

EFFECT OF PLANT RESIDUALS, ORGANIC FERTILIZER AND SOME TREATMENTS THAT REDUCE SALINITY EFFECT ON GROWTH, YIELD AND QUALITY OF EGGPLANT (*Solanum melongea* L.)

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ABSTRACT

Two field experiments were carried out at a Farm in El-Mataryia district, Dakahlia Governorate during the two growing seasons of 2011 and 2012 to study the effect of organic fertilization and ammonium thiosulfate (ATS) levels that reduce salinity effect on vegetative growth, yield and its components and chemical constituents of eggplant crop Black Beauty cultivar. The experiments were carried out by using split – plots system in a randomized complete blocks design with three replications. The main plots were arranged with organic fertilization treatments. The sub plots were assigned to ammonium thiosulfate levels.

The obvious results of this investigation can be summarized as follows:

Using farmyard manure (FYM) and potassium humate (KH) treatments significantly increased all studied characters as compared with other organic fertilization treatments in both seasons. Application rice residues (RS) caused significant increases on all studied characters as compared with control treatment (without organic fertilization) in both seasons.

All studied characters were significantly influenced by different ATS levels in the both seasons. The highest values of these traits were resulted from using 30 L/fed and 40 L/fed of ATS, respectively in both seasons.

Generally, it could be recommended that using FYM or KH, respectively along with 30 L ATS/fed to enhance vegetative growth characters, yield and its components and chemical constituents of eggplant fruits. Also, it could be recommended that using RS combined with 30 L ATS/fed to enhance studied characters as compared with control treatment (without organic fertilization) and also to reduce sources of environmental pollution and maintain human health.

INTRODUCTION

Eggplant (*Solanum melongea* L.) is one of the oldest and popular vegetable crops in Egypt. It is cultivated for local consumption as well as for exportation. It is grown in most cultivated area in Egypt.

It is well known that high productivity of any crop is the final goal of many factors and operations. In addition, the pronounced role of the agronomical processes such as utilization of organic fertilizers (rice residues, farmyard manure and potassium humate) and ammonium thiosulfate levels are consider as important factors to reduce salinity effect on growth and yield of eggplant crop.

In general, soil optimum acidity (pH) for most vegetables cultivation is between 6.0 to 6.5. Eggplant is considered as a moderately sensitive crop to salinity (Bruria *et al.*, 1986).

Rice residues improved the physic - chemical and microbiological properties of saline soil. (Dileep *et al.* 2006).

Rice residues are important natural resource and recycling of these residues improves soil physical, chemical and biological properties (Mandal *et al.*, 2004 and Brar and Walia, 2010).

Soil pH is greatly influenced by addition of organic matter (OM) through different organic amendments (Walker *et al.*, 2004). Organic manures may increase soil fertility and thus the crop production potential possibly by changes in the soils physical and chemical properties including nutrient bioavailability, soil structure, water holding capacity, cation exchange capacity, reduce soil pH, microbial community and activity (Muhammad and Khattak, 2009). Bryan and Jeff (2003) revealed that the organic materials contain carbon, which serves as a food resource for soil organisms such as bacteria, algae, fungi and earthworms. They also found that increasing levels of soil humus has a number of benefits for plants which increased water and nutrient holding capacity, reserve of slow release nutrients, resistance to soil pH change and soil warmth. Furthermore, humic acid increased stimulation of plant growth due to hormones. Humic acid is particularly used to decrease the negative effects of chemical fertilizers and could have beneficial effect on nutrition of plants (Martinez *et al.*, 1983).

Ammonium thiosulfate is a standard product of the USA fluid fertilizer. Sales of ATS have steadily increased owing to its natural advantages; a) Compatibility with most fluid NPK sources. b) More rapid oxidation than elemental sources. c) Higher analysis than other fluid sulfur (S) sources. d) ATS can enhance micronutrient availability, alkaline soil, saline soil, slow soil urease, slow nitrification and improve the availability of phosphorus fertilizers (Goos, 1995).

