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RESPONSE OF LEEK PLANTS TO ORGANIC AND BIOFERTILIZERS AS WELL AS SULPHUR SPRAYING IN COMPLETE OR PARTIAL REPLACEMENT OF MINERAL FERTILIZATION AND NUTRITIVE VALUES

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ABSTRACT

Two field experiments were carried out on leek (*Allium porrum* L.) plants cv. Bleustar to study the effect of organic manure fertilizer (combination of cattle 3 tons / fed. and chicken manure 1.5 tons/fed at 1:1 ratio), the recommended rate of mineral fertilizers (90 N + 60 P_2O_5 + 50 K_2O / fed.), mixture of organic manure and mineral fertilizer(½ OR + ½ MN)or one and half dose of organic manure and uninoculation or inoculation seedling with microbein or nitrobein as well as spraying plants with sulphur at the rate of 0, 0.5 and 1.0 g/l every 10 days intervals (36 treatments) on vegetative growth characters, total yield, pseudostems characters and nutritive values of pseudostem.

Application the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) led to obtain the highest values of plant fresh weight, number and fresh weight of leaves per plant, fresh weight and diameter of pseudostem and total yield in both seasons. Inoculation plants with microbein followed by nitrobein led to obtain the highest values of vegetative growth characters in both seasons, except number of leaves and length of pseudostem in which microbein or nitrobein led to obtain the highest values in the first and second seasons, respectively as comparing with uninoculation treatments.

Spraying leek plants with sulphur at the rate of 0.5 g/l followed by 1 g/l caused the highest values of vegetative growth characters as comparing with non spraying ones. The highest total yield were obtained with application of one and half dose of organic manure (1½ OR) or the mixture of organic manure and mineral fertilizers (½ MN + ½ OR), inoculation with microbein and spraying plants with sulphur at the rate of 0.5 g/l in both seasons. The highest fresh weight of pseudostem were obtained with application the mixture of organic manure and mineral fertilizer with inoculation plants with microbein or nitrobein in the first and second seasons, respectively and spraying sulphur at the rate of 0.5 g/l. Regarding to nutritive values of pseudostem, the highest values of dry matter and total carbohydrates were obtained with application organic manure, inoculation plants with nitrobein and spraying with sulphur at the rate of 0.5 g/l. The highest volatile oil and sulphur percentage were obtained with applying the mixture of organic manure and mineral fertilizer or one and half dose of organic manure and inoculation with microbein or nitrobein with spraying sulphur at the rate of 1.0 g/l. The highest protein percentage and nitrate accumulation were obtained with the application mineral fertilizer, inoculation plants with nitrobein and spraying with sulphur at the rate of 1.0 g/l. The lowest nitrate accumulation was obtained with applying organic manure or (½ MN + ½ OR), without inoculation or inoculation with nitrobein but without spraying sulphur or spraying at the rate of 0.5 g/l. The highest values of essential, non-essential, total and individual amino acids were recorded by the plants supplied with the recommended dose of NPK when compared with those supplied with the different dose of organic fertilizer. Moreover, high values of these

amino acids were obtained but the plants treated with sulphur, nitrobein and microbein either alone or combination when compared with its corresponding control untreated plants.

INTRODUCTION

Leek (*Allium porrum* L.) is one of the economically most important field vegetable crops in Europe. It has high anti-microbial, anti-fungal and anti-carcinogenic activities (Ernst, 1997). The leaves and long white blanched thickened stem (pseudo-stem) are eaten, cooked or can be added to salad. Organic, biofertilizers and sulphur are very important sources for providing the plants with their nutritional requirements without having undesirable impact on environment. Trials were carried out to investigate the possibility of partial or complete replacement of mineral fertilizers with organic and biofertilizers on growth and yield. In this respect, Rooster and Devliegher (1998) and Valdes-Mendez *et al.* (1999) on leek, Varu *et al*. (1997) and Khalil *et al.* (2002) on onion, they mentioned that vegetative growth parameters and yield were the higher with application of organic manure plus half rate of mineral fertilizers than recommended mineral fertilizer alone. Moreover, Shen *et al.* (2005) on leek and Devi and Limi (2005) on onion reported that combination of *Azospirillum* and phosphotika with 75 kg N, 45 kg P_2O_5 + 30 kg K_2O / ha resulted in the maximum bulb yield of onion compared with the recommended rate 90 kg N, 60 kg P_2O_5 and 30 kg K_2O/ha. .Sulphur fertilizer improved growth and yield of leek or garlic plants by increasing number of leaves per plant, plant heigh, fresh and dry weight of plants (Eppendorfer and Eggum, 1996 and Wani 2005).

