J. Agric. Sci. Mansoura Univ., 30 (10): 6317 - 6324, 2005

EFFECT OF ALLYL DISULFIDE FROM ESSENTIAL OIL OF GARLIC ON ADULTS OF FOUR SPECIES OF STORED GRAIN INSECTS, *Callosobruchus chinensis* (L.), *Callosobruchus maculatus* (F.), *Tribolium castaneum* (HBST.) AND *Sitophilus oryzae (L.)* .

Swidan, M. H.
Department of Biological and Geological Sciences, Faculty of Education, Alexandria University, Alexandria, Egypt .

ABSTRACT

Allyl disulfide, a major constituent of the essential oil garlic, *Allium sativum,* was tested against *Callosobruchus chinensis* (L.), *C. maculatus* (F.), *Tribolium castaneum* (Hbst.) and *Sitophilus oryzae* (L.) for fumigant and contact toxicity . The study revealed that allyl disulfide was more toxic to *C. chinesis* than the other insects in both fumigant and contact toxicity. The LC50 values of fumigant toxicity were 0.64, 0.63, 0.46 and 3.75µL/Lair for *C. chinensis*, *T.castaneum* and *S. oryzae,* respectively. As for the contact toxicity, which was performed using topical application, the LD50 values were 22.1, 22.8, 24.2 and 94.0 ppm /insect for *C. chinensis, C. maculatus*, *T.castaneum* and *S. oryzae,* respectively.

Keywords: allyl disulfide, fumigant toxicity, contact toxicity. stored grain insects.

INTRODUCTION

Since antiquity, plants and plant products have been shown to display not only their pharmacological benefits but other biological properties including pesticidal activities. Among these interesting plants *Alliums* pp show pesticidal effects (Golob *et al.*1999) most often linked to volatile substances derived from sulfur amino acids.

When cell membranes are ruptured the amino acids, S-alk(en)y-cysteine sulfoxides , come into contact with alliinase enzymes present in unstable (Lancaster *et al.*1981). S-alk(en)yl-cysteine sulfoxide are then cleaved to produce alk(en)yl sulphenic acids that rearrange to from vestibule thiosulfinates in all *Allium* spp. (Block *et al.*1992).

Depending on break down conditions diallyl thiosulfinate, the main thiosulfinate from garlic is transformed into 66% disulfide, 14% monosulfide and 9% trisulfide along with various proportions of thiosulfonate, vinyldithiines and ajoene (Block *et al.*1984).

The secondary substances of *Allium sativum* have been studied for thier pesticidal effects. Sulfur compounds in *Allium* have been shown to have not only insecticidal, acaricidal, nematicidal, herbicidal, fungicidal and bactericidal effects, but also repellents against arthropods (Auger *et al.* 2004).

Few studies had been done on the toxic effect of the constituents of garlic on stored grain insects. Chiam *et al.* (1999) tested the effect of allyl disulfide on adults and larvae of *T. castaneum* and adults of *S. zeamais* . They found that allyl disulfide had adultcide, ovicide and larvicide effect towards *T. castaneum* and *S. zeamaiz*. Huang *et al.* (2000) found that methyl allyl disulfide and diallyl trisulfide has toxic effect towards *S. zeamais* and *T.*

castaneum. Koul (2004) found that sulfur compounds had toxic and deterrent effect towards adults of *S. oryzae* and *T. castaneum*.

Based on the results of the various workers on the bioactivity of garlic constituents on storedgrain insects, the present study was conducted to evaluate the contact and fumigant toxicity of allyl disulfide, a major volatile component from garlic essential oil on adults of *Callosobruchus chinensis, C. maculatus, T. castaneum* and *S. oryzae*.

MATERIALS AND METHODS

A: Insects:

Stock cultures of the tested insects were maintained at the laboratories of Faculty of Education, Alexandria University since 1997. *C. chinensis* and *C. maculatus* were reared using the procedure described by Strong *et al.* (1968). *S.oryzae* and *T. castaneum* were reared according to the FAO method (1974).

B: Chemical:

Allyl disulfide (80% purity) was purchased from Sigma-Aldrich-Inc., U.S.A. The chemical was diluted with analytical reagent acetone to prepare the desired concentrations.

C: Bioassay:

(I) Fumigant toxicity:

In order to test the fumigant toxicity of allyl disulfide on the tested insects, gastight glass jars of 500 ml volume with screwed metallic caps were used as exposure chambers.

A Watman No. 1 filter paper (2.0 cm diameter) was glued on the underside of the cap and impregnated with aliquots of 25 µl of allyl disulfide in acetone; 25 µl of acetone alone was applied to controls. The solvent was allowed to evaporate for 2 minuets and the cap containig the treated filter paper was screwed tightly onto the glass jars containing 40 adult of each tested insects(12-24 hour old for *C. chinensis,C.maculatus* and 7-10 days old for *T. castaneum* and *S. oryzae*) . Three replicates were setup for each of the tested five concentrations of allyl disulfide and the control. Glass jars were then kept in incubator at 30 ± l°C and 45-55% R H. Mortality was assessed by immobility of the insects and habits charecteristic of death. Immobile insects were exposed to the influence of gentle heat from a 20 W halogen lamb to further assess mortality.

(II) Contact toxicity

A series of dilutions of allyl disulfide was prepared using analytical reagent acetone as a solvent. Adults of the tested insects (12-24 hours old for *C. chinensis* and *C. maculatus* and 7-10 days old for *T. castaneum* and *S. oryzae*) were anthesized on crushed ice, then they were treated topically with 1 µl of an acetonic solution of allyl disulfide on the thoracic dorsum of the tested insects using micro applicator. Solvent was allowed to evaporate for 2 minuts. Five concentrations of allyl disulfide were tested. Control insects were treated with acetone alone. After treatment, insects were transferred to 5 cm Petri dishes and kept in incubator at 30 ± l°C and 45- 55% RH. Twenty insects were used for each concentration of allyl disulfide and the control group, respectively.