Therefore, the aim of this investigation was to determine the effect of organic fertilizers (rice residues, farmyard manure and potassium humate) and ammonium thiosulfate (ATS) that reduce salinity effect on vegetative growth, yield and its components and chemical constituents of eggplant fruits. Also, the aim of this investigation was to reduce air pollution resulted from rice straw burning for maintain human health and reduce sources of environmental pollution.

MATERIALS AND METHODS

The present study was carried out during 2011 and 2012 seasons at a private Farm in El-Mataryia district, Dakahlia Governorate. The goal of these trials was to clarify the effect of organic fertilization and ammonium thiosulfate (ATS) levels on vegetative growth, yield and its components and chemical constituents of eggplant crop, Black Beauty cultivar.

The experimental layout was a split – plots system in a randomized complete blocks design with three replications. The main plots were arranged with four organic fertilization treatments as follows;

- 1- Without organic fertilization (control treatment).
- 2- Rice residues (RS) at the rate of 4 t/fed.
- 3- Farmyard manure (FYM) at the rate of 15 m³/fed.
- 4- Potassium humate (KH) 4.5 % at the rate 2 L/fed.

Rice residues (RS) and farmyard manure (FYM) were added to the experimental units before transplanting in the interior of ridges and then turned over via hack. Before that, samples of RS and FYM were taken to estimate its chemical analysis as shown in Table 1.

Table 1: Chemical analysis of RS and FYM during the two seasons.

Contents	Rice residues (RS)		Farmyard manure (FYM)	
	2011	2012	2011	2012
Organic matter (OM) %	44.30	42.60	35.20	36.10
C %	25.80	26.9	20.20	21.10
N %	1.09	1.07	1.32	1.41
C/N	23 : 7	23 : 2	15 : 5	14 : 8
P %	0.19	0.18	0.26	0.29
K %	0.14	0.13	0.16	0.15
pH (1 : 5)	4.90	4.80	6.10	6.20
EC (1 : 10)	5.10	5.20	4.20	4.10

The sub plots were assigned to ammonium thiosulfate (ATS 12 – 0 – 0 – 26 S) levels *i.e.* 0, 10, 20, 30 and 50 L/fed. Potassium humate (KH) 4.5 % and ammonium thiosulfate (ATS) were applied separately as follows; 25 % before transplanting, 25 % at 4 weeks after transplanting, 25 % at 8 weeks after transplanting and 25 % at 12 weeks after transplanting. The common recommended chemical fertilizers (N, P and K) rates (mineral) were carried out at the rate of 150 kg ammonium sulfate (20.5 % N), 250 kg calcium superphosphate (15.5 % P₂O₅) and 50 kg potassium sulfate (48.52 % K₂O). All doses of chemical fertilizers were applied as following; 30 % at 4 weeks after transplanting, 35 % at 8 weeks after transplanting and 35 % at 12 weeks after transplanting.

Each experimental unit contains 4 rows, 3.75 m long and 0.70 m width occupying an area of 10.5 m² (*i.e.* 1/400 feddan). The preceding winter crop was garlic (*Allium sativum* L.) in both seasons.

The experiments were carried out in a clay loam soil with medium fertility. Soil samples were taken at random from the experimental field area at a depth of 0 to 50 cm before soil preparation to measure the physical and chemical soil properties as shown in Table 2.

Table 2: Physical and chemical soil characteristics of the experimental sites during the two growing seasons.

Soil analysis	2011	2012	
A: Mechanical analysis			
Clay (%)	49.00	55.0	
Silt (%)	30.40	29.4	
Fine sand (%)	18.70	12.7	
Coarse sand (%)	1.90	2.89	
Texture class	Clay	Clay	
Organic matter (%)	1.14	2.91	
B: Chemical analyses			
pH (1 : 2.5)	8.12	8.11	
E.C. ds m ⁻¹ (1 : 5)	1.07	1.90	
Saturation percentage (SP %)	72.00	71.50	
Available N (ppm)	46.50	48.1	
Available P (ppm)	4.30	4.70	
Exchangeable K (ppm)	375	226	
Cations (meq/100 g soil)	Ca ⁺⁺	1.25	4.25
	Mg ⁺⁺	0.67	2.41
	Na ⁺	3.25	2.93
	K ⁺	0.31	0.16
Anions (meq/100 g soil)	CO ₃ ⁻⁻	-	-
	HCO ₃ ⁻	0.94	4.61
	Cl ⁻	2.66	2.73
	SO ₄ ⁻⁻	1.88	2.39

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Irrigation water was applied from El-Salam Canal. El Salam Canal water content of Nile river water and drainage water percentage (1:1). So, irrigation water was applied quality medium and saline water. So, irrigation water due to salinity of soil.

