diameter and the addition of yeast extract led to a significant increase in branches number per plant compared with the control .

Yeast extract caused the highest increase in plant height (54.92 and 58.00 cm) , number of leaves (308.56 and 316.33), the thickness of the stems (0.79 and 0.76 cm) and the number of branches per plant (16.64 and 18.25) in the first and second seasons, respectively compared to the other treatments.

The improvement of plant growth characteristics after yeast treatment may be due to the fact that yeast is a natural source of cytokinins that stimulate cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Kraig and Haber, 1980; Spencer *et al*. 1983; Castelfranco and Beale, 1983 and Fathy and Farid, 1996). It also contains sugar, proteins, amino acids and vitamins (Shady, 1978). This results are in agreement with those obtained by Mustafa and El-Shazly (2013) on Washington Navel orange and El Sagan (2015) on cucumber plants.

Table (3) showed that in the two seasons there was an increment in leaves area per plant , leaves and stem dry weights after applying any of the natural extracts by foliar spray or soil drench compared to the control. Addition of yeast extract by foliar spray or using yeast or onion extracts by soil drench caused a significant increase in leaves area per plant compared to the control. Also, applying yeast extract to the soil caused a significant increase in leaves and stems dry weight compared to the control during the two seasons. Generally, the maximum expansion of *Pentas lanceolata* (1255.37 and 1265.74 cm^2) ,the heaviest leaves and stem dry weights (8 and 8.71g) and (8.54 and 8.82 g) were obtained after drench application of yeast extract during the two seasons, respectively.

The significant increase of leaves area, leaves dry weight and stem dry weight per plant after yeast addition to soil may be due to the explanation of (Lonhienne *et al*.,2013) who mentioned that the addition of live or dead yeast to fertilized soil substantially increased the nitrogen and phosphorus content of roots and shoots of tomato (*Solanum lycopersicum*) and young sugarcane plants. Yeast addition to soil also increased the root-to-shoot ratio in both species and induced species-specific morphological changes that included increased tillering in sugarcane and greater shoot biomass in tomato plants.

Table (2). Means of the plant height (cm), number of leaves per plant, stem diameter (cm) and branches number of *Pentas Lanceolata*, as influenced by the addition of different types of natural extracts (T) during the two seasons of 2014 and 2015.

Natural extract type (T)	Plant height (cm)		Number of leaves per plant		Stem diameter (cm)		Branches number	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	39.78c	46.83b	167.94d	221.25c	0.57c	0.57c	9.31b	10.61c
Yeast	54.92a	58.00a	308.56a	316.33a	0.79a	0.76a	16.64a	18.25a
Ginger	45.36bc	51.11b	210.75bc	225.28bc	0.62bc	0.62bc	10.11b	12.31bc
Liquorice	48.17b	55.08a	187.19cd	262.25bd	0.64b	0.65b	10.50b	14.00b
Onion	45.33bc	53.22a	239.08b	288.64ab	0.63b	0.66b	10.50b	14.42b
Garlic	44.69bc	52.11b	216.25bc	269.19b	0.61b	0.66b	9.94b	12.11bc
$L.S.D._{at\ 0.05}$(T)	6.26	5.44	37.84	45.48	0.05	0.06	1.97	2.94

Means of treatments in the column have the same letters, are not significantly different at 5% level

Table (3). Means of the leaves area per plant (cm^2), leaves dry weight per plant (g) and stem dry weight per plant (g) of *Pentas Lanceolata*, as influenced by the addition of different types of natural extract (T) by different application methods (M) during the two seasons of 2014 and 2015.