Each concentration was repeated six times. Mortality was recorded 24, 48, 72 and 96 hours after treatment. Mortality was assessed by immobility of the insects and habits characteristic of death. Immobile insects were exposed to the influence of gentle heat from a 20 W halogen lamp to futher assess mortality.

D: Statistical analysis:

Percent mortality was transformed to the angular scale for analysis of variance (ANOVA) as given by Steel and Torrie (1980), and the analysis was done using SAS program (SAS,1985).Treatment means were compared using FLSD 0.5 (Fishers least significant difference). Data obtained from the various dose- response bioassays were subjected to probit analysis to estimate LD50, LC90, LC50, and LD90 of allyl disulfide, (Finny, 1971).

RESULTS

Table 1and figure 1(a, b) show the fumigant toxic effect of allyl disulfide towords *C. chinensis, C. maculatus, T. castaneum* and *S. oryzae* adults. The table shows that at the concentration 3.2 µL/L of allyl disulfide, the mean mortality percents were 93.8, 89.6 and 86.3 for *C. chinensis, C. maculatus* and *T. castaneum* adults, respectively. At the concentration 30 µL/L the mean mortality percent for *S. oryzae* was 88.3. Table 1 also shows that at concentratio of 1.6 µL/L of allyl disulfide, the mean percents of mortality were 65.2, 81.9 and 63.1 for *C. chinensis, C. maculatus* and *T. castaneum* , respectively. At concentration 20 µL/L air the mean mortality percent was 88.1 for *S. oryzae*. At concentration 0.8 µL/L of allyl disulfide, the mean mortality percents were 19.4 for *C. chinensis* and 63.1 and 43.1 for *C. maculatus* and *T. castaneum*, respectively. 62.7 % mortality was achived when *S. oryzae* was fumigated with 10 µL/L air of allay1 disulfide. Table 1 also shows that the mean percent of mortality was gradually declained when the tested insects were fumigated with 0.4, 0.2, 5 and 2 µL/L of allay1 disulfide, respectively.

Table 1: Mean mortality percentage for *C. chinensis, C. maculatus, T. castaneum* and *S. oryzae* after fumigation with different concentrations of allyl disulfide.

Concentrations µL/L air	Mean percent of insect mortality				
	C. chinensis	*C. maculatus*	*T. castaneu*	Concentrations µL/L air	*S. oryzae*
Control	0.0^{e}	0.0^{e}	0.4^{e}	Control	0.0^{e}
0. 2	4.2^{e}	11.0^{d}	8.8^{c}	2	21.3^{d}
0.4	14.8^{cd}	26.4^{c}	14.2^{c}	4	41.7^{c}
0.8	19.4^{c}	63.1^{b}	43.1^{c}	10	62.7^{b}
1.6	65.2^{b}	81.9^{a}	63.1^{b}	20	88.1^{a}
3.2	93.8^{a}	89.6^{a}	86.3^{a}	30	88.3^{a}

Means having the same letter are not significantly different according to FLSD .05 performed on the angular scale.

