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EFFECT OF FOLIAR SPRAY WITH SOME STMULANT MATERIALS ON YIELD AND SEED CHEMICAL CONSTITUENTS OF PEA PLANTS

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ABSTRACT: *Two field experiments were carried out during winter seasons of 2011/2012 and 2012/2013 at the Agriculture Research Farm, El-Kassasien Hort. Res. Station, Ismalia Governorate, Egypt, to study the effect of foliar spray with some stimulant materials active dry yeast, seaweed extract, humic acid and their mixtures on yield and its components as well as seed chemical constituents of pea plants (Pisum sativum L.) c.v Master B grown under sandy soil conditions using drip irrigation system.*

Spraying pea plants with active dry yeast at 5or 10g /l, seaweed extract and humic acid at 0.1or 0.2% as well as the mixture among them had a stimulative effect on yield and its components and seed chemical constituents except fiber percentage as compared to untreated plants.

Significant increases in the yield and it's components and chemical constituents of seeds (nitrogen, protein, total sugars and total carbohydrates%) were recorded by foliar application of the mixture of active dry yeast at 10 g/l + seaweed extract at 0.2% + humic acid at 0.2% followed by the mixture of active dry yeast at 5 g/l + seaweed extract at 0.1% + humic acid at 0.1%.

Key words: *Pea (Pisum sativum), active dry yeast, seaweed extract, humic acid, yield, seed chemical constituents.*

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the most important and popular leguminous vegetable crops, This crop is widely used as a source of protein in human diets due to its high content of protein, ascorbic acid, B vitamins, carbohydrates, balanced amino acids composition and good digestibility. Increasing the productivity of peas green pods and dry seeds with high quality is considered an important aim that could be achieved through using the foliar application of some stimulant materials, i.e. active dry yeast (ADY) , seaweed extract (SWE) and humic acid (HA). Moreover, reducing environmental pollution through decreasing the amount of chemical fertilizers is of great demand nowadays for human, safety and reducing air and water pollution (Ahmed, 2013).

Yeasts are considered as a natural source of Bs vitamins and most of the essential elements (Nagodawithana, 1991). In addition, yeast extract is the natural component that contains many of the nutrient elements and cytokininis, which is safe and non-pollutant. It has a considerable amount of amino acids (Abou Zaid, 1984).

El-Desuki and El-Gereadly (2006) indicated that, pods yield and pod quality were improved by spraying pea plants with yeast extract as compared with control. Mohamed, (2005) also found that active dry yeast as foliar application had a beneficial effect on, yield and chemical constituents of bean plants especially at the highest rate (1.5g/l). Spraying pea plants with active dry Baker's yeast led to a significant increase in yield and its components, (Abdel-Aziz and Zakher 2010).

Also, foliar spray with yeast had simulative effect on yield and its components Tartoura (2001) on pea; El-Tohamy and El-Gereadly (2007) and Nour and Eisa (2009) on snap bean; Nassar *et al.,* (2011) on kidney bean and Ahmed and Gheeth (2013) on cowpea.

Chemical composition as N, protein and P percentages were in enhanced by foliar

application with yeast as studied by Nour and Eisa (2009) on snap bean; Nassar *et al.* (2011) on kidney bean and Ahmed and Gheeth (2013) on cowpea.

Pramanick *et al.,* (2013) reported that foliar spray with seaweed extract of green gram at 1.5% recorded the highest grain yield and crop quality.

Nowadays the use of humic acid has increased with increasing the agricultural production. The most economical humic acid is almost applied directly to the soil and/or as a foliar application to the plants. Bio-organic fertilizer has been reported to be important in reducing the amount of chemical fertilizers application and hence reducing the environmental pollution along with reducing the production cost (Gad El-Hak et al. 2012).

Many investigators reported that spraying plants with humic acid improved the productivity (Senesi and Loffredo 1994, Khan *et al,.* 2012; Gad El-Hak *et al*. 2012; and Dawa *et al*. 2013; on pea, El-Bassiony *et al*. 2010; and Hanafy *et al.* 2010; on snap bean, El-Hefny 2010; Azarpour *et al*., 2011) on cowpea.