Treatment		Leaves area per plant (cm^2)		Leaves dry weight per plant (g)		Stem dry weight per plant (g)	
Application method (T)	Natural extract type (M)	2014	2015	2014	2015	2014	2015
Soil drench	Control	492.32c	573.69e	3.07d	4.04d	2.71d	3.54d
	Yeast	1255.37a	1265.74a	8.00a	8.71a	8.54a	8.82a
	Ginger	532.60c	671.23c	3.61d	4.20bcd	3.05cd	3.39d
	Liquorice	515.43c	715.23bcde	3.63d	4.41bcd	3.30cd	3.74cd
	Onion	725.74b	820.52bc	4.29c	5.17bcd	3.60cd	4.91bc
	Garlic	542.76c	851.78bc	3.39d	4.80bcd	2.94cd	4.43cd
Foliar spray	Control	496.54c	583.24de	3.24d	4.08cd	2.81d	3.76cd
	Yeast	730.09b	885.02b	5.04b	5.34b	4.57b	5.81b
	Ginger	517.68c	751.17bcde	3.51d	4.51b	3.04cd	4.13cd
	Liquorice	536.32c	786.53bcd	3.52d	4.69bcd	3.41cd	4.77bc
	Onion	587.35c	880.89b	3.86c	5.19bc	3.87bc	4.87bc
	Garlic	605.71bc	774.73bc	4.15c	4.63b	3.83bc	4.41cd
L.S.D. $_{at\ 0.05}$ (M x T)		130.30	205.79	0.63	1.14	0.94	1.34

Means of treatments in the column have the same letters , are not significantly different at 5% level

Flowering characteristics:

For flowering starting date (days) and flowers full opening (days), there were insignificant difference between treatments while for the number of inflorescences per plant and flower longevity, Table (4) showed that the different natural extracts caused increment in number of inflorescences per plant and flower longevity in both seasons, but, only the addition of the yeast extract recorded a significant increase in this data compared with the control during the two seasons.

Also using of yeast extract gave the maximum number of inflorescences (16.64 and 17.33) and the longest flowering duration (37.03 and 37.11 days) in the first and second season, respectively, compared with the other treatments.

The positive effects of applying yeast extract was attributed to its own contents of different nutrients, high percentage of protein and large amounts of vitamin B (Glick, 1995; Fathy and Farid, 1996); physiological roles of vitamins and amino acids in the yeast extract which increased the metabolic processes role and levels of endogenous hormones, i.e., IAA and GA3 (Chaliakhyan, 1957 and Sarhan and Abdullah, 2010) which may have promoted the vegetative growth characters which in turn reflected on increasing number of inflorescences and flower longevity.

Data in Table (5) cleared that the addition of the different types of natural extracts by soil drench or foliar application methods had a marked effect on inflorescence dry weight (g) and the addition of yeast extract by soil drench or foliar spray or using onion extract as foliar spray resulted in significant increase

in the inflorescence dry weight compared to the control during the two successive seasons. The increasing of inflorescence dry weight (2.87 and 2.83g) in the first and second seasons, respectively was obtained after the application of yeast extract by soil drench, and compared to the other treatments.

Table (4). Means of number of inflorescences per plant and flower longevity (days) of *Pentas Lanceolata*, as influenced by the addition of different types of natural extracts (T) during the two seasons of 2014 and 2015.

Natural extract type (T)	Number of inflorescences per plant		Flower longevity (days)	
	2014	2015	2014	2015
Control	6.97c	9.28c	30.28b	29.44c
Yeast	16.89a	17.33a	37.03a	37.11a
Ginger	9.53bc	10.47c	32.61b	33.33b
Liquorice	10.19bc	10.22c	35.81a	34.00b
Onion	11.86b	13.33b	31.53b	32.36b
Garlic	10.58bc	10.47c	30.78b	31.94bc
L.S.D. $_{at\ 0.05}$ (T)	3.75	2.53	2.67	2.71

Means of treatments in the column have the same letters , are not significantly different at 5% level .

Table (5). Means of inflorescences dry weight per plant (g) of *Pentas Lanceolata*, as influenced by the addition of different types of natural extract (T) by different application methods (M) during the two seasons of 2014 and 2015.