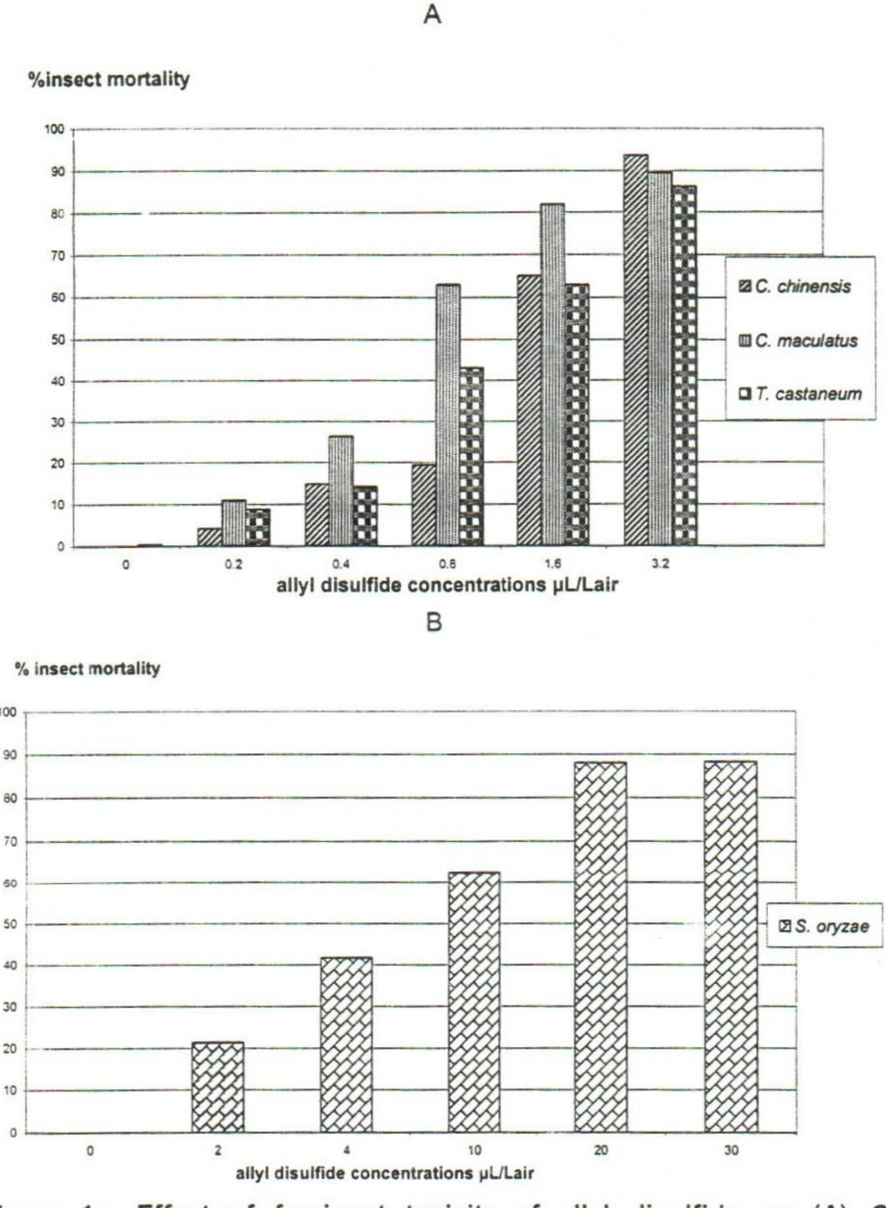

Figure 1a: Effect of fumigant toxicity of allyl disulfide on (A) *C. chinensis, C. maculates* , *T. castaneum* and (B) on *S. oryzae*

Table 2 and figure2 (a, b) shows the mean mortality percents for *C. chinensis*, *C. maculatus, T. castaeum* and *S. oryzae* after topical application with different concentrations of allay disulfide. It is clearly seen from the table that there is significant differences in the mean mortality percent for *C. chinensis* due to treatment with 50 and 40 ppm/insect of ally1 disulfide, respectively. No significant difference is observed in the mean mortality percent for *C. maculates* and *T. castaneum* after treatment with the same concentration. The table also shows that there is no significant difference in the mean mortality percent for *C. chinensis, C.maculatus* and *T.castaneum* after topical application with 30 and 20 ppm/insect of allyl disulfide. Their is a significant difference in the mean mortality percent for *C. chinensis* and *C. maculatus* after topical application with 10 ppm/insect of allyl disulfide and the control group. No significant difference is observed in the mean mortality percent for *C. castaneum* after treatment with the aforementioned concentration and the control group.

Table 2: Mean mortality percentage for *C. chinensis, C. maculatus, T. castaneum* and *S. oryzae* after topical application with different concentrations of allyl disulfide.

Concentrations (ppm/insect)	Mean percent of insect mortality				
	C. chinensis	*C. maculatus*	*T. castaneum*	Concentrations (ppm/insect)	*S. oryzae*
Control	0.8[d]	1.3[e]	1.7[d]	Control	0.5[e]
10	12.9[c]	7.9[d]	2.1[d]	50	15.3[d]
20	17.9[c]	22.1[c]	16.7[c]	100	33.0[c]
30	33.8[b]	36.7[b]	42.5[b]	200	58.8[b]
40	42.5[b]	71.3[a]	76.5[a]	300	88.3[b]
50	81.7[a]	82.9[a]	81.7[a]	400	88.8[a]

Means having the same letter are not significantly different according to FLSD .05 performed on the angular scale.

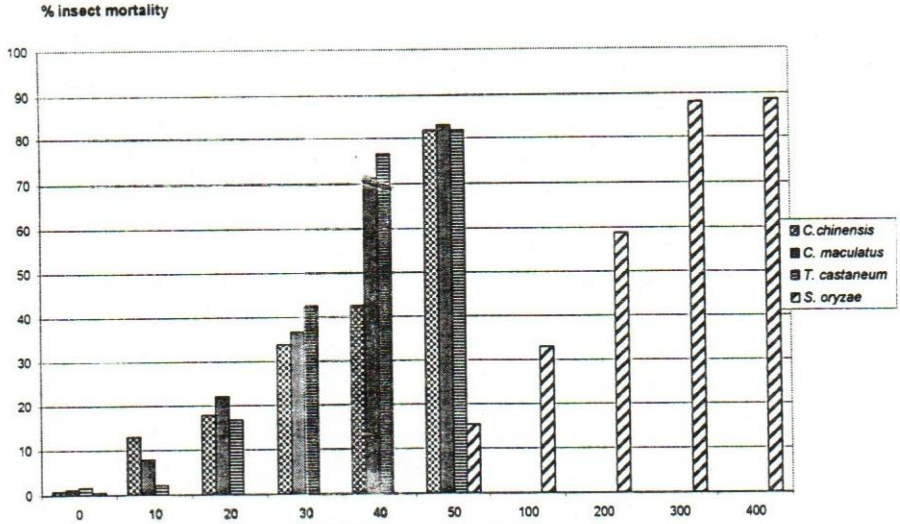

Figure 2: effect of topical application of allyl disulfid on *C. chinensis* , *C. maculates T. castaneum* and *S.aryzae* .

Effect of topical application of allyl disulfide on *S. oryzae* adult is also represented in table 2. As seen from the table, no significant difference is observed in the mean mortality percent for *S.oryzae* after treatment with 400 and 300 ppm/insect of allyl disulfide, respectively. Significant differences were observed in the mean mortality percent for *S. oryzae* between 200 and 100 ppm/insect of allyl disulfide and between 50 ppm/insect and the control group.

Table 3 shows the LC50, LC 90 values of fumigant toxicity and LD 50,LD 90 values of contact toxicity of allyl disulfide for *C.chinensis, C. maculatus, T. castaneum* and *S.oryzae* adults. It is seen that *C.chinensis* adults are more sensitive to the fumigant and contact toxicity of allyl disulfide exhibiting LC50 and LD50 values of 0.46 µL/Lair-and 22.1 ppm, respectively. *C.maulatus* and *T. castanum* adults responded, more or less, equally to the fumigant and contact toxicity of allyl disulfide. *S. oryzae* was the most tolerant insect towards the tested compound.

Table 3: LC_{50}, and LC_{90} values of fumigant toxicity and LD_{50}, LD_{90} values of contact toxicity of allyl disulfide for *C. chinensis, C. maculatus, T. castaneum* and *S. oryzae*. adults.