MATERIALS AND METHODS

Two field experiments were carried out during winter seasons of 2011/2012 and 2012/2013 at the Agriculture Research Farm, El-Kassasien Hort. Res. Station, Ismalia Governorate, Egypt, to study the effect of foliar spray with some stimulant materials (active dry yeast, seaweed extracts, humic acid and their mixture) on yield and its components as well as seeds chemical constituents, of pea plants (*Pisum sativum* L.) c.v Master B.

The physical and chemical properties of the experimental soil field are presented in Table 1 according to Chapman and Pratt (1982).

Table 1: The soil physical and chemical properties of the experimental site during 2011/2012 and 2012/2013 seasons

Properties	2011/2012	2012/2013
Physical Properties		
Sand (%)	96.5	95.6
Silt (%)	1.7	1.6
Clay(%)	1.8	2.8
Texture	sandy	sandy
Chemical properties		
Organic matter (%)	0.03	0.08
pH	8.1	8.1
Available N (ppm)	5.4	6.9
Available P (ppm)	5.5	6.2
Available K (ppm)	52	64
Calcium carbonate (%)	0.18	0.26

Sample of the soil was obtained from 25 cm soil surface.

This experiment included nine treatments as follow:

Active dry yeast (ADY) at 5g/l and 10g/l, seaweed extract (SWE) at 0.1% and 0.2%, humic acid (HA) at 0.1 and 0.2%, (active dry yeast at5g/l + seaweed extract at 0.1% + humic acid at 0.1%) and (active dry yeast at10g/l + seaweed extract at 0.2% + humic acid at 0.2%) as well as control (sprayed with tap water).These treatments were distributed in a randomized complete block design with three replications.

Seeds of pea cv. Master B were obtained from Horticultural Research Institute, Agriculture Research Center, Egypt. Seeds were inoculated with *Rizobium leguminosarum bv.viciae* then sown on November 1th and 3th in 2011/2012and 2012/2013, respectively (at the rate of 400g /fed) on both sides of drippers lines (two seeds /hill) at 25 cm apart. At 15 days from sowing plants were thinned leaving one plant / hill. The experimental unit area was 10.5m^2 It contained 3 dripper lines with 5m length for each with 70cm wide. Plants of one dripper line (3.5m^2) was used for samples to measure the vegetative growth and N_2 fixation parameters (in the first part of this research) and the other two dripper lines (7m^2) were used for yield determination. One dripper line was left between each two experimental units without spraying as a guard row to avoid the overlapping of spraying solution.

Active dry yeast (*Socchoromycu cervisiae*) at 5g and 10 g /L.was activated by using source of carbon and nitrogen according to Barnett *et al.,* (1990).

Seaweed extract (Alga 600Commercial product) was obtained from Leili Agrochemistry CO., LTD. It contains 65% organic matter, 1% N, 18% K2O, 2% S, 10% Alginic acid, 0.42% Mg and 0.30% Fe.

Humic acid Commercial product (Hammer) obtained from UAD Co, Union for Agricultural Development. It containts 86% humic acid, 6% K2O and 7% fulvic acid.

The foliar application treatments were sprayed twice during the growth period of plant at 30 and 40 days from sowing. Each experimental unit received 2L solution of active dry yeast, seaweed extract, humic acid and their mixtures using spreading agent (super film) in all treatments. The untreated plants (check) were sprayed with tap water with spreading agent.

All plots received equal amounts of compost at rate of 30m^3/feddan during soil preparation, without adding any chemical fertilizers during all the growing season.

The other recommended agricultural practices for commercial pea production were followed.

Data recorded:

The obtained data in this study were as follows.

A. Yield and its components:

Mature green pods were continuously harvested at suitable maturity stage and the following data were recorded: Number of pods/plant, average pod weight (g), number of seeds/pod, weight of seeds/pod (g), average weight of 100 seeds (g), green pods yield /plant (g) and total green pods yield /fed in addition, Netting percentage was calculated.