Table 3: Chemical analysis of the irrigation water of El-Salam Canal used in the experimental field during the two growing seasons.

Properties	2011	2012	
pH	8.22	8.12	
E.C. dS m ⁻¹	1.26	1.25	
Anions (meq L ⁻¹)	CO ₃ ⁻⁻	-	-
	HCO ₃ ⁻	2.30	2.40
	Cl ⁻	7.61	7.56
	SO ₄ ⁻⁻	2.89	2.87
Cations (meq L ⁻¹)	Ca ⁺⁺	3.38	3.36
	Mg ⁺⁺	2.98	2.99
	Na ⁺	6.30	6.40
	K ⁺	0.14	0.15
SAR	3.53	3.54	

* Soil and Water Analysis Institute, Mansoura Lab., Agricultural Research Center (ARC).

The experimental field was well prepared through three ploughings, compaction, leveling, ridging and then divided into the experimental units with dimensions as previously mentioned.

The transplanting was carried out during the first week of April in both seasons. The seedlings (45 days old) were sown on both sides of the ridges at 50 cm apart. The harvest was done after 90 days from transplanting at 45 days intervals in the both seasons of this study. The common agricultural practices for growing eggplant seedling according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Studied characters:

A- Vegetative Growth Characters:

At 65 days after transplanting a random sample of four guarded plants was taken from the inner rows of each sub plot to estimate plant vegetative growth characters as follows:

- 1- Plant height (cm).
- 2- Number of leaves/plant.
- 3- Leaves area/plant (cm²).
- 4- Fresh and dry weight of leaves.
- 5- Chlorophyll readings: It was measured by Minolta chlorophyll meter produced by Minolta Camera Co. LTD.

B- Yield and its Components:

The harvest was done after 90 days from transplanting at 45 days intervals (fruits were harvested all 5 days).

- 1- Early yield weight in t/fed (first 3 pickings).
- 2- Yield weight in t/fed (from the fourth picking till end of harvesting).
- 3- Total yield weight in t/fed (1 + 2).

Random samples of fruits at harvesting time (from the fourth picking) were taken from each sub-plot to determine the following traits:

- 1- Average fruit weight (g).
- 2- Average fruit diameter (cm).
- 3- Average fruit height (cm).
- 4- Fruit firmness (lb/m²).

C- Chemical Constituents:

Random samples of fruits at harvesting time (from the fourth picking) were taken from each sub-plot to determine the following traits:

- 1- **Total nitrogen (%)** was determined according to the method described by Pregle (1945) using micro-Kjeldahl.
- 2- **Total phosphorus (%)** was determined colorimetrically using the chlorostannous reduce molybdo phosphoric blue clour method in sulphoric system as described by Jackson (1967).
- 3- **Potassium (%)** was determined using a flame photometer according to Black (1965).
- 4- **Nitrate and nitrite contents** were extracted by 2 % acetic acid using of N-1 naphthyle ethylene diamine dihydrochlorid as an indicator. A pinkish colour intensity of the filtrate was measured by a spectrophotometer at wave length 540 n.m according to the method described by Singh (1988).
- 5- **Total soluble solids (TSS %)** was estimated using Gali 110 refractometer as Brown and Zerban (1938).
- 6- **Ascorbic acid (Vitamin C)** was determined by titration with 2.6 dichlorophenol blue dye according to the method reported in A.O.A.C. (1990).
- 7- **Total iron** was measured in the digested plant samples using an Atomic Absorption spectrophotometer according to Chapman and Pratt (1961).

8- Dry matter and moisture %.