Tested insect	Fumigant toxicity (µL/Lair)		Contact toxicity (ppm/insect)	
	LC_{50}	LC_{90}	LD_{50}	LD_{90}
C. chinensis	0.46	1.31	22.1	38.8
C. maculatus	0.63	1.14	22.8	41.3
T. castaneum	0.64	1.94	24.2	48.1
S. oryzae	3.75	12.65	94.0	244

DISCUSSION

Most contact toxicity tests have bee carried out using the filter paper impregation technique, which simulates filed conditions. The advantage of the topical application technique, however, is that the actual dose cousing mortality in the different species or different life stages of a single species can be determined and compared. In The present study, allyl disulfide when applied topially was found to be more effective against *C. chinensis* adult followed by *C. maculatus, T. castaneum* and *S. oryzae* .*S oryzae* was more tolerent to allyl disulfide . Similar results were obtained by Chiam *et al.* (1999) in whit *T. castaneum* was found to be more sensitive to the toxic effect of allyl disulfide than *S. zeamais* adults.

Toxicity of sulfur compounds to insects had been reported by several authors. Di-n-propyl disulfide were shown to be larvicidal to *Aedes aegypti* Linnaeus (yellowfever mosquito), *Heliothis Virescens* (Fabricius) (tobacco budworm) and *Helicoverpa zea* (Boddie) (Corn earworm) (Balandrin *et al.* 1988). Dugravot *et al.* (2003) reported that sulfur compounds has toxic effect on *C. maculatus* and its parasitoid *Dinarmus basalis* .

Koul (2004) reported that Di-n-propyl disulfide and diallyl disulfide have toxic and deterrents effect on *S.oryzae* and *T. castaneum* adults. He added that both compounds were more toxic to *T. castaneum* when compared with *S.oryzae*.

Huang et. al. (2000) tested the contact and fumigant toxicity of methyl allyl disulfide and diallyl trisulfide (major constituents of essential oil of garlic) on *S. zeamaiz* and *T.castaneum.* They found That the tested compounds were more toxic to *T. castaneum* adults than to *S. zeamais* adults . Auger *et al.* (2004) tested the toxicity of 3 sulfur compounds from garlic oil on the termites *Reticulitermes santonensis* and *R. grassei.* Tested compounds were dimethyl disulfide, dipropyl disulfide and diallyl disulfide. They found that *R. grassei* was more sevsitive to the effect of each disulfide than *R. santonensis.*

The insecticidal effect of sulfur compounds requires knowledge of their toxic mode of action. Dugravot et. al. (2003) suggested that sulfur compounds could inhibit the mitochondrial respiratory chain with the target being the cytochrome oxidase .

In conclusion, sulfur compounds from plants exhibited great insecticidal activities with potential application in crop protection. They are of interest because they could become an alternative of natural origin, rather than conventional synthetic compounds and even a replacement of methyl bromide. To complete the knowledge of insecticidal effects of sulfur compounds, futher studies on stored product insects have to be performed.

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تأثير ثنائي كبريتيد الأليل – من الزيت الطيار للثوم – علي بعض أنواع من حشرات الحبوب المخزونة وهي ***Callosobruchus chinensis* (L.), *Callosobruchus maculatus* (F.), *Tribolium castaneum* (Hbst.) and *Sitophilus oryzae* (L.) .**

محمد حسن سويدان

جامعة الإسكندرية – كلية التربية ، قسم العلوم البيولوجية و الجيولوجية، الشاطبي الإسكندرية – جمهورية مصر العربية .

يعتبر ثنائي كبيريتيد الاليل مكون رئيسي من مكونات زيت الثوم الطيار . تم أختبار هذه المادة علي اربعة من حشرات الحبوب المخزونة وهي :–

Callosobruchus chinensis, Callosobruchus maculatus, Tribolium castaneum and *Sitophilus oryzae*.

وذلك باستخدام برطمان زجاجي محكم الأغلاق لدراسة التأثير السام لأبخرة تلك المادة بالأضافة إلي المعاملة بالملامسة لبيان تأثير السميةبالملامسة لمادة *ثنائي كبيريتيد الاليل*.

وجد أن الطور البالغ لحشرة *C. chinensis* هو أكثر الاطوار البالغة تأثرا لأبخرة تلك المادة وكانت قيمة LC_{50} لها هي 0.46 µL/Lair

أما حشرتي *C. maculatus,* و *T. castaneum* فكانت قيمة LC_{50} لهما هي µL/Lair 0.46 , 0.63 . بين البحث أن حشرة *S. oryzae* هي أقل الحشرات المختبرة تأثرا بأبخرة *ثنائي كبيريتيد الاليل*وكانت قيمة LD_{50} لها 3.75 µL/Lair

أما في حالة التأثيربالملامسة لمادة ثنائي كبريتيد الأليل علي الحشرات تحت الأختبار فكانت قيمة LD_{50} لحشرة *C. chinensis* هي ٢٢,١ *جزء من المليون وقيمة* LD_{50} لحشرة *C. maculatus* هي ٢٢,٨ جزء من المليون وقيمة LD_{50} لحشرة *T. castaneum* هي ٢٤,٢ جزء من المليون . أما تلك القيمة للحشرة S. oryzae فكانت ٩٤,٠ جز من المليون لكل حشرة .