On the other hand, Meena and Singh (1998) and Abbey *et al.* (2002) pointed out that increasing S application rates increased growth characters and yield of onion but higher level caused antagonistic effect. S was more effective in the presence than in the absence of organic manure (Khalaf and Taha, 1988). The application of S reduced the nitrate content of bulb onion (Losak, 2005).

Thus, the aim of this study was carried out to investigate the possibility of partial or complete replacement of mineral fertilizers (NPK) with organic, bio and/ or sulphur fertilizers either alone or in combination on growth, yield and nutritive values of leek plant, such as nitrate accumulation, minerals, protein, carbohydrates and amino acids .

MATERIALS AND METHODS

The present study was carried out at the Agricultural Experimental station, Faculty of Agriculture, Cairo University, Giza, Egypt in the two successive seasons (2003-2004 and 2004-2005). The mechanical and chemical analysis of the experimental soil was carried out according to Jackson (1962) and shown in Table (1) as average in both seasons.

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Table (1): Physical and chemical characteristic of experimental soil

Clay %	Silt %	Fine sand %	Coarse sand %	$CaCO_3$ %	pH	EC ds/m	Organic mater %	Total N %	P_2O_5 ppm	K_2O ppm
20.0	41.7	30.6	7.7	1.3	7.8	1.01	2.00	0.1	31.1	105.8

Seeds of leek (*Allium porrum* L.) cultivars, namely, Bleustar (from Enzazaden Co., Holland) were sown in the nursery on 12th August in the two seasons. At 60 days from sowing the seedlings were transplanted to the field at 20 cm apart on ridge 70 cm width and 4 meter length. The experiment unit consisted of 4 ridges formed 11.2 m^2 area. Furrow irrigation system was followed in both seasons.

The experiment included 36 treatments arranged in split-split plot design (using three replicates for each treatments) as follows:

1-Main plot treatments which included 4 different treatments:

a- Mineral fertilizers NPK (as recommended by the Ministry of Agriculture) in which the NPK mineral fertilizers were added at the rates of 90 kg N/fed. as 440 kg ammonium sulphate /fed. (20.5 % N), 60 kg P_2O_5/fed as 400 kg calcium superphosphate (15.5% P_2O_5) and 50 kg K_2O /fed. as 100 kg potassium sulphate (48.50 % K_2O).

During the soil preparation calcium super phosphate was added, while N and K fertilizers were divided into two equal portions to be added at 30 and 60 days after transplanting.

b- Organic manure (OR) fertilizers in which the amount of organic manure added depending on and equal to the amount of N in mineral fertilizer (90 kg N/fed.).The organic manure was a combination of cattle manure (3tons/fed.) and chicken manure (1.5tons/fed.) on 1:1 ratio. The chemical analysis of organic manure fertilizers was as shown in Table (2) as average in both seasons.

Table (2): Chemical analysis of chicken and cattle manure used at experimental period.

Fertilizers	Organic matter %	pH	EC ds/m	N %	P %	K %
Chicken manure	65.7	8.01	2.3	2.1	1.1	0.92
Cattle manure	73.2	7.90	2.1	1.05	0.5	0.71

Organic manure fertilizers were added during the soil preparation.

c- Mixture of mineral fertilizers (MN) and organic manure (OR) at the ratio of 1 : 1 (½ MN + ½ OR).

d- One and half dose of organic manure fertilizers (1½ OR) which equal to 135 kg N/fed.

2- Sub main plot treatments in which each of the previously main plot treatment received three different biofertilizers treatments as follows:

a) Without inoculation (W).

b) Inoculation with nitrobien (T), *Azotobacter* sp. + *Azotopirrllum* sp.

c)Inoculation with microbien (K) which included *Azotobacter* + *Azospirillum* sp. + *Bacillus megaterium* + *Pesudomonas*.