B. Seed chemical constituents:

At the second harvest, sample of green seeds was dried at 70^{o}C till constant weight, then finely ground separatel. modified Micro-kjeldahl apparatus of Parnars and Wagner as described by Jones *et al.,* (1991) Total N-determination was done using according to A.O.A.C. (1984), crude protein of each sample was calculated by multiplying the total nitrogen by the factor 6.25.

Total soluble sugar in seeds was determined according to the method described by Sadasivam and Manickam, (1996). Reducing sugar was estimated by Nelson-Somogy method as described by Naguib (1964).

Total carbohydrate was determined colorimetrically using the method described by Dubois *et al.* (1956). Crude fiber was determined according to the method of Maynard (1970).

C. Statistical analysis:

The data of these experiment were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and the differences among treatments were compared using Duncan's multiple range test (Duncan, 1955),

RESULTS AND DISCUSSION

Yield and its components

Results in Tables (2 and 3) illustrate the effect of some stimulant substances on yield and its components; i.e., number of pods per plant, average pod weight per plant, number of seeds per pod, weight of seed per pod, weight of 100 seeds, netting percentage, green pods yield per plant and green pods yield per feddan. It is obvious from the data that spraying pea plants with the mixture of active dry yeast (ADY) at 10g/l + seaweed extract (SWE) at 0.2% + humic acid (HA) at 0.2%, in general, was the most favorable treatment for enhancing number of pods per plant (18.8 and 20.3), number of seeds per pod (9.4 and 8.9), weight of seeds per pod (3.19 and 3.14 g,) weight of 100 seeds (45.4 and 48.9 g), netting percentage (49.6 and 49.1) and green pods yield per plant (121.2 and 129.8 g) as well as green pods per feddan (3.689 and 3.889 ton) in 1st and 2nd seasons, respectively, followed by spraying pea plants with the mixture of (ADY) at 5g/l + (SWE) at 0.1% + (HA) at 0.1% . On the other hand, average pod weight did not significantly affected by spraying pea plants with all studied treatments. These results are true in both seasons of study.

The enhancing effect of active dry yeast on pea yield and its components may be due to that yeast via its cytokinins content and the high content of vit. B and nutrient elements as well as organic compounds (Nagodawithana, 1991), which might be playing a role in distribution and translocation of metabolites from leaves towards the reproductive organs and this in turn lead to the improvement of pea yield.

The enhancing effect of humic acid on yield and its components could be explained as a humic acid is rich in both organic and mineral substances which are essential to plant growth and consequently increase yield quality and quantity (Gad El-Hak *et al.,* 2012). In addition, humic acid compounds may have various biochemical effects either at cell wall, membrane level or in the cytoplasm, that's in role increased photosynthesis and respiration rates in plants (Chen and Avied 1990) and consequently could positively affect pods yield and also the foliar spray of humic acid not only improved growth and nutrients uptake of some crops but also enhanced their yields (Pademet *et al.,* 1999; Neriet *et al.,* 2002). In addition the significant positive effect of humic acide application were found on yield of faba bean (Shuixiu and Ruizhen, 2001).

The simulative effect of seaweed extract on pea yield and its components may be due to that seaweed extract has applied to soil or sprayed on plants as fertilizer, which contain many growth regulators such as cytokines, auxins, gibberllins and betanins besides most of macro and micro elements that necessary for the development, productivity of plant as well as enhance plant defense against pest and diseases (Khan *et al.,* 2009 and Jayaraman *et al.,* 2010).

Similar findings with active dry yeast foliar application were obtained by El-Desuki and El-Gereadly (2006) and Abdel-Aziz and Zakher (2010) on pea, Mohamed (2005), Nour and Eisa (2009) on snap bean, Ahmed and Gheeth (2013) on cowpea, pramanick *et al* (2013) on green gram.

In addition, the obtained results with humic acid foliar application are in a harmony with those reported by many researchers such as Senesi and Loffredo 1994, Khan *et al,.* (2012), Gad El-Hak *et al.* (2012) and Dawa *et al.* (2013) on pea, El-Bassiony *et al.*(2012); Hanafy *et al.* (2010) on snap bean, El-Hefny (2010); Azarpour *et al.*, (2011) on cowpea.