J. Agric. Sci. Mansoura Univ., 30 (10): 6325 - 6333, 2005

SOME TECHNOLOGICAL CHARACTERISTICS AND YIELD OF SOME COTTON VARIETIES AS AFFECTED BY APPLICATION OF UREA AMMONIUM NITRATE, SULPHUR AND PHOSPHORIEN

Hammad, S. A.*; A. A. Abd El-Magid, ; H. G. Abu El-Fotoh** and M. H. El-Mancy*****

***Soil Sci. Dept., Fac. of Agriculture, Mansoura University**
****Plant Nutrition Dept., Soil, Water & Env. Inst., Agric. Res. Center**
*****Efficient Productivity Inst., Zagazig Univ., Egypt.**

ABSTRACT

Two field experiments were carried out in farmer fields during 2003 and 2004 summer seasons at Sherbeen, Dakhalia governorate to study the effect of UAN (Urea ammonium nitrate, 32% N), agric. sulphur (S) and phosphorien (Biofertilizer) application under recommended dose of NPK fertilizers (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}) on cotton plant growth, seed cotton yield, lint percent, oil content of seeds and protein content of kernel seeds of the Egyptian cotton varieties Giza 86, G. 87, G. 88 and G. 89.The results indicated that:

1. The highest seed cotton yieldfed^{-1} was realized from all varieties by foliar UAN application under recommended dose of NPK (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}).
2. Using phosphorien, UAN and S with NPK (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}) increased lint percent, plant height, No. of open bolls/plant, seed index and boll weight in four cotton varieties.
3. The study showed the vital importance of soil analysis, which indicated low levels of available N, P, K and S and the soil must be fertilized with the economically beneficial amounts of these nutrients when cropped with cotton.
4. Protein, oil content in seeds and N, P and S contents fully developed leaves at the beginning of flowering stage and were increased by using UAN, phosphorien and S treatments application.
5. These clearly concluded that UAN, phosphorien and S treatments could be used with NPK (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}) under the Egyptian conditions as effective for improving seed cotton yield and quality of cotton varieties Giza 86, G. 87, G. 88 and G. 89. Meanwhile, these treatments lowered soil pH which resulted in increasing the availability of some nutrients as P and S in soil.

INTRODUCTION

Cotton is considered one of the major crops which plays an important role in Egyptian economy. Egyptian cotton (*Gossypium barbadense*) is an important cash crop for the Egyptian farmer, and a vital source of row material for Egyptian income. The efforts of most agronomists are to increase its productivity.

The intensive cultivation depletes the Egyptian soil of some plant nutrients, which could be compensated by fertilizers application. The early recorded results on cotton fertilization under local conditions indicated that nitrogen is the limiting element for cotton production.

Sulphur compounds have been known as soil amendment to correct soil alkalinity. Many studies as reported by Mathers (1970) stressed that the role of sulphur is to increase the availability of plant nutrients as a result of its oxidation to sulphuric acid. Hilal *et al.* (1979) reported that when elemental sulphur was well distributed in the top 10 cm of alkaline calacarous soils, it exerted a better effect on soil properties as compared with the addition of diluted sulphuric acid to the soil surface.

Interactions between added S and P received the attention of many investigations, Aulakh and Pasrisha (1977) showed that the yield increased with the application of S and P individually but decreased when S and P were applied in different combinations. In Egypt, Eid and Hamissa, (1969), Yassen *et al.*(1990), Khater *et al.*, (1991), El-Akabawy *et al.*, (2000) and Abd El-Magid, (2002) came to the same results.

The biofertilization like, (phosphorien) and sulphur on cotton are studied by several Egyptian researchers who indicated that cotton plants responded positively to phosphorin and sulphur (Neptune *et al.*, 1975, Nasseem *et al.*, 1981, Bayoumi *et al.*, 1985 and Abd El-Magid., 2002).

This work aimed to study the effect of nitrogen (UAN), sulphur and biofertilizer (phosphorien) treatments on cotton yield production for 4 varieties of cotton.

MATERIALS AND METHODS

Two field experiments were carried out in farmer fields during 2003 and 2004 summer seasons at Sherbeen, Dakhalia governorate to evaluate the effect of UAN (Urea ammonium nitrate, 32% N), agric. sulphur (S) and phosphorien (Biofertilizer) application under recommended dose of NPK fertilizers (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}) on cotton varieties (*Gossypium barbadensel* L.) Giza 86, G. 87, G. 88 and G. 89.

The experiment was designed in RCB with split plot design involving 16 treatments. Each treatment was replicated four times. So that, the total treatments equal 64 plots. Each plot = 3x3.5 m. The used treatments were as follows:

A. **Varities:**Giza 86 (v_1), Giza 87 (v_2), Giza 88 (v_3) and Giza 89 (v_4).

B. **Fertilizer treatments:** treatments could be illustrated as the following:

1. **Control**: N = 70 N kg fed^{-1} as ammonium sulphate (20.5%N). the nitrogen was added in two equal doses, the first after thinning (35 days after sowing) and the second after one month later. P = 30 P_2O_5 kg fed^{-1} as calcium superphosphate (15.5 % P_2O_5) and K= 24 K_2O kg fed^{-1} as potassium sulphate (48% K_2O). the phosphorus and potassium were applied during soil preparation before seeding.
2. **Urea ammonium nitrate (UAN, 32% N)**: The applied rate was 10 N kg fed^{-1}as foliar solution with two equal doses at 60 and 90 days from sowing date as 300 L fed^{-1}.
3. **Sulphur application (200 S kg fed^{-1}):** Fine powder sulphur was that applied during soil preparation before sowing.
4. **Phosphorien (biofertilizer):** The inoculation performed through mixing seeds with the appropriate amount of this after coating with arabic gum as adhesive material just prior to sowing.

The soil is clayey in texture. The physical and chemical analysis of the soil are shown in Table 1.

Table 1 :The physical and chemical analysis of the soil samples.

Seasons	Soil texture	O.M %	$CaCO^{-3}$ %	$CaSO^{=4}$ %	$SO^{=4}$ meq/L	pH (1:2.5)	EC dSm^{-1}	Total N ppm	Available nutrients	
									P	K
1st season	Clayey	1.97	3.75	0.005	1.52	7.8	0.52	615	5.20	375
2nd season	Clayey	1.97	25.41	0.013	3.7	8.3	1.29	532	4.90	354

Cotton seeds were sown in April (12th and 17th) in the first and second seasons, respectively.