Roots of leek transplants were dipped into the biofertilizers prepared solution before transplanting.

3- Sub-sub main plot treatments in which each sub-plot treatment received three different sulphur fertilizer levels; S_0 (0.0g/l), S_1 (0.5 g S/1) and S_2 (1.0 gS/1) sprayed every 10 days intervals starting at 30 days from transplanting.

Vegetative growth and yield components were recoded at 135 days from transplanting as follows: plant height, number of leaves/plant, plant and leaves fresh weights, dry matter % , length, diameter and weight of pseudo – stem (the extended leaf sheaths and young leaf blades), and total yield (plants of each plot were harvested and weighted in kg/plot then it calculated to ton/fed.

Nutritive values of pseudostem: Samples of pseudostem at harvesting were taken and dry matter percentage was determined.

Determination of N, P and K were carried out on the ground dry materials of plants which were digested using sulfuric acid, salicylic acid and hydrogen peroxide according to Linder (1944). Nitrogen was determined using the micro-kejeldahl apparotus of Parnos – Wagner as described by Van Schouwenburg and Walinga (1978). Phosphorus was estimated colorometically by using chlorostannous reduced molybdophosphoric blue color method according to Chapman and Parker (1961). Potassium was determined using the flame photometer . NO_3 – N was determined in distilled water extracts of dried tissue by the procedure of Cataldo *et al*. (1975) by using salicylic acid and then calculated as mg / 100 gram fresh weight. Total carbohydrates were determined in the dry matter by using the phenol sulphuric acid reagent according to Dubois et al. (1956). Individual and total amino acids percentage were determined according to the method described by Widner and Eggum (1966). Oxidation was carried out by using performing acid, to protect methinonine and cysteine from destruction during acid hydrolysis, following acid hydrolysis in the oven at 110^{o}C for hours. High performance amino acid analyzer, Backman 7300 was used for amino acids determination. Volatile oil percentage was determined using the return flow microdistillation apparatus, according to the procedure adopted form Guenther(1952).For the determination of sulphur ,by ashing of pseudostem was carried out according to A.O.A.C (1975) with using magnesium nitrate at 400C and then sulphur was precipitate as barium sulphate by using barium chloride. Sulphur was calculated from the weight of barium sulphate by using 0.1374 as a factor to convert the weight of barium sulphate to sulpur.

Statistical analysis:

Data for growth, yield and chemical composition were statistical analysis using a Micro computer Program for the Design, Management and Analysis of Agronomic Research Experiments Original Version . Significance of the differences between treatments was estimated as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1-Vegetative growth characters :

1.1-Effects of the sources and levels of fertilizers:

Data presented in Tables (3-6) indicated that the effect of different sources and levels of fertilizers on vegetative growth characters which were significant in both seasons.

1.1.1-Plant height**:** data presented in Table (3) indicated the effect of sources and levels of fertilizers on plant height were significant in both seasons. In the first season, application of organic (OR) or mineral fertilizers (MN) caused the tallest plants without significant . Full and half dose of organic fertilizers (1½ OR) resulted in the shortest plants. In the second season, the plants received the mixtures of organic and mineral fertilizers (½ OR + ½ MN) or mineral fertilizers (MN) were the tallest ones without significant. Meanwhile, plants received organic manure (OR) were the shortest ones.

1.1.2-Number of leaves per plant**:**.(Table 3) Leek plants fertilized with the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) recorded the highest number of leaves per plant in both seasons. Meanwhile the application of full and half dose of organic manure (1½OR)or mineral fertilization (MN) caused the lowest values in the first and second seasons, respectively.

1.1.3-Plant fresh weight**:** (Table 4) **l**eek plants received the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) were the heaviest, while those fertilized with mineral fertilizers (MN) gave the lowest values in both seasons.

1.1.4-Fresh weight of leaves: (Table 4) applying the mixture of organic manure and mineral fertilizer(½ OR + ½ MN) resulted in the highest fresh weight of leaves. However, the application of organic manure(OR) caused the lowest values in both seasons.

1.1.5-Pseudostem height**:** (Table 5) Application of the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) or mineral fertilizers (MN) caused the tallest pesudostem in the first and second seasons, respectively. In contrary, the shortest ones were obtained by applying mineral fertilizer (MN) or the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) in the first and second seasons, respectively.

