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# CONTROLLING OF PURPLE BLOTCH DISEASE AND IMPROVING GROWTH AND YIELD OF CHINESE GARLIC BY USING NEW LOCAL ANTI-FUNGUS ($S_3$ AND $TS_3$), BIO-AGENT (PG) AND ANTITRANSPIRANT.

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## ABSTRACT

Field experiments were carried out during 1997/98 and 1998/99 seasons at Mansoura Research Station to study the possibility of using some newer safety combinations prepared from micro- and macro-elements ($S_3$ and others $TS_3$) (combinations of antibiotics, sulfathizole and salicylic acid), VG, PG and sulfur in controlling Chinese garlic serious disease (purple blotch), improving its growth and yield.

The most effective treatment in controlling such disease and improving growth and bulb yield was ($S_3$) (combined from S, $ZnSO_4$, $MnSO_4$ and fatty acids esters) (5 ml/L), which recorded the lowest disease severity % (25.8 and 25.0%) at the two seasons, respectively.

Vapor guard (VG) (2 ml/L), $TS_3$ (0.4 gm/L) and plant guard (PG) (2.5 ml/L) were followed $S_3$ in their effect, they were also of potent suppressive effect on purple blotch disease. Since, they scored low disease severity % (30.9 and 30.1%, 37.0 and 36.5% and 40.9 and 40.1%) for each of them at both seasons, respectively. They followed this potent fungicidal effect by considerable improvement in growth and yield of their plants relative to the control and other treatments.

Such newer treatments suggested to be more cost effective and may lesser the development of fungicide resistance. Meanwhile, the results of statistical correlation between disease severity % and some characters confirm the present findings.

## INTRODUCTION

Garlic (*Allium sativum* L.) is an important vegetable crop in Egypt for both local consumption and export. At recent years, Chinese garlic was extensively cultivated in Egypt due to its good quality and high productivity. It is seriously infected with purple blotch fungal disease caused by *Puccinia allii* (Walker, 1931). Such disease was first reported on Chinese garlic in Egypt by Sadik and Fayzalla (1986), causing great reduction in growth and yield. Up till now, synthetic fungicides of higher cost used as a unique control method for this disease with no potent results in some cases. Also, this method imposes various undesirable side -effects as residual toxicity, environmental pollution and development of fungicides resistance (Edwards, 1973).

Recently, considerable attention has been given for use of safely less cost alternative method in controlling fungus diseases.

In this regard, safe combinations of some nutrient elements as Mn, Zn, Fe and Cu salt, as well as K salts, i.e. $KHCO_3$, KOH and $KMnO_4$ alone or combined with mineral oil known to be used (Nironenko, 1965; Attia *et al.*, 1982; Monged *et al.*, 1986; Biddle, 1987; Wicks *et al.*, 1990; Ziv and Zitter,

1992. Ali *et al.*, 1994 and Farid *et al.*, 2000). Film-forming products (antitranspirant) as vapor guard also used (Ziv, 1983 and Ziv and Zitter, 1992). Such materials are non-phytotoxic resistant to weathering for at least 1 week and biodegradable.

Antibiotics and salicylic acid suggested to be used in reducing the severity of some fungicidal bacterial diseases and/or for inducing plant resistance particularly with some pathogen, which became less affected with the common fungicides (Shoeib and Hassanein, 1994; Shengquan *et al.*, 1995; Yung-Xing *et al.*, 1997; Kassemeyer *et al.*, 1998 and Farid *et al.*, 2000).

On the other hand, Trichoderma (bio-agent) known to be used as a safe bio anti-fungus for controlling some fungus diseases (Kassemyer *et al.*, 1998 and Farid *et al.*, 2000).

Present work aimed to study the effect of some alternative methods for suppressing the severity of purple blotch disease of Chinese garlic and improve its bulb yield and quality.

## MATERIALS AND METHODS

Field experiments were conducted at Mansoura Research Station during 1997/98 and 1998/99 seasons to investigate the potentiality of some new safety local alternatives (based on their anti pathogenic effects) for controlling purple blotchy spots of Chinese garlic and improve its growth, bulb yield and quality.

Cloves were planted on Oct. 1$^{st}$ at spacing of 10 cm of one side of ridges spaced 60 cm apart. Fertilizers, were applied at three times, 6, 9 and 12 weeks from planting (80 kg N, 45 kg $P_2O_5$ and 60 kg $K_2O$ / fed.). The general agricultural practices were applied as recommended for Chinese garlic, except those related to the studied factors. The experimental design was randomized blocks with three replicates.