All data of this study were statistically analyzed according to the technique of variance (ANOVA) for the split-plot design as published by Gomez and Gomez (1984) using "MSTAT-C" Computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Effect of organic fertilization treatments:

As shown from data in Table 4, rice residues (RS) application caused significant increases on plant height, number of leaves/plant, plant leaf area, fresh weight of leaves, dry weight of leaves, total chlorophyll, N, P and K percentages in eggplant leaves as compared with control treatment (without organic fertilization) in both seasons of this study. Plant height, number of leaves/plant, plant leaf area, fresh weight of leaves, dry weight of leaves, total chlorophyll, N, P and K percentages in eggplant leaves were significantly increased by using farmyard manure (FYM) and potassium humate (KH) treatments, respectively as compared with other organic fertilization treatments in both seasons of this study.

Application of rice residues (RS) caused significant increases on early yield weight, yield weight, total yield weight, fruit weight, diameter, height and firmness as compared with control treatment (without organic fertilization) in both seasons of this study as shown from data in Table 5. Early yield weight, yield weight, total yield weight, fruit weight, diameter, height and firmness of eggplant were significantly increased by using farmyard manure (FYM) and potassium humate (KH) treatments, respectively as compared with other organic fertilization treatments in both seasons of this study.

As shown from data in Tables 6 and 7, using rice residues (RS) caused significant increases on N, P, K, NO₃, NO₂, TSS, vitamin C, Fe, dry matter and moisture percentages in eggplant fruits as compared with control treatment (without organic fertilization) in both growing seasons. N, P, K, NO₃, NO₂, TSS, vitamin C, Fe, dry matter and moisture percentages in eggplant fruits were significantly increased by using farmyard manure (FYM) and potassium humate (KH) treatments, respectively as compared with other organic fertilization treatments in both seasons of this study.

These results may be due to applying rice residues improved the physical, chemical and microbiological properties of saline soil as mentioned by Dileep *et al.* (2006). The obtained results are in accordance with those reported by Ali (2011).

The enhancing effects of FYM treatment may be due to the fact that organic manures are valuable source of many fertilizers and essential macro and micronutrients to plants and serves as a good natural soil texture conditioner being rich in organic matter (Mishref *et al.*, 2000). The obtained results are in accordance with those documented by Suge *et al.* (2011).

The enhancing effect of KH treatment may be due to potassium humate which increased stimulation of plant growth due to hormones and could have beneficial effect on nutrition of plants (Martinez *et al.*, 1983). The obtained results are in accordance with those of Selim *et al.* (2009) and Azarpour *et al.* (2012).

2- Effect of ammonium thiosulfate (ATS) levels:

Plant height, number of leaves/plant, plant leaf area, fresh weight of leaves, dry weight of leaves, total chlorophyll, N, P and K percentages in eggplant leaves were significantly influenced by different ATS levels in the two growing seasons of this study as shown from data in Table 4. The highest values of these traits were resulted from using 30 L/fed, 40 L/fed, 20 L/fed and 10 L/fed of ATS, respectively in both seasons of this study.

Early yield weight, yield weight, total yield weight, fruit weight, diameter, height and firmness of eggplant were significantly influenced by different ATS levels in the two growing seasons as shown from data in Table 5. The highest values of these traits were resulted from using 30 L/fed and 40 L/fed of ATS, respectively in both seasons of this study.

N, P, K, NO₃, NO₂, TSS, vitamin C, Fe, dry matter and moisture percentages in eggplant fruits were significantly influenced by different ATS levels in the two growing seasons of this study as shown from data in Tables 6 and 7. The highest values of these traits were resulted from using 30 L/fed and 40 L/fed of ATS, respectively in both experiments.

The results may be due to ATS can enhanced micronutrients availability of saline soil and improved the availability of phosphorus fertilizers (Goos,1995) as well as enhanced micronutrients availability and soil pH change due to it was content of S and SO₄. Similar results were reported by Wilson *et al.* (2011), Zadavec (2011) and Seehuber *et al.* (2012).