1.1.6-Pseudostem diameter**:** (Table5)The highest Pseudostem diameter were obtained with the application of the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) or full and half dose of organic manure (1½ OR) in the first and second seasons, respectively. Plants received mineral fertilizers (MN) had the lowest values in both seasons.

1.1.7-Fresh weight of pseudostem: (Table6) The highest fresh weight of pseudostem were obtained with applying full and half dose of organic manure (1½ OR) or the mixture of organic manure and mineral fertilizers (½ OR + ½ Mn) in the first and second seasons, respectively. On the other hand, the lowest values were recorded by plants received mineral fertilizers (MN) in both seasons.

1.2Effects of biofertilizers:

The effect of biofertilizers on vegetative growth characters were significant, data presented in Tables (3-6) indicated that the highest values

were obtained when inoculated leek plants with microbein (K) followed by nitrobein (T) in both seasons, expect number of leaves per plant and height of pseudostem gave the highest values when inoculated plants with nitrobien (T) in the second season as well as diameter of pseudostem in the first season. On the other hand, without application biofertilizers the values of vegetative growth characters significantly decreased compared with inoculated leek plants.

1.3Effect of sulphur spraying:

Data presented in Tables (3-6) indicated that foliar application with sulphur significantly affected the most vegetative growth characters in both seasons. The plants sprayed with 0.5 gm/l. (S_1) gave the higher values of vegetative growth characters than ones sprayed with 1gm/l. (S_2), while the plants not spraying with sulphur (S_0) had the lowest values in both seasons. However, the effects of sulphur foliar spraying on leaves number per plant as well as length and diameter of pseudostem were not significant in the second season.

1.4Effect of the interaction between sources and levels of fertilizers and biofertiliers :

The effect of the interactions between sources and levels of fertilizers and biofertilizers on vegetative growth characters were significant in both seasons(Tables 3-6) The highest values of plant height, fresh weight of plant, leaves and pseudostem as well as number of leaves per plant and length of pseudostem were obtained by applying mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and inoculated plants with microbein (K), expect diameter of pseudostem which had the highest values with application the mixture of organic manure (½ OR + ½ MN) and inoculated with nitrobein (T), in the first season.

Meanwhile, in the second season the highest values of plant height and number of leaves per plant as well as fresh weight and diameter of pseudostem were obtained by adding the mixture of organic fertilizer and mineral fertilizers (½ OR + ½ MN) and inoculated plants with nitrobien (T), expect fresh weight of plant and leaves which had the highest values with application ½ OR + ½ MN and inoculation plants with microbein (K) as well as length of pseudostem which the highest with applying full and half dose of organic manure (1½ OR) and inoculation with nitrobein (T).

On the other hand, leek plants received mineral fertilizers (MN) without inoculation had the lowest values of fresh weight of plants, number of leaves per plant, fresh weight and diameter of pseudostem in both seasons as well as fresh weight of leaves in the second season.

However, length of plant and pseudostem were the shortest with application full and half dose of organic manure without inoculation plants with biofertilizer (W) in both seasons as well as fresh weight of leaves in the first season. Association of biofertilizers with organic manure caused significant increasing in vegetative growth parameters comparing to mineral fertilizers.

1.5Effect of the interaction of sources and levels and sulphur spraying:

The effect of the interactions between the sources and levels of fertilizers and spraying sulphur on vegetative growth characters were

significant in both seasons(Tables 3-6). Leek plants received the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and sprayed with sulphur at the rate of 0.5 g/l (S_1) had the highest values of fresh weights of plant, leaves, pseudostem and number of leaves in both seasons as well as length and diameter of pseudostem in the first season. However, in the second season the tallest plants and pseudostem were obtained when applying mineral fertilizers (MN) followed by the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and sprayed with sulphur at the rate of 0.5 g/l On the other hand, the tallest plants were obtained with application organic manure (OR) and spraying sulphur at the rate of 0.5 mg/l. in the first season as well as the lowest values of pseudostem diameter were obtained by applying full and half dose of organic manure (1½ OR) followed by mineral fertilizers (MN) and spraying sulphur at the rate of 0.5 g/l (S_1) in the second season. Application of mineral fertilizers (MN) without spraying sulphur (S_0) caused the lowest values of fresh weight of plants, leaves and pseudostem as well as number of leaves per plant and diameter of pseudostem in both seasons. Meanwhile, the shortest plants and pseudostem were obtained when applying full and half dose of organic manure (1½ OR) or organic manure (OR) without spraying sulphur (S_0) in the first and second seasons, respectively.