The suggested treatments (alternatives) for safety controlling of purple blotch disease were as follows:-

1. Plant guard (known bio-anti-fungus (*Trichoderma sp.*), 2.5 ml/L.
2. Vapor guard (anti-transpirant), 2.0 ml/L.
3. Micronized sulfur (4 gm/L).
4. $S_1$ (New combination of KOH, $H_3PO_4$, Oleic acid and acetone) (5 ml/L).
5. $S_2$ (New anti-fungus, mixture of Cu, Fe and Mn salts) (2 gm/L).
6. $S_3$ (New anti-fungus combination of sulfur, Zn, Mn and esters of fatty acids) (5 ml/L).
7. $S_4$ (New anti-fungus combination of KOH, oleic acid and acetone) (10 ml/L).
8. $S_5$ (New anti-fungus combination of $KHCO_3$ and mineralized oil) (0.5%).
9. $S_6$ Combination of CuO, FeO and $MnSO_4$ (2 gm/L).
10. $TS_3$ new combination of antibiotic, salicylic acid and sulfathiazole (0.4 gm/L). $TS_3$ was used for controlling cucumber downy mildew (Farid *et al.*, 2000).
11. Control treatment (spraying with tap water only).

Spraying times were 100, 115 and 130 days after planting.

Samples of 20 plants were taken from each plot, 150 days after planting and the following data were recorded: plant length (cm), number of leaves / plant, top fresh weight (gm) / plant, top dry weight (gm) / plant and leaf area ($cm^2$) / plant.

Under natural infection condition, disease severity (purple blotch spots) was recorded by counting diseased plants in 100 plants from each plot, the number of spots appearing on the leaves of diseased plants was also counted.

Formula of Sherwood and Hagedorn (1958) was used.

$$DSI\ (\%) = \frac{(\text{Disease class})\ (\text{No. of diseased plants in that class})}{\text{Total No. of plants} \times 4} \times 100$$

DSI: Disease severity index.

Disease class:
- 0 = No symptoms.
- 1 = 1-10 lesions / plant.
- 2 = 11-20 lesions / plant.
- 3 = 21-30 lesions / plant.
- 4 = More than 30 lesions.

Harvesting took place at the end of the growing season. The garlic yield was determined after curing for 15 days. Yield was recorded in term of No. of cloves / bulb, weight of cloves / bulb, bulb weight (gm) and total yield / fed. also, bulb diameter and TSS content of cloves were determined.

Present work aimed to investigate the efficiency of some available local safety and of less cost agent, which suggested to be of inhibitional potent effect on fungus diseased specially when they are in certain combinations, i.e. some nutrient element, and salts, oils and antibiotics as well as antitranspirant and bio-agent all to suppress the severity of purple blotch disease of Chinese garlic and improve its bulb yield and quality.

## RESULTS AND DISCUSSION

**I. Disease severity and growth parameters:**

Tables 1 and 2 showed the effect of plant guard, vapour guard, micronized sulfur (those known to be commonly used), $S_1$, $S_2$, $S_3$, $S_4$, $S_5$, $S_6$ and $TS_3$ (those a newer anti-fungus combinations prepared by mixing of some nutrient elements, i.e. Mn, Zn and Fe, as well as antibiotic and salicylic acid in Mansoura Res. Laboratory on the severity of purple blotch disease and growth parameters of Chinese garlic cultivated in field under natural infection conditions during 1997/98 and 1998/99 seasons.

Table 1: Effect of some new local anti-fungus combinations, bio-agent and antitranspirant on growth and disease severity of Chinese garlic grown in field during 1997/98 season.