Treatments		Inflorescences dry weight per plant (g)	
Application method (M)	**Natural extract Type (T)**	**2014**	**2015**
Soil drench	Control	0.93 e	1.00 d
	Yeast	2.87 a	2.83 a
	Ginger	1.12 cde	1.08 cd
	Liquorice	1.41 bcd	1.14 cd
	Onion	1.45 bcd	1.42 bcd
	Garlic	1.09 cde	1.32 cd
Foliar spray	Control	0.96 de	0.97 d
	Yeast	1.69 b	1.88 b
	Ginger	1.26 bcde	1.26 cd
	Liquorice	1.21 bcde	1.37 cd
	Onion	1.53 bc	1.54 bc
	Garlic	1.40 bcde	1.19 c
L.S.D. $_{at\ 0.05}$ (M xT)		0.49	0.49

Means of treatments in the column have the same letters , are not significantly different at 5% level .

Root characteristics:

Data in Table (6) showed that, although, root volume (cm^3) of *Pentas Lanceolata* plants was increased by the addition of the different types of natural extracts, only using the yeast or liquorice extracts caused a significant increase during the two seasons. On the other hand, the application of liquorice root extract caused the highest increase in root volume (13.17 and 16.17 cm^3) in the first and second seasons respectively, compared with the other treatments.

Data in Table (7) cleared that there was a remarkable increase in roots dry weight after the addition of any natural extract by soil drench or foliar spray . There was a significant increase in roots dry weight after the addition of the yeast extract by soil drench or foliar spray and using liquorice root extract as soil drench, during the two seasons. However, the heaviest root dry weight (2.63 and 3.03g) in the first and second seasons respectively was obtained after soil drench application of liquorice root extract.

The beneficial effect of liquorice extract on root characteristics may be due to their direct and indirect stimulatory and antioxidant protective effect. Also, liquorice extract is rich in many essential minerals, i.e. Mg, Fe, Ca and K as well as many natural antioxidants including, total phenols, flavonoids, tannins, saponins and carotenoids (Morsi *et al.,* 2008).

These results are in harmony with those obtained by Ahmed *et al.*(2012) on carnation plant and Ahmed *et al*. (2015) on *Mathiola incana*.

Table (6). Means of volume of roots (cm^3) of *Pentas Lanceolata L*, as influenced by the addition of different types of natural extracts (T) during the two seasons of 2014 and 2015.

Natural extract type (T)	Volume of roots (cm^3)	
	2014	2015
Control	7.17b	10.42b
Yeast	12.92a	16.00a
Ginger	8.50b	11.50b
Liquorice	13.17a	16.17a
Onion	9.33b	13.67a
Garlic	9.00b	11.25b
L.S.D. at 0.05 (T)	2.81	3.09

Means of treatments in the column have the same letters , are not significantly different at 5% level .

Table (7). Means of roots dry weight per plant (g) of *Pentas Lanceolata L.*, as influenced by the addition of different types of natural extract (T) by different application methods (M) during the two seasons of 2014 and 2015.

Treatment		Roots dry weight per plant (g)	
Application method (M)	**Natural extract type (T)**	**2014**	**2015**
Soil drench	Control	1.28c	1.90c
	Yeast	2.37a	2.87a
	Ginger	1.60bc	1.92c
	Liquorice	2.63a	3.03a
	Onion	2.00ab	2.45abc
	Garlic	1.54bc	1.73c
Foliar spray	Control	1.41bc	1.72c
	Yeast	2.39a	2.95a
	Ginger	1.67bc	1.96bc
	Liquorice	1.90abc	2.88a
	Onion	1.72abc	2.78ab
	Garlic	1.90abc	2.29abc
L.S.D. $_{at\ 0.05}$ (M x T)		0.69	0.83

Means of treatments in the column have the same letters , are not significantly different at 5% level .

Chemical composition

Table (8) cleared that the application of any of the mentioned natural extracts has a positive effect on chlorophyll a, chlorophyll b and total carbohydrate contents.