The obtained results with seaweed foliar nutrition agree with those El – Aidy *et al.,* (2002) on sweat paper, Awad *et al.,* (2006) on potato, Nour *et al.,* (2010) on tomato and Pramanick *et al.,* (2013) on green gram.

Table 2

Table 3

Seed chemical constituents

Seed chemical constituents; i.e., nitrogen, crude protein, non reducing sugars, reducing sugars, total sugars and total carbohydrates as well as fibers percentage as affected by foliar spray with active dry yeast, seaweed extract and humic acid as well as the mixture of them are shown in Tables (4 and 5). Data in such Tables revealed that spraying pea plants with the mixture of ADY at 10g/l + SWE at 0.2% + HA at 0.2% , in general, was the most favorable treatments which significantly enhancing seed nitrogen percentage (3.36 and 3.72%), crude protein (21.0 and 23.2%), non reducing sugars (12.8 and 12.9%), reducing sugars (3.78 and 3.95%) and total sugars (16.6 and 16.8%) as well as total carbohydrates (67.8 and 68.4%) in 1st and 2nd seasons, respectively, followed by spraying pea plants with the mixture of ADY at 5g/l + SWE at 0.1% + HA at 0.1% with no significant differences between them. On the other hand the lowest values of seed chemical constituents were recorded in seeds of untreated plants.

Concerning fibers percentage, it is obvious from the same data in Tables 4 and 5 that spraying pea plants with ADY, SWE and HA as well as the mixture of them showed a significant effect on fibers percentage in both seasons of study, the minimum values of fibers (5.98 and 5.96%) were obtained from plants sprayed with the mixture of the three substances at the high used concentration, while untreated plants gave the maximum values of fibers percentage (7.81 and 7.62%) in 1st and 2nd seasons, respectively, The increases of seeds chemical constituents by foliar application of active dry yeast might be attributed to that macro and micronutrients increased the capacity of plant leaves to absorb these nutrients for building up plant metabolites, which in turn contributes much to the increase of nutrients in seeds uptake (Mandour *et al.,* 1986).

The stimulatory effects of humic substances have been directly correlated with enhanced uptake of macronutrients, such as nitrogen, phosphorus and sulfur (Chen and Avied 1990).

Similar findings with active dry yeast foliar applications were obtained by Nour and Eisa (2009) on snap bean; Nassar *et al.* (2011) on Kidney bean and Ahmed and Gheeth (2013) on cowpea.

In addition, the obtained results with humic acid foliar application are in a harmony with those reported by Gad El-Hak *et al*. (2012) and Dawa *et al*. (2013).

The obtained results with saweed extract foliar nutrition agree with those Awad *et al.,* (2006) on potato, Nour *et al.,* (2010) on tomato and Pramanick *et al.,* (2013) on green gram.

Conclusion

From the previous results of this investigation, it could be concluded that pea plants grown under similar growing conditions of this study sprayed with mixture of active dry yeast at 10g/l + seaweed extract at 0.2% + humic acid at 0.2% or with mixture of active dry yeast at 5g/l + seaweed extract at 0.1% + humic acid at 0.1% produce high plant growth, dry weight, root system, pod yield and yield components as well as chemical constituents of seeds.

Table 4

Table 5

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تأثير رش بعض المواد المنشطة على المحصول والمحتوى الكيماوى لبذور نباتات البسلة

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الملخص العربى

أجريت تجربتان حقليتان خلال فصل الشتاء لموسمى ٢٠١٢/٢٠١١ ، ٢٠١٢ / ٢٠١٣ فى مزرعة التجارب البحثية ، محطة بحوث البساتين بالقصاصين ، مركز البحوث الزراعية ، محافظة الأسماعيلية ، لدراسة تأثير الرش الورقى ببعض المواد الطبيعية (الخميرة الجافة النشطه ، مستخلص الأعشاب البحرية ، حمض الهيومك والمخاليط بينهم) على المحصول ومكوناته وكذلك المحتوى الكيماوى لبذور نباتات البسلة صنف ماستر ب الناميه تحت ظروف الأراضى الرمليه مع استخدام نظام الرى بالتنقيط.