| Treatments | Plant height (cm) | No. of leaves / plant | Top F.W. (gm) / plant | Top D.W. (gm) / plant | Leaf area ($cm^2$) / plant | Disease severity of purple blotch (%) |
|---|---|---|---|---|---|---|
| Plant guard (2.5 ml/L) | 76.7 cd | 10.7 b | 97.0 cd | 18.7 bcd | 581.0 cd | 40.9 g |
| Vapour guard (2.0 ml/L) | 84.3 ab | 12.3 ab | 104.0 b | 20.3 ab | 683.5 b | 30.9 i |
| Micronized sulfur (4 gm/L) | 75.3 cde | 11.3 ab | 95.1 cde | 18.5 cd | 635.3 bc | 49.5 e |
| $S_1$ (5 ml/L) | 75.6 cde | 11.7 ab | 93.4 cde | 17.3 de | 589.7 cd | 50.4 d |
| $S_2$ (2 gm/L) | 73.d def | 11.7 ab | 89.7 efg | 16.0 ef | 564.1 d | 48.4 f |
| $S_3$ (5 ml/L) | 87.0 a | 12.67 a | 110.4 a | 21.7 a | 765.3 a | 25.8 j |
| $S_4$ (10 ml/L) | 72.3defg | 11.3 ab | 90.7def | 18.0 d | 632.7 bc | 58.8 b |
| $S_5$ (0.5%) | 67.3 g | 11.0 ab | 83.3 g | 15.6 f | 579.8 cd | 53.8 c |
| $S_6$ (2 gm/L) | 69.7 fg | 11.67 ab | 86.6 fg | 16.4 ef | 552.6 d | 58.6 b |
| $TS_1$ (0.4 gm/L) | 79.7 bc | 11.67 ab | 99.5 bc | 20.0 bc | 693.6 b | 37.8 h |
| Control | 70.7 efg | 11.0 ab | 33.8 g | 16.0 ef | 542.1 d | 76.05 a |

Means followed by the same letter(s) within each column do not significantly differed using Duncan's Multiple Range Test at the level of 5%.

Table 2: Effect of some new local anti-fungus combinations, bio-agent and antitranspirant on growth and disease severity of Chinese garlic grown in field during 1998/99 season.

| Treatments | Plant height (cm) | No. of leaves / plant | Top F.W. (gm) / plant | Top D.W. (gm) / plant | Leaf area ($cm^2$) / plant | Disease severity of purple blotch (%) |
|---|---|---|---|---|---|---|
| Plant guard (2.5 ml/L) | 80.0 cd | 11.67abc | 99.6 b | 19.67 bc | 672.0 bc | 40.1 f |
| Vapour guard (2.0 ml/L) | 84.3 b | 12.33 ab | 113.0 a | 22.40 a | 773.2 a | 30.1 h |
| Micronized sulfur (4 gm/L) | 79.3 cd | 11.67abc | 100.0 b | 19.57 bc | 666.5 bc | 48.6 d |
| $S_1$ (5 ml/L) | 80.7 bc | 12.0 abc | 97.3 bc | 18.80bcd | 640.6bcd | 49.2 d |
| $S_2$ (2 gm/L) | 74.7 def | 11.67abc | 91.3 bcd | 17.83cde | 617.0bcde | 47.1 e |
| $S_3$ (5 ml/L) | 89.7 a | 13.00 a | 113.0 a | 22.3 a | 778.6 a | 25.0 i |
| $S_4$ (10 ml/L) | 72.6 efg | 11.33abc | 92.2 bcd | 18.43bcd | 654.3 bc | 25.0 i |
| $S_5$ (0.5%) | 68.3 g | 11.00 bc | 87.0 cd | 17.7 de | 595.1cde | 57.6 b |
| $S_6$ (2 gm/L) | 68.0 g | 11.33abc | 83.5 d | 16.13 e | 560.4 e | 51.3 c |
| $TS_1$ (0.4 gm/L) | 77.8 de | 11.00 bc | 95.0 bc | 20.00 b | 682.2 b | 57.7 b |
| Control | 71.0 fg | 10.33 c | 83.0 d | 15.97 e | 574.6 de | 36.5 g |

Means followed by the same letter(s) within each column do not significanll75.3 ay differed using Duncan's Multiple Range Test at the level of 5%.

Such data indicated that all the used treatments significantly reduced the severity of garlic purple blotch disease relative to control treatment at the two seasons. It is also evident that those treatments improved vegetative growth (top fresh weight and dry weight and leaf area) in parallel with their anti-fungus (suppressive level) effect compared with those of control treatment in both seasons.

It is obvious from the same data that $S_3$ ($ZnSO_4$ + $MnSO_4$ + Sulfur + ester of fatty acids) (5 ml/L) was the most potent one of the highest suppressive effect on disease severity (reduced disease severity to the lowest values 25.8 and 25.0% at the two seasons, respectively), also $S_3$ was of the highest growth parameters.

This followed by vapour guard (VG), by $TS_3$ and by plant guard (PG) in decreased order, those also were of clear fungicidal effect on growth parameters of garlic plant at the two seasons.

Other treatments reduced the severity of purple blotch disease relative to the control, but they could not significantly improve growth parameters.