The application of yeast extract caused the highest increase in chlorophyll a (20.88 and 18.10 mg/g), chlorophyll b (7.85 and 6.06 mg/g) fresh weight and total carbohydrate (20.40 and 23.36 %) content in the two growing seasons .

The positive effect of yeast on chlorophyll a and b content may be due to the role of yeast cytokinins which delay the aging of leaves by reducing the degradation of chlorophyll and enhancing the protein and RNA synthesis. (Castelfranco and Beale, 1983). The increase in chl. a and b leads to a consequent increase in total carbohydrates (Stino *et al.* 2009). Similar findings were obtained by Taha *et al.,*(2011) on cucumber plants and Mustafa and El-Shazly (2013) on Washington Navel orange

Table (8). Means of chlorophyll a , chlorophyll b (mg/g) and total carbohydrate content (%) of *Pentas Lanceolata*, as influenced by the addition of different types of natural extracts (T) during the two seasons of 2014 and 2015.

Natural extract type (T)	Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Total carbohydrate content (%)	
	2014	2015	2014	2015	2014	2015
Control	14.84c	18.10b	4.85b	6.06c	16.80b	18.20b
Yeast	20.88a	30.23a	7.85a	11.36a	20.40a	23.36a
Ginger	16.87bc	25.42a	5.37b	9.13b	16.73b	19.32b
Liquorice	16.67bc	25.68a	5.76b	8.69b	16.97b	19.67b
Onion	18.43ab	25.05a	5.98b	9.61ab	18.02b	20.54b
Garlic	17.24bc	28.22a	4.95b	10.48ab	16.85b	19.98b
L.S.D. $_{at\ 0.05}$ (T)	2.98	5.49	1.34	1.97	2.21	2.45

Means of treatments in the column have the same letters , are not significantly different at 5% level .

It may be concluded from this study that a five grams per liter of yeast extract caused a significant increase in most of the studied characteristics (vegetative ,flowering and chemical composition), while liquorice root extract led to the highest increase in volume and dry weight of roots. Leaves area, leaves dry weight, stem dry weight and inflorescences dry weight per plant were significantly increased by the addition of yeast extract to the soil by drench.

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الملخص العربي

تأثير بعض المستخلصات الطبيعية وطرق إضافتها على نمو نبات البنتس

نجلاء محمد مصطفى ، مجد الدين فؤاد رضا

فرع بحوث نباتات الزينة بأنطونيادس – الإسكندرية – معهد بحوث البساتين – مركز البحوث الزراعية

أجريت هذه الدراسة خلال الموسمين الزراعيين ٢٠١٤ و ٢٠١٥ بفرع بحوث الزينة وتنسيق الحدائق بحديقة انطونيادس التابع لمعهد بحوث البساتين– مركز البحوث الزراعية – وزارة الزراعة– الاسكندرية– مصر. وذلك لدراسة تاثير مستخلصات كل من الخميرة ، الثوم ، البصل ، الجنزبيل وعرق سوس وطريقة إضفاتها على النمو الخضري والزهري والمحتوى الكيماوي لنبات البنتس .

أوضحت النتائج أن كل المستخلصات المستخدمة أدت إلى تأثير إيجابي على نمو وإزهار نبات البنتس وأن المعاملة ٥جرام / لتر من مستخلص الخميرة ادت إلى زيادة معنوية في معظم الصفات المدروسة (النمو الخضري – النمو الزهري – المحتوى الكيمائي) . بينما أعلى زيادة معنوية في الحجم والوزن الجاف للجذور تم الحصول عليها بعد المعاملة بمستخلص جذور العرق سوس . كما أدت إضافة مستخلص الخميرة إلى التربة إلى أعلى زيادة معنوية في مساحة الأوراق والوزن الجاف لكل من الأوراق والسيقان والنورات .

الكلمات الكاشفة : البنتس ، مستخلص الخميرة ، مستخلص الثوم ، مستخلص البصل ، مستخلص الجنزبيل ، مستخلص الثوم ، مستخلص جذور العرق سوس .