أدى رش نباتات البسلة بالخميرة الجافة النشطه بتركيز ٥ أو ١٠ جم / لتر ومستخلص الأعشاب البحرية بتركيز ٠.١ أو ٠.٢% وحمض الهيومك بتركيز ٠.١ أو ٠.٢% وكذلك معاملتى المخاليط بينهم أدت إلى حدوث تأثير منشط على المحصول ومكوناته و المحتوى الكيماوى للبذور مقارنة بالنباتات غير المعاملة (الكنترول).

سجلت نباتات البسلة المعاملة بمخلوط من الخميرة الجافة النشطه بتركيز ١٠ جم /لتر + مستخلص الأعشاب البحرية بتركيز ٠.٢% + حمض الهيومك بتركيز ٠.٢% زيادة معنوية بالنسبة لكل من المحصول ومكوناته وأيضا المحتوى الكيماوى للبذور متمثلا فى النسبة المئوية لكل من النيتروجين ، البروتين الكلى ، السكريات الكلية والمختزلة والكربوهيدرات الكلية، تليها معاملة الرش بمخلوط من الخميرة الجافة النشطه بتركيز ٥ جم /لتر + مستخلص الأعشاب البحرية بتركيز ٠.١% + حمض الهيومك بتركيز ٠.١%.

Table 2. Effect of foliar spray with some stimulant materials on yield and its components of pea plants during 2011/2012 season.

Characters / Treatments	No. of pods/ plant	Average pod Wt.(g)	No. of seeds/pod	Wt.of seeds/pod (g)	Wt.of 100 seeds (g)	Netting (%)	Green pods yield	
							gm / plant	tons /fed.
Control	15.3d	6.25a	7.6e	2.63c	40.11e	42.2f	95.6c	2.848d
ADY 5g/l	16.3cd	6.10a	8.6b-d	2.87a-c	43.06b	47.0c	99.5c	2.994cd
ADY 10g/l	17.8b	6.11a	8.9ab	2.92a-c	44.81a	47.8b	108.8a-c	3.335b
SWE 0.1%	15.9cd	6.12a	7.9de	2.79bc	40.33de	45.5e	97.4c	2.864d
SWE 0.2%	16.7c	5.90a	8.0c-e	2.71c	41.23cd	45.9de	98.4c	2.988cd
HA 0.1%	15.8cd	6.66a	8.6b-d	3.10ab	41.78c	46.5cd	105.1bc	3.220bc
HA 0.2%	16.2cd	6.62a	8.7a-c	3.10ab	42.73b	46.8c	107.3bc	3.143bc
ADY at 5g/l + SWE at 1% + HA at 1%	18.7ab	6.11a	9.3ab	2.99a-c	44.62a	49.0a	114.1ab	3.336b
ADY at 10g/l + SWE at2% + HA at 2%	18.8a	6.44a	9.4a	3.19a	45.42a	49.6a	121.2a	3.689a

Values having the same alphabetical letter (s) did not significance differ at 0.05 level of a probability according to Duncan's multiple range test.
ADY: active dry yeast, SWE : seaweed extract ,HA: humic acid

Table 3. Effect of foliar spray with some stimulant materials on yield and its components of pea plants during 2012/2013 season

Characters / Treatments	No. of pods/ plant	Average pod Wt.(g)	No. of seeds/pod	Wt.of seeds/pod (g)	Wt.of 100 seeds (g)	Netting (%)	Green pods yield	
							gm / plant	tons /fed.
Control	16.7ef	5.95a	7.3d	2.49d	38.10e	41.9f	99.29c	2.939d
ADY 5g/l	16.5f	6.58a	8.7ab	3.05a	41.59d	46.3cd	108.61bc	3.273b-d
ADY 10g/l	18.3b-d	6.25a	8.8ab	2.95ab	43.94c	47.1c	114.25a-c	3.317bc
SWE 0.1%	17.3d-f	5.88a	8.0c	2.65cd	38.30e	45.0e	101.85c	2.963cd
SWE 0.2%	17.8c-e	5.82a	8.6ab	2.64cd	38.06e	45.3e	103.64c	3.156b-d
HA 0.1%	18.1b-d	5.96a	8.0c	2.74b-d	38.71e	45.9de	108.0bc	3.198b-d
HA 0.2%	18.7bc	5.95a	8.3bc	2.87a-c	40.56d	48.3b	111.27bc	3.392b
ADY at 5g/l + SWE at 1% + HA at 1%	19.3ab	6.32a	8.8ab	3.10a	46.16b	49.0a	122.13ab	3.524b
ADY at 10g/l + SWE at2% + HA at 2%	20.3a	6.39a	8.9a	3.14a	48.92a	49.1a	129.84a	3.889a