Seed contents were determined according to A. O. A. C. (1970), lint percentage (%) was calculated as the ratio between weight of lint (g) and seed cotton weight (g).

Plant samples were oven dried at 70°c till a constant weight and the dry weight was recorded. The plant materials were ground and sub-samples of 0.1(g) were wet-digested using $H_2SO^{=}_4$-$HCLO_4$ mixture according to Peterburgsiki (1968). Total nitrogen was determined by Kjeldahl method as aforementioned by Hesse, (1971), Phosphorus was determined calorimetrically at a wave length of 725 nm using Ziess spectrophotometer (Spekol) as described by Jackson (1967), potassium was determined using Gallen Kamp flame photometer as described by Jackson (1967).

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) and the least significant differences between the treatment means as published by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of nitrogen, phosphorien and sulfur on seed cotton yield:

The data in Table 2 indicate that seed yield and lint percentage of cotton were significantly affected with N, P and S application in 2003 and 2004 seasons.

Seed cotton yield, the most important parameter, was affected positively and significantly by NPS application and its splitting. Pooled data with respect seed cotton yield in Table 2 clearly indicate that fertilization of cotton plants with UAN, S and phosphorien caused a significant increased in the seed cotton yield of cotton plants over their respective control. However, the interaction effects of UAN, S and phosphorien were found to be significant.

A synergistic effect of UAN, S and phosphorien application in increasing seed cotton yield might be attributed to the enhanced root activities and root nodulation of plants resulting in a higher uptake of nutrients and thereby increasing the vegetation growth and yield, similar findings are absorbed by Rahee and Chahai (1977), Goos (1985), El-Akabawy *et al.* (2000) and Abd-Magid (2002).

Cotton yield and its components:

Data in Table 2 reveal that lint % values were slightly increased by the applications of the different treatments of UAN, S and phosphorien in comparison with the control in both seasons. The lowest lint % values were more effective by using UAN treatment on varieties G. 86, G. 87 and G. 88.

Table 2:Seed cotton yield (Kentar fed^{-1}) and lint percent as affected by different fertilization treatments.

Varieties	Treat.	Seed cotton yield (Kentar fed^{-1}) 2003	2004	Average	Δ increase %	Lint % 2003	2004	Average	Δ increase %
G. 86	Control	7.97	8.35	8.16		38.33	38.36	38.35	
	UAN	9.45	10.45	9.95	21.94	39.41	39.80	39.61	3.29
	Phosph.	9.14	10.16	9.65	18.26	40.21	40.50	40.36	5.24
	Sulphur	8.83	9.65	9.24	13.24	40.56	40.68	40.62	5.92
L.S.D at 0.05		1.23	1.92			0.65	0.72		
G. 87	Control	6.23	6.95	6.60		28.82	29.10	28.96	
	UAN	8.34	9.44	9.90	34.74	29.68	30.35	30.02	3.66
	Phosph.	8.12	9.11	9.62	30.57	30.49	30.68	30.59	5.63
	Sulphur	7.85	8.95	8.40	27.31	30.72	30.82	30.77	6.25
L.S.D at 0.05		1.52	1.88			0.59	0.58		
G. 88	Control	6.77	7.84	7.15		32.27	32.65	32.46	
	UAN	8.95	9.25	9.10	27.20	33.55	33.72	33.64	3.64
	Phosph.	8.42	8.96	8.69	21.47	34.20	34.35	34.28	5.61
	Sulphur	8.15	8.74	8.45	18.05	34.50	34.65	34.58	6.53
L.S.D at 0.05		1.35	1.62			0.57	0.68		
G. 87	Control	7.85	8.48	8.17		34.44	35.10	34.77	
	UAN	9.85	9.93	9.89	21.13	36.40	36.85	36.63	5.35
	Phosph.	9.32	9.65	9.49	16.17	36.77	37.20	36.99	6.38
	Sulphur	8.76	9.13	8.95	9.55	37.19	37.35	37.27	7.19
L.S.D at 0.05		1.50	1.25			0.68	0.69		

As shown in Table 3, cotton plant characteristics were significantly affected by UAN, S and phosphorien. The plant height which increased due to UAN application can be ascribed to the nitrogen effect on all varieties. Open bolls (O.B.) per plant, boll weight (B.W.) and seed index were increased by using UAN, S and phosphorien treatments with all cotton varieties. The function of UAN, S and phosphorien in the cotton plants lies in their participation in protein structure in the from of the nitrogen, S and P bearing amino acids (Koinov and Petkov, 1976 and Abdel-Magid, 2002).

As seen in Table 4, the mean values of N, P, K and S contents in the developed cotton leaves at the beginning of flowering stage were increased by affecting UAN, S and Phosphorien treatments applications. These increases in N, P, K and S contents in the developed cotton leaves were caused increase in cotton yield and may be due to the UAN, S and phosphorien treatments to all cotton plants varieties which led to the depletion of N, P, K and S in the soil solution during the growth period of plants.

Table 3:Cotton characteristics as affected by different fertilization treatments.