3- Effect of the interaction between organic fertilization treatments and ammonium thiosulfate levels:

The interaction between organic fertilization treatments and ammonium thiosulfate levels had a significant effect on most studied characters as shown from data in Tables 4, 5, 6 and 7. We have enough reported the significant interaction between organic fertilization treatments and ammonium thiosulfate levels on early yield weight, yield weight, total yield weight of eggplant. The favourable interaction treatments of organic fertilization treatments and ammonium thiosulfate levels on yields was using FYM and KH, respectively with 30 L/fed of ATS in both seasons of this study (Tables 8, 9 and 10). These results may be due to the role of organic manure which enhanced physico – chemical and biological characteristics of soils also the role of ATS which it was enhanced micronutrient availability of saline soil and improved pH of soil.

Table 8: Early yield weight (first 3 pickings) of eggplant as affected by the interaction between organic fertilization and ammonium thiosulfate levels during 2011 and 2012 seasons.

Organic fertilization	ATS levels				
	0 L/fed	10 L/fed	20 L/fed	30 L/fed	40 L/fed
2011 season					
Without (control)	1.643	1.748	1.860	2.040	2.081
RS (4 t/fed)	2.107	2.171	2.314	2.544	2.418
FYM (15 m ³ /fed)	2.637	2.763	2.870	3.138	3.064
KH (2 L/fed)	2.341	2.451	2.543	2.719	2.657
F. test	*				
LSD (5 %)	0.152				
2012 season					
Without (control)	1.61	1.70	1.81	2.09	2.53
RS (4 t/fed)	2.04	2.15	2.25	2.43	2.38
FYM (15 m ³ /fed)	2.68	2.80	2.84	3.09	3.01
KH (2 L/fed)	2.25	2.51	2.55	2.73	2.59
F. test	*				
LSD (5 %)	0.163				

RS = Rice residues FYM = farmyard manure KH = Potassium humate
 ATS = Ammonium thiosulfate (12 – 0 – 0 – 26 NPKS)

Table 9: Yield weight (from the fourth picking till end of harvesting) of eggplant as affected by the interaction between organic fertilization and ammonium thiosulfate levels during 2011 and 2012 seasons.

Organic fertilization	ATS levels				
	0 L/fed	10 L/fed	20 L/fed	30 L/fed	40 L/fed
2011 season					
Without (control)	3.546	3.762	3.968	4.376	4.157
RS (4 t/fed)	4.210	3.638	4.925	5.354	5.132
FYM (15 m ³ /fed)	5.569	5.821	6.035	6.247	6.157
KH (2 L/fed)	4.978	5.199	5.383	5.733	5.610
F. test	*				
LSD (5 %)	0.145				
2012 season					
Without (control)	3.534	3.708	3.930	4.189	4.256
RS (4 t/fed)	4.346	4.599	4.797	5.170	5.033
FYM (15 m ³ /fed)	5.635	5.903	5.983	6.191	6.024
KH (2 L/fed)	4.803	5.023	5.406	5.769	5.648
F. test	*				
LSD (5 %)	0.100				

RS = Rice residues FYM = farmyard manure KH = Potassium humate
 ATS = Ammonium thiosulfate (12 – 0 – 0 – 26 NPKS)

Table 10: Total yield of early yield and yield weight of eggplant as affected by the interaction between organic fertilization and ammonium thiosulfate levels during 2011 and 2012 seasons.

Organic fertilization	ATS levels				
	0 L/fed	10 L/fed	20 L/fed	30 L/fed	40 L/fed
2011 season					
Without (control)	5.189	5.510	5.828	6.416	6.238
RS (4 t/fed)	6.317	5.809	7.239	7.898	7.550
FYM (15 m ³ /fed)	8.206	8.584	8.905	9.385	9.221
KH (2 L/fed)	7.319	7.650	7.926	8.452	8.267
F. test	*				
LSD (5 %)	0.160				
2012 season					
Without (control)	5.153	5.415	5.747	6.286	6.793
RS (4 t/fed)	6.388	6.750	7.047	7.607	7.416
FYM (15 m ³ /fed)	8.319	8.706	8.827	9.289	9.038
KH (2 L/fed)	7.056	7.537	7.963	8.506	8.245
F. test	*				
LSD (5 %)	0.175				