On the other hand, treated control plants were severely infected by purple blotch disease, since they scored the highest severity (%) values 76.05 and 75.30 at the two seasons, respectively, they were also of the lowest growth parameters.

The results of correlation (Table 5) coincided the harmony between the fungicidal effect on treatments and the growth status of their plants.

These results were in agreement with the results of Attia *et al.* (1982), Monged *et al.* (1986), Biddle (1987), Ali *et al.* (1994) and Farid *et al.* (2000) regarding the effect of anti-fungus combinations ($S_1$, $S_2$ and $S_3$), which containing different micro-elements (Cu, Mn, Zn and Fe); Shengquan *et al.* (1995), Kassemyer *et al.* (1998) and Farid *et al.* (2000) about the effect of $TS_3$. Han (1990) and Ziv and Zitter (1992) about the effect of vapour guard (film forming product); Kassemyer *et al.* (1998) and Farid *et al.* (2000) regarding the effect of plant guard (bio-anti-fungus agent).

Herein the excellent controlling activities of $S_3$ (combination of $ZnSO_4$, $MnSO_4$, sulfur and fatty acids ester) might be due to the additive inhibitional effects of such components on growth and sporulation, as well as phytotoxins production and the physiological processes of the fungus (Sharma *et al.*, 1976; Fahim *et al.*, 1994 and Welch, 1995).

In addition to the fungicidal effect of $S_3$, its same components (Zn, Mn and S) had an essential nutritive functions. Those (fungicidal and nutritive activities) together might be the cause for its pronounced beneficial effect on garlic plant growth (maintain healthy leaves of the greatest surface area and dry matter production).

The potent controlling effect of vapour guard (VG) on purple blotch disease might be due to its role as a artificial barrier on leaf surfaces thereby the inhibition of the foliar pathogen development (Ziv and Zitter, 1992). Also, it had been reported that film-forming polymers, i.e. VG provided protection against many foliar pathogens, including both obligate and facultative parasites (Han, 1990). It may be also considered the anti-transpirantional function of VG in relation with water content of plant and thereby the growth and yield efficiency.

On the other hand, the potentiality of $TS_3$ in controlling purple blotch disease and improving garlic growth might be due to the direct inhibitional effect (anti-microbial effect) of its components (antibiotic, sulfathiazole and salicylic acid) besides to the role of salicylic acid in inducing the resistance case by plant due to its function in signal transaction system and gene expression alteration (Kassemeyer et al., 1998; Shengquan et al., 1995 and Farid et al., 2000).

With respect to the beneficial effect of the anti-fungus combinations, which contained K-salts (KOH and $KHCO_3$), $S_4$, $S_5$ and $S_1$ in reducing the severity of purple blotch disease.

This might be due their effect on decomposing the fungus components (mycelium and spores), collapse of hyphal walls and shrinkage of conidia by the direct contact (Homma and Arimoto, 1990; Wicks et al., 1990 and Yung-Xing et al., 1997). Added to the known beneficial effects of K as an important nutrient element on growth and development of garlic plant.

**II. Bulb yield and quality:**

Data in Tables 3 and 4 showed the effect of anti-fungus combinations on Chinese garlic yield and quality parameters, i.e. clove number / bulb, clove weight (gm), bulb weight (gm), total yield ton / fed., bulb diameter and TSS% of cloves during 1997/98 and 1998/99 seasons.

Such data revealed that all treatments improved most of the above mentioned characters, compared with those of the untreated plants. Significant differences were detected between these treatments and the control and among them in most cases. Same data indicated that $S_3$ was the most superior one of the significant highest bulb yield and quality relative to all treatments and control in the two seasons.

This superiority could be due to its highest fungicidal effect on purple blotch disease (great suppressive activities) and to its effect of improving growth case of garlic plants, i.e. leaf surface area and dry matter yield those which known to be closely related with the yield of under ground part (clove and bulb weight and size), as well as the total soluble solids content. The data in Tables 1, 2 and 5 coincided this interpretation.

Also, it is obvious from the same data that vapour guard (VG), plant guard (PG) and $TS_3$ followed $S_3$ in their effect on yield and quality of garlic bulb with insignificant differences among them in most cases, but with significant differences between them and other treatments and the control during both seasons.

The effect of these treatments was in the same beneficial effect trend of them on controlling the disease and improving growth parameters of Chinese garlic (Tables 1 and 2).