Varieties	Treat.	Plant height (cm)		Seed index (g)		Open boll plant-1		Boll weight	
		2003	2004	2003	2004	2003	2004	2003	2004
G. 86	Control	73.8	75.2	8.41	8.53	6.8	7.2	2.45	2.48
	UAN	77.8	79.3	9.76	9.85	7.2	7.4	2.53	2.58
	Phosph	71.9	73.7	10.03	10.15	7.3	7.6	2.47	2.51
	Sulphur	72.3	74.5	10.80	10.87	7.5	7.8	2.51	2.56
L.S.D at 0.05		2.00	1.79	2.15	1.98	0.71	0.40	0.46	0.32
G. 87	Control	69.7	72.7	8.70	8.76	5.7	6.5	2.10	2.15
	UAN	72.9	76.4	10.21	10.42	6.5	6.8	2.16	2.21
	Phosph	68.5	71.5	10.43	10.58	6.6	6.9	2.14	2.19
	Sulphur	68.7	71.2	10.76	10.85	6.7	7.2	2.14	2.23
L.S.D at 0.05		1.56	1.86	1.36	1.20	0.65	0.36	0.66	0.39
G. 88	Control	72.4	74.8	8.83	8.86	5.9	6.8	2.14	2.19
	UAN	75.8	78.3	10.50	10.63	6.2	6.9	2.19	2.26
	Phosph	72.2	73.3	10.70	10.84	6.4	6.8	2.22	2.27
	Sulphur	71.3	72.8	10.80	10.89	6.6	6.9	2.20	2.28
L.S.D at 0.05		1.00	0.98	2.10	1.00	0.60	0.28	0.59	0.65
G. 87	Control	73.5	75.4	8.18	8.24	6.7	7.1	2.25	2.28
	UAN	76.9	78.5	9.22	9.34	6.9	7.4	2.27	2.34
	Phosph	72.1	73.9	9.86	9.95	6.8	7.5	2.29	2.32
	Sulphur	71.6	73.3	10.21	10.34	7.3	7.8	2.26	2.35
L.S.D at 0.05		0.96	0.75	1.00	1.85	0.70	0.46	0.71	0.75

Cotton yield response to UAN, S and phosphorien has been recorded by several Egyptian authors (El-Aggory *et al.* 1991 and Abd el-Magid, 2002).

Seeds cotton of oil and Kernel seeds content of protein:

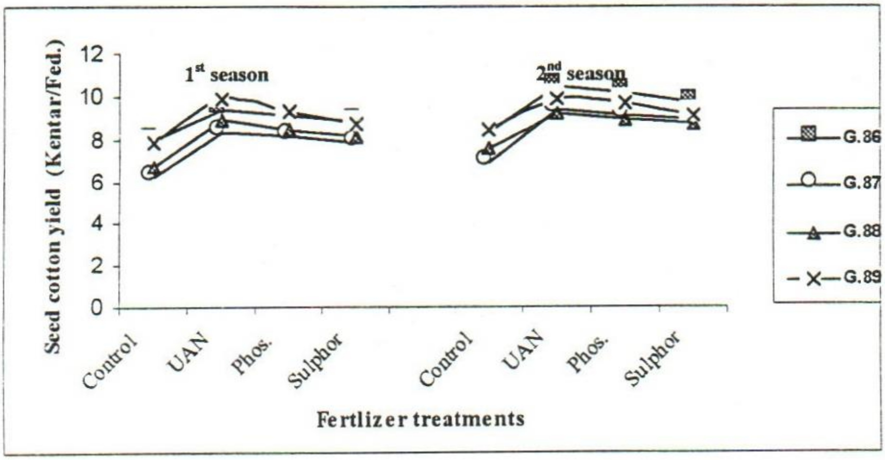
Data of Table 5 reveal that, increasing oil % and protein % in the seeds compared to control was significantly and positively correlated with using UAN, S and phosphorien treatments in all cotton varieties. Seed content of oil % reached the maximum when using phosphorien and S but the maximum seed content of protein % obtained by UAN treatment on all cotton varieties. This result is in good agreement with that obtained by EL-Akabawy *et al.* (2000), Abdel-Magid (2002) and Ragaa (1976).

Table 4:Mean values of N, P, K and S concentrations of fully developed cotton leaves as affected by different fertilization treatments.

Varieties	Treat.	Nutrient Concentrations (%)							
		N		P		K		S	
		2003	2004	2003	2004	2003	2004	2003	2004
G. 86	Control	4.1	4.3	0.26	0.28	3.2	3.1	0.23	0.22
	UAN	4.8	4.9	0.31	0.32	3.6	3.5	0.27	0.26
	Phosph.	4.5	4.6	0.28	0.28	3.4	3.4	0.24	0.26
	Sulphur	4.7	4.8	0.29	0.31	3.5	3.3	0.22	0.35
L.S.D at 0.05		0.29	0.35	0.09	0.10	0.24	0.26	0.034	0.039
G. 87	Control	3.9	3.7	0.27	0.25	3.1	3.0	0.21	0.20
	UAN	4.6	4.3	0.30	0.31	3.7	3.5	0.25	0.27
	Phosph.	4.2	4.1	0.29	0.28	3.5	3.2	0.23	0.25
	Sulphur	4.4	4.5	0.28	0.31	3.5	3.4	0.34	0.33
L.S.D at 0.05		0.22	0.28	0.07	0.09	0.31	0.28	0.032	0.036
G. 88	Control	3.8	3.4	0.25	0.23	3.4	3.2	0.24	0.22
	UAN	4.5	4.6	0.34	0.32	3.5	3.1	0.25	0.27
	Phosph.	4.3	4.1	0.32	0.34	3.3	3.2	0.24	0.26
	Sulphur	4.3	4.7	0.30	0.35	3.5	3.4	0.33	0.35
L.S.D at 0.05		0.24	0.31	0.08	0.11	0.28	0.27	0.034	0.039
G. 87	Control	4.2	4.3	0.28	0.26	3.5	3.2	0.21	0.23
	UAN	4.7	4.9	0.33	0.29	3.6	3.4	0.25	0.28
	Phosph.	4.6	4.2	0.31	0.32	3.4	3.1	0.24	0.27
	Sulphur	4.8	4.9	0.32	0.34	3.5	3.4	0.32	0.36
L.S.D at 0.05		0.20	0.25	0.08	0.09	0.26	0.25	0.035	0.042

Table 5:Oil and protein contents of the cotton seeds as affected by different fertilization treatments.