RS = Rice residues FYM = farmyard manure KH = Potassium humate
 ATS = Ammonium thiosulfate (12 – 0 – 0 – 26 NPKS)

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تأثير المخلفات النباتية والسماذ العضوي وبعض المعاملات التي تقلل من تأثير الملوحة على النمو والمحصول والجودة في نبت الباذنجان
هالة عبد الغفار السيد * ، عابدة محمد عبد الرحيم * ، السيد إبراهيم الجميلي ** و التميمي السيد محمد إسماعيل**
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يهدف هذا البحث إلى دراسة تأثير الأسمدة العضوية (مخلفات قش الأرز ، السماذ البلدي وهيومات البوتاسيوم) وثيوسلفات الأمونيوم لخفض تأثير الملوحة على النمو الخضري والمحصول ومكوناته والمحتوى الكيماوي لثمار الباذنجان وذلك تحت الظروف البيئية لمركز المطرية – محافظة الدقهلية. كما يهدف هذا البحث أيضاً إلى خفض التلوث الهوائي الناتج عن حرق قش الأرز وذلك للحفاظ على صحة الإنسان وخفض مصادر تلوث البيئة. لذلك نفذت تجربتان حقليتان بمزرعة خاصة بمركز المطرية - محافظة الدقهلية خلال موسمي 2011 و 2012. نفذت التجارب في تصميم القطع المنشقة مرة واحدة في ثلاث مكررات. حيث اشتملت القطع الرئيسية على معاملات للتسميد العضوي ، بينما اجتوت القطع المنشقة على مستويات من ثيوسلفات الأمونيوم ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:
وجد أن إضافة مخلفات قش الأرز أدت إلى زيادة معنوية في جميع الصفات تحت الدراسة مقارنةً بمعاملة الكنترول في كلا موسمي الزراعة. كذلك وجد أن جميع الصفات تحت الدراسة قد زادت معنوياً باستخدام السماذ البلدي وهيومات البوتاسيوم على التوالي مقارنةً بمعاملات التسميد العضوي الأخرى في كلا موسمي الزراعة.

وجد أن جميع الصفات تحت الدراسة قد تأثرت معنوياً بمستويات سماذ ثيوسلفات الأمونيوم وكانت أعلى القيم لتلك الصفات عند استعمال 30 لتر ثيوسلفات الأمونيوم/فدان في كلا موسمي الزراعة. عموماً من النتائج المتحصل عليها في هذه الدراسة يمكن التوصية بالتسميد العضوي لمحصول الباذنجان بالسماذ البلدي أو هيومات البوتاسيوم مع استعمال سماذ ثيوسلفات الأمونيوم بمعدل 30 لتر/فدان لتحسين صفات النمو الخضري والحصول على أعلى محصول كلي وأفضل صفات للمحتوى الكيماوي للثمار. كما يمكن التوصية أيضاً بالتسميد العضوي لمحصول الباذنجان بمخلفات قش الأرز مع استعمال سماذ ثيوسلفات الأمونيوم بمعدل 30 لتر/فدان لتحسين صفات النمو الخضري والمحصول ومكوناته وكذلك المحتوى الكيماوي للثمار مقارنةً بمعاملة الكنترول (بدون تسميد عضوي).

قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة
كلية الزراعة – جامعة الاسكندرية

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Table 4: Plant height, number of leaves/plant, leaves area/plant, fresh and dry weight of leaves and total chlorophyll of eggplant after 65 days after transplanting as affected by organic fertilization and ammonium thiosulfate levels as well as their interaction during 2011 and 2012 seasons.