Other treatments were of slight beneficial effect on garlic yield and quality with no clear differences among them and the control in the two seasons.

Similar results were obtained by Altia et al. (1982), Monged et al. (1986), Biddle (1987), Wicks et al. (1990), Ziv and Zitler (1992), Shengquan et al. (1995), Yung-Xing et al. (1997), Kassemayer et al. (1998) and Farid et al. (2000).

Table 3: Effect of some new local anti-fungus combinations, bio-agent and antitranspirant on yield and quality of Chinese garlic grown in field during 1997/98 season.

| Treatments | Clove No. / bulb | Clove weight (gm) | Bulb weight (gm) | Bulb diameter (cm) | Total yield (Ton/fed.) | TSS (%) |
|---|---|---|---|---|---|---|
| Plant guard (2.5 ml/L) | 22.3abcd | 3.8 bc | 83.1 bc | 5.967bcd | 5.700 bc | 33.00 ab |
| Vapour guard (2.0 ml/L) | 21.6abcd | 4.0 b | 85.5 b | 6.133 bc | 5.840 b | 31.67bcd |
| Micronized sulfur (4 gm/L) | 24.3 ab | 3.2 def | 75.8 cde | 5.400def | 5.147 d | 30.67cde |
| $S_1$ (5 ml/L) | 21.6abcd | 3.4 bcde | 75.5 de | 5.457def | 5.107 de | 31.00cde |
| $S_2$ (2 gm/L) | 20.0 d | 3.8 bc | 78.3 cd | 5.633cde | 5.290 cd | 32.00 bc |
| $S_3$ (5 ml/L) | 20.0 d | 4.8 a | 96.8 a | 6.767 a | 6.477 a | 34.67 a |
| $S_4$ (10 ml/L) | 20.7 cd | 3.7 bcd | 75.5 de | 5.433def | 5.107 de | 31.67bcd |
| $S_5$ (0.5%) | 21.0bcd | 3.3 cdef | 72.9 de | 5.000 f | 4.903def | 30.00 de |
| $S_6$ (2 gm/L) | 24.6 a | 2.9 ef | 73.4 de | 5.300 ef | 4.657 ef | 28.67 e |
| $TS_1$ (0.4 gm/L) | 23.3abcd | 3.9 bc | 83.2 bc | 6.257 ab | 5.757 b | 34.00 a |
| Control | 23.5abc | 2.7 f | 70.7 e | 5.200 ef | 4.617 f | 26.00 f |

Means followed by the same letter(s) within each column do not significantly differed using Duncan's Multiple Range Test at the level of 5%.

Table 4: Effect of some new local anti-fungus combinations, bio-agent and antitranspirant on yield and quality of Chinese garlic grown in field during 1998/99 season.

| Treatments | Clove No. / bulb | Clove weight (gm) | Bulb weight (gm) | Bulb diameter (cm) | Total yield (Ton/fed.) | TSS (%) |
|---|---|---|---|---|---|---|
| Plant guard (2.5 ml/L) | 21.67bc | 3.66 bc | 84.3 bc | 6.00bcd | 5.787 bc | 32.0 ab |
| Vapour guard (2.0 ml/L) | 21.00bc | 4.30 b | 88.8 b | 6.367 b | 6.297 ab | 30.3 bcd |
| Micronized sulfur (4 gm/L) | 23.67abc | 3.40 cd | 78.9 cd | 5.667def | 5.373 cd | 29.8 cd |
| $S_1$ (5 ml/L) | 22.67abc | 3.60 c | 78.3 cd | 5.833cde | 5.407 cd | 30.3 bcd |
| $S_2$ (2 gm/L) | 21.60bc | 3.70 bc | 78.7 cd | 6.267 bc | 5.243 cd | 31.3 abc |
| $S_3$ (5 ml/L) | 21.00bc | 4.97 a | 104.0 a | 7.033 a | 6.730 a | 32.8 a |
| $S_4$ (10 ml/L) | 20.70 c | 3.70 bc | 77.3 d | 5.567def | 5.127 d | 30.7 bc |
| $S_5$ (0.5%) | 22.00bc | 3.40 cd | 73.5 de | 5.233 fg | 4.897 de | 28.6 d |
| $S_6$ (2 gm/L) | 25.70 a | 2.90 d | 75.0 de | 5.433efg | 4.417 e | 30.2 bcd |
| $TS_1$ (0.4 gm/L) | 21.60bc | 3.90 bc | 85.0 bc | 6.357 b | 5.483 cd | 33.0 a |
| Control | 24.30ab | 2.70 d | 69.0 e | 4.957 g | 4.507 e | 24.3 e |

Means followed by the same letter(s) within each column do not significantly differed using Duncan's Multiple Range Test at the level of 5%.