Values having the same alphabetical letter (s) did not significance differ at 0.05 level of a probability according to Duncan's multiple range test.
ADY nactive dry yest, SWE : seaweed extract , HA humic acid

Table 4. Effect of foliar spray with some stimulant materials on chemical constituents of pea seeds during 2011/2012 season

Characters / Treatments	Chemical constituents (%)						
	N	Crude Protein	Non reducing sugars	Reducing sugars	Total sugars	Total carbohy-drates	Fibers
Control	2.33e	14.56e	12.14c	2.93e	15.07e	60.0c	7.81a
ADY 5g/l	2.51e	15.69e	12.32bc	3.00e	15.32de	62.8a-c	7.32b
ADY 10g/l	3.00cd	18.75cd	12.54ab	3.32bc	15.86c	65.1a-c	6.75c
SWE 0.1%	2.35e	14.69e	12.05c	3.06de	15.11e	62.0bc	7.41b
SWE 0.2%	2.85d	17.81d	12.28bc	3.24c	15.52d	63.8a-c	6.85c
HA 0.1%	2.42e	15.13e	12.05c	3.19cd	15.24e	63.9a-c	7.22b
HA 0.2%	3.11bc	19.44bc	12.77a	3.44b	16.21b	65.2ab	6.47d
ADY at 5g/l + SWE at 1% + HA at 1%	3.27ab	20.44ab	12.81a	3.65a	16.46ab	67.3a	6.32d
ADY at 10g/l + SWE at2% + HA at 2%	3.36a	21.00a	12.80a	3.78a	16.58a	67.8a	5.98e

Values having the same alphabetical letter (s) did not significance differ at 0.05 level of a probability according to Duncan's multiple range test.
ADY nactive dry yest, SWE : seaweed extract , HA humic acid

Table 5. Effect of foliar spray with some stimulant materials on chemical constituents of pea seeds during 2012/2013 season.

Characters / Treatments	Chemical constituents (%)						
	N	Crude Protein	Non reducing sugars	Reducing sugars	Total sugars	Total carbohy-drates	Fibers
Control	2.61h	16.31h	12.18c	3.01e	15.19h	61.3d	7.62a
ADY 5g/l	2.84fg	17.75fg	12.39bc	3.19de	15.58fg	63.1b-d	7.29bc
ADY 10g/l	3.21cd	20.06cd	12.55a-c	3.64c	16.19cd	65.7a-c	6.61de
SWE 0.1%	2.75gh	17.19gh	12.28c	3.12de	15.40gh	62.4cd	7.35b
SWE 0.2%	3.09de	19.31de	12.40bc	3.53c	15.93de	64.9a-d	6.79d
HA 0.1%	2.98ef	18.63ef	12.44bc	3.31d	15.75ef	64.1b-d	7.05c
HA 0.2%	3.36bc	21.00bc	12.72a-c	3.72bc	16.44bc	66.5ab	6.39ef
ADY at 5g/l + SWE at 1% + HA at 1%	3.51b	21.94b	12.82ab	3.86ab	16.68ab	67.9a	6.17fg
ADY at 10g/l + SWE at2% + HA at 2%	3.72a	23.25a	12.88a	3.95a	16.83a	68.4a	5.96g

Values having the same alphabetical letter (s) did not significance differ at 0.05 level of a probability according to Duncan's multiple range test.
ADY nactive dry yest, SWE : seaweed extract , AH: humic acid