Characters Treatments	Plant height (cm)		Number of leaves/plant		Leaves area/plant (cm ²)		Fresh weight of leaves (g)		Dry weight of leaves (g)		Total Chlorophyll (SPAD)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Organic fertilization:												
Without (control)	64.76	64.47	31.57	32.14	79.20	79.58	84.23	85.84	13.19	14.32	73.86	73.89
RS (4 t/fed)	66.24	67.01	32.98	33.92	83.37	83.18	94.88	95.95	14.33	14.81	74.70	74.79
FYM (15 m ³ /fed)	75.35	77.01	39.60	40.09	94.91	96.00	134.24	137.06	19.90	20.33	75.40	75.52
KH (2 L/fed)	73.95	73.40	36.05	37.61	93.12	93.59	123.01	125.19	17.85	18.34	74.77	74.78
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.50	0.64	0.77	0.92	0.62	0.37	1.17	0.84	0.55	0.40	0.28	0.23
B- ATS levels:												
0 L/fed (control)	62.08	63.79	30.43	31.59	83.88	84.16	99.01	101.01	15.02	15.49	73.60	73.72
10 L/fed	67.57	68.41	32.80	34.00	86.49	86.85	104.25	106.29	15.60	16.24	74.19	74.24
20 L/fed	70.56	70.30	35.64	35.99	87.35	88.05	110.41	112.03	16.30	16.77	74.75	74.78
30 L/fed	76.90	76.87	39.07	40.16	91.19	91.83	117.75	119.73	17.86	18.55	75.86	75.90
40 L/fed	73.27	73.00	37.31	37.96	89.35	89.55	114.01	115.99	16.81	17.70	75.03	75.09
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.72	0.53	0.49	1.08	0.60	0.45	1.28	0.97	0.36	0.32	0.26	0.20
C- Interaction: AxB	*	*	*	*	*	*	*	*	*	*	NS	NS

RS = Rice residues FYM = farmyard manure KH = Potassium humate

ATS = Ammonium thiosulfate (12 – 0 – 0 – 26 NPKS)

Table 5: Early yield weight (first 3 pickings), yield weight (from the fourth picking till end of harvesting), total yield of early yield and yield weight, fruit weight, diameter, height and firmness of eggplant as affected by organic fertilization and ammonium thiosulfate levels as well as their interaction during 2011 and 2012 seasons.

Characters Treatments	Early yield weight (t/fed)		Yield weight (t/fed)		Total yield (t/fed)		Fruit weight (g)		Fruit diameter (cm)		Fruit height (cm)		Fruit firmness (lb/m ²)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Organic fertilization:														
Without (control)	1.874	1.955	3.962	3.923	5.836	5.879	209.5	210.0	8.76	8.92	15.81	9.76	62.83	62.19
RS (4 t/fed)	2.311	2.253	4.652	4.789	6.963	7.042	253.0	256.7	9.70	9.86	10.63	10.88	60.59	59.26
FYM (15 m ³ /fed)	2.894	2.889	5.966	5.947	8.860	8.836	358.9	364.9	10.46	10.63	11.65	11.97	55.31	54.02
KH (2 L/fed)	2.542	4.132	5.381	5.330	7.923	9.461	303.1	311.1	10.00	10.18	11.20	11.48	56.84	55.31
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.115	0.124	0.137	0.101	0.136	0.213	3.9	2.6	0.10	0.04	0.23	0.06	0.12	0.03
B- ATS levels:														
0 L/fed (control)	2.182	2.150	4.576	4.580	6.758	6.729	231.0	235.7	8.82	9.03	9.98	10.24	61.22	60.05
10 L/fed	2.283	2.294	4.605	4.808	6.888	7.102	253.3	257.4	9.27	9.47	10.35	10.60	60.22	58.73
20 L/fed	2.397	2.367	5.078	5.029	7.475	7.396	286.5	285.9	9.84	10.00	10.81	11.03	59.13	57.48
30 L/fed	2.610	2.592	5.427	5.330	8.038	7.922	329.0	336.9	10.55	10.67	11.62	11.84	57.00	56.05
40 L/fed	2.555	4.633	5.264	5.240	7.819	9.873	305.8	312.5	10.17	10.30	18.85	11.40	56.90	56.16
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.124	0.142	0.124	0.110	0.123	0.241	4.7	2.2	0.14	0.05	0.38	0.05	0.18	0.04
C- Interaction: AxB	*	*	*	*	*	*	*	*	*	*	NS	*	*	*

RS = Rice residues FYM = farmyard manure KH = Potassium humate ATS = Ammonium thiosulfate (12 – 0 – 0 – 26 NPKS)

Table 6: Nitrogen, phosphorus, potassium percentages, nitrate (NO₃) and nitrite (NO₂) contents in eggplant fruits at harvesting time as affected by organic fertilization and ammonium thiosulfate levels as well as their interaction during 2011 and 2012 seasons.