Vari.	Treat.	Oil %				Protien %			
		2003	2004	Average	Δ increase %	2003	2004	Average	Δ increase %
G. 86	Control	19.45	20.63	20.04		55.13	56.36	55.75	
	UAN	22.15	23.46	22.81	13.81	58.25	59.47	58.86	5.58
	Phosph.	22.83	23.95	23.39	16.72	56.76	58.65	57.71	3.52
	Sulphur	23.20	24.34	23.77	18.61	57.65	59.74	58.70	5.29
L.S.D at 0.05		0.45	0.54			0.72	0.36		
G. 87	Control	18.76	19.58	19.17		53.45	54.65	54.05	
	UAN	20.85	21.64	21.25	10.85	57.34	58.25	57.80	6.94
	Phosph.	20.64	21.95	21.30	11.11	56.83	57.94	57.39	6.18
	Sulphur	21.35	21.87	21.61	12.73	58.47	58.85	58.66	8.53
L.S.D at 0.05		0.41	0.49			0.69	0.75		
G. 88	Control	20.24	20.85	20.55		56.62	57.45	57.04	
	UAN	21.37	22.42	21.90	6.57	59.24	59.95	59.60	4.49
	Phosph.	20.72	21.67	21.20	3.16	60.35	60.87	60.61	6.26
	Sulphur	20.95	21.36	21.16	2.97	60.59	61.15	60.87	6.71
L.S.D at 0.05		0.43	0.48			0.75	0.89		
G. 87	Control	18.95	19.65	19.30		56.24	57.25	56.75	
	UAN	21.63	22.45	22.04	14.20	58.65	59.52	59.09	4.12
	Phosph.	22.32	22.57	22.45	16.32	57.84	58.65	58.25	2.64
	Sulphur	22.15	22.48	22.32	15.65	58.23	58.95	58.59	3.24
L.S.D at 0.05		0.48	0.51			0.85	0.85		



Fig(1):Relationship between seed cotton yield (KentarFed^{-1}) and Fertilizer treatments during 2003 and 2004 seasons.

CONCLUSION

Going through the data, it may be inferred that results lead further support to the contention that nefits resulting from the use of UAN, phosphorien and sulphur individual with NPK (70 N + 30 P_2O_5 + 24 K_2O kg fed^{-1}) are added to the cotton plants and the pH was lowered and reflected in increasing the availability of soil nutrients and beneficial for better yield.

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J. Agric. Sci. Mansoura Univ., 30 (10), October, 2005

أثر إضافة اليوريا أمونيوم نترات والفوسفورين والكبريت الزراعي على بعض مكونات النبات ومحصول بعض أصناف القطن

سامي عبد الحميد حماد* - عبد المجيد أبوالمعاطي عبد المجيد ** - حسن جمعه أبوالفتوح** ومحمد حبيب المنسي***
*قسم علوم الأراضي - كلية الزراعة- جامعة المنصورة ،
**قسم بحوث تغذية النبات- معهد بحوث الأراضي والمياه والبيئة-مركز البحوث الزراعية
*** معهد الكفاية الإنتاجية - جامعة الزقازيق

أجريت تجربتان حقليتان في حقول المزارعين بمركز شربين -محافظة الدقهلية- خلال موسمي ٢٠٠٣، ٢٠٠٤م لدراسة تأثير إضافة اليوريا امونيوم نترات والمخصب الحيوي فوسفورين وكذلك الكبريت الزراعي مع استخدام مستوى السماد النتروجيني والفوسفور والبوتاسيوم ٧٠+ ٣٠ + ٢٤ كجم/فدان ، وذلك على تحسين انتاجية وجودة محصول أربعة أصناف القطن ، وهي جيزة ٨٦ ، جيزة ٨٧ ، وجيزة ٨٨ ، وجيزة ٨٩.

وقد أوضحت النتائج التي تم الحصول عليها كما يلي:

١- استخدام سماد اليوريا أمونيوم نترات رشا على النباتات أدى إلى الحصول على أعلى زيادة في محصول القطن المزهر للفدان.

٢- استخدام سماد اليوريا أمونيوم نترات والمخصب الحيوي فوسفورين والكبريت الزراعي مع المعدل الموصى به من النتروجين والفوسفور والبوتاسيوم ٧٠+ ٣٠ + ٢٤ كجم/فدان أدى إلى زيادة انتاجية محصول القطن الزهر و تصافي الحليج و زيادة في طول النباتات ، وزيادة عدد اللوز المتفتح ، وزيادة وزن اللوزة.

٣- أظهرت الدراسة الأهمية الكبرى لاختبارات التربة قبل عمل التوصية السمادية لمحصول القطن.

٤- زيادة نسبة الزيت والبروتين في بذور القطن ، ومحتوى الأوراق كاملة النمو من الأزوت والفوسفور والكبريت عند بداية الإزهار نتيجة استخدام المعدل الموصى به من الأزوت والفوسفور والبوتاسيوم، والرش بسماد اليوريا أمونيوم نترات والمخصب الحيوي فوسفور ين والكبريت الزراعي.

هذه النتائج تؤكد بوضوح مدى فاعلية استخدام رش سماد اليوريا أمونيوم نترات، وإضافة المخصب الحيوي فوسفور ين والكبريت الزراعي مع المعدل الموصى به ن، فو و بو (٧٠+ ٣٠ + ٢٤ كجم/فدان) تحت ظروف الأراضي المصرية مما يؤدي إلى تحسين إنتاجية وجودة محصول القطن للأصناف جيزة ٨٦ ، جيزة ٨٧ ، وجيزة ٨٨ ، وجيزة ٨٩، وكذلك العمل على خفض ال pH للتربة ، مما يؤدي إلى سهولة ويسر انطلاق العناصر الغذائية في التربة.