III. Correlation studies:

Data in Table 5 illustrated correlation coefficient values of disease severity (%) of purple blotch disease vrs leaf area, yield and yield quality parameters of Chinese garlic cloves and bulbs as affected by different treatments during the two seasons, 1997/98 and 1998/99.

**Table 5: Correlation coefficient values of disease severity (%) of purple blotch disease vrs leaf area, yield and yield quality parameters of Chinese garlic cloves and bulbs during the two seasons, 1997/98 and 1998/99.**

| Characters vrs. | Disease severity (%) | |
|---|---|---|
| | 1997/98 | 1998/99 |
| Leaf area | -0.768 | -0.720 |
| Clove No. / pulp | 0.433 | 0.270 |
| Clove weight | -0.804 | -0.790 |
| Bulb weight | -0.852 | -0.835 |
| Total yield (Ton/fed.) | -0.856 | -0.871 |
| TSS (%) | -0.759 | -0.819 |

Such data revealed that all the studied parameters, except clove number were negatively correlated with disease severity (%) at the two seasons.

This indicated that, as the treatment reduced the severity of disease the growth, yield and quality of garlic bulbs were considerably improved.

Such results could confirm the previously discussed results (Tables 1, 2, 3 and 4).

Finally, it could be concluded that $S_3$ (the newer local safety nutritive combination of sulfur, $ZnSO_4$, $MnSO_4$ and esters of fatty acids) was of excellent controlling effect on purple blotch Chinese garlic on serious disease and of the best promotional effect on its growth, bulb yield and quality.

Also, vapour guard (VG), $TS_3$ and plant guard (PG) were too of pronounced beneficial effect in controlling such serious disease and in improving the growth and yield of Chinese garlic plants.

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## مقاومة اللطعة الإرجوانية وتحسين نمو ومحصول الثوم الصيني بإستخدام مضادات فطرية جديدة ($S_3$, $TS_3$) والمضاد البيولوجي (PG) ومضاد النتح (VG).

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أجريت تجارب حقلية في الأعوام ١٩٩٧ – ١٩٩٨ ، ١٩٩٨ – ١٩٩٩ في المزرعة البحثية بالمنصورة لدراسة إمكانية إستخدام بعض المركبات الجديدة الأمنه المحلية التجهيز من العناصر المعدنية الصغرى والكبرى ، بالإضافة لإستخدام المضاد الفطري البيولوجي (PG) ومضاد النتح (VG) والكبريت الميكروني لمقاومة مرض اللفحة الإرجوانية وتحسين نمو ومحصول الثوم الصيني.

كان المركب الجديد ($S_3$) بمعدل ٥ مل/لتر والمكون من (الكبريت وسلفات الزنك وسلفات المنجنيز وإسترات الأحماض الدهنية) هو الأكثر فعالية على الإطلاق في المقاومة وتحسين النمو والمحصول والجودة حيث سجل أقل شدة إصابة في الموسمين ٢٥,٨ و ٢٥,٠% على التوالي مقارنة بباقي المعاملات والمقارنة.

يليه في التأثير مضاد النتح (VG) ٢ مل/لتر والمضاد الفطري الجديد ($TS_3$) ٤,٠ جم/لتر والمكون من (التتراسيكلين والسلفاثيازول وحمض السلسليك) والمضاد الفطري (PG) وبفاعلية محدودة وبدون وجود فرق معنوي بينها حيث سجلت شدة إصابة منخفضة مقارنة بباقي المعاملات والمقارنة (٣٠,٩ و ٣٠,١% – ٣٧,٥ و ٣٦,٥% – ٤٠,٩ و ٤٠,١%) لكلا منها في الموسمين على التوالي. كذلك كان لها جميعا تأثير ملموس في تحسين النمو والمحصول.

مثل هذه المعاملات الجديدة $S_3$, $TS_3$ هي مركبات آمنة قليلة التكلفة ومحلية وذات تأثير فعال في مقاومة أحد أمراض الثوم الصيني الخطيرة. كذلك جاءت نتائج الإرتباط الإحصائي بين شدة الإصابة (%) وبعض صفات النمو والمحصول مؤكدة لتلك النتائج.