Characters Treatments	N (%)		P (%)		K (%)		NO ₃ (ppm)		NO ₂ (ppm)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Organic fertilization:										
Without (control)	2.20	2.15	0.270	0.269	2.44	2.44	32.57	32.53	0.653	0.644
RS (4 t/fed)	2.42	2.40	0.285	0.285	2.62	2.61	35.81	35.40	0.723	0.712
FYM (15 m ³ /fed)	2.84	2.84	0.302	0.303	2.70	2.71	41.92	41.15	0.841	0.831
KH (2 L/fed)	2.60	2.58	0.321	0.319	2.84	2.83	38.38	38.23	0.771	0.756
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.01	0.01	0.001	0.001	0.02	0.01	0.77	1.04	0.001	0.006
B- ATS levels:										
0 L/fed (control)	2.27	2.25	0.260	0.260	2.53	2.50	33.40	33.25	0.672	0.662
10 L/fed	2.40	2.38	0.280	0.278	2.59	2.60	35.68	34.87	0.709	0.700
20 L/fed	2.54	2.50	0.299	0.298	2.66	2.64	37.31	37.10	0.752	0.739
30 L/fed	2.72	2.71	0.321	0.323	2.75	2.76	40.07	39.78	0.809	0.799
40 L/fed	2.66	2.62	0.314	0.310	2.74	2.73	39.39	39.13	0.792	0.778
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.03	0.03	0.002	0.002	0.03	0.03	1.17	1.36	0.002	0.016
C- Interaction: AxB	*	*	*	*	NS	NS	NS	NS	NS	NS

RS = Rice residues FYM = farmyard manure KH = Potassium humate
 ATS = Ammonium thiosulfate (12 - 0 - 0 - 26 NPKS)

Table 7: Total soluble solids (TSS %), ascorbic acid (Vitamin C), total iron (Fe) contents, dry matter and moisture percentages in eggplant fruits at harvesting time as affected by organic fertilization and ammonium thiosulfate levels as well as their interaction during 2011 and 2012 seasons.

Characters Treatments	TSS (%)		Vitamin C (mg/100 g)		Fe (ppm)		Dry matter (%)		Moisture (%)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Organic fertilization:										
Without (control)	4.38	4.36	8.30	8.30	27.48	27.33	4.74	4.76	95.25	95.23
RS (4 t/fed)	4.66	4.65	9.76	9.77	31.19	30.66	4.97	4.98	95.03	95.01
FYM (15 m ³ /fed)	5.22	5.20	12.45	12.46	34.80	34.46	5.44	5.46	94.55	94.53
KH (2 L/fed)	4.94	4.93	11.25	11.29	37.40	37.01	5.14	5.17	94.85	94.82
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.02	0.01	0.03	0.05	0.44	0.33	0.01	0.01	0.01	0.01
B- ATS levels:										
0 L/fed (control)	4.58	4.55	9.70	9.73	29.33	29.19	4.86	4.87	95.13	95.12
10 L/fed	4.68	4.67	9.99	9.95	31.03	30.62	4.96	4.98	95.03	95.01
20 L/fed	4.81	4.80	10.35	10.39	32.73	32.41	5.09	5.10	94.90	94.89
30 L/fed	4.99	4.97	11.19	11.18	35.57	35.76	5.27	5.29	94.72	94.70
40 L/fed	4.94	4.93	10.98	11.02	34.93	33.84	5.19	5.21	94.80	94.78
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.01	0.04	0.18	0.12	1.48	1.38	0.03	0.04	0.03	0.04
C- Interaction: AxB	*	*	NS	NS	NS	NS	*	*	*	*

RS = Rice residues FYM = farmyard manure KH = Potassium humate ATS = Ammonium thiosulfate (12 - 0 - 0 - 26 NPKS)