1.6Effect of the interactions between biofertilizers and sulphur spraying:

With respect to the effect of interactions between biofertilizers and foliar application with sulphur on vegetative growth characters the results revealed significant effects in both seasons (Tables 3-6).

The highest values of plant height, fresh weight of plant, leaves and pseudostem and length of pseudostem in both seasons as well as number of leaves per plant in the first season were obtained by applying microbein (K) and spraying sulphur at the rate of 0.5 g/l (S_1). Meanwhile, the highest values of pseudostem diameter in the first season and number of leaves per plant in the second season were obtained with application nitrobien (T)and spraying sulphur at the rate of 0.5 g/l (s_1). On the other hand, the lowest values of most vegetative characters were recorded by unionculated plants which were not sprayed with sulphur.

1.7Effects of the interaction between sources and levels of fertilizers x biofertilizers x sulphur:

Data presented in Tables (3-6) indicated that the interactions between the sources and levels of fertilizers, biofertilizers and sulphur foliar spraying on vegetative growth characters were significant in both seasons. The highest values of fresh weights of plant, leaves and pseudostem, number of leaves and diameter of pseudostem as well as height of plant or pseudostem were recorded by plants received the mixture of organic manure and mineral fertilizers (½OR+½ MN), organic manure (OR) or full and half dose of organic (1½OR) and inoculated with microbein (K) (for most vegetative growth characters) or nitrobein (T) and spraying suphur at the rate of 0.5 gm/l (S_1). On the other hand, the lowest values of most characters were obtained by the plants fertilized with mineral fertilizers without inoculation or spraying with sulphur.

It concluded that, it can partially replace mineral fertilizers with the mixture of organic manure and mineral fertilizer or complete replacement it with organic manure or full half of dose organic manure and inoculated plants with microbein or nitrobein and foliar spraying with sulphur at the rate of 0.5 g/l.

2-Total yield :

Data presented in Table (6) indicated the effect of different sources and levels of fertilizers, biofertilizers and foliar spraying with sulphur on yield which were significant. Using the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) caused the higher yield compared to full and half amount of organic manure (1½ OR) followed by organic manure (OR) then mineral fertilizers(MN) which significantly decreased the yield, in both seasons. Inoculated leek plants with microbein (K) resulted in the heaviest yield followed by nitrobein (T). Whereas uninoculated leek plants gave the lowest values in both seasons. Foliar application with sulphur had a pronounce effect on yield. Leek plants sprayed at the rate 0.5 g/l (S_1) significantly increament the yield compared with sulphur sprayed at 1.0 g/l (S_2). Leek plants non-sprayed with sulphur gave the lowest values. Regarding the effect of all interactions on yield, they were significant in both seasons.

The interaction between sources and levels of fertilizers and biofertilizers inoculation was significant, in both seasons (Table 6). Using the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and inoculation with microbein (K) followed by nitrobein (T) led to the highest yield. Meanwhile application mineral fertilizer without inoculation resulted in the lowest values.

The effect of the interaction between sources levels of fertilizers and foliar application with sulphur on yield was significant. Application of the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and spraying sulphur at 0.5 g (S_1) followed by 1.0 g (S_2) resulted in the highest yield.

Inoculation leek plants with microbein (K) followed by nitrobein (T) and spraying with sulphur at 0.5 g /l. led to the highest values in both seasons. Uninoculated leek plants unsprayed sulphur or sprayed by sulphur at 0.5g/l in the first or second season, respectively gave the lowest values. The interactions between the sources and levels of fertilizers, biofertilizers and sulphur spraying were significant. The highest yield were obtained with applying full and half does of organic manure (1½ OR) followed by the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) with inoculated plants with microbein (K) and sprayed plants with sulphur at the rate of 0.5 g/l (S_1) in the first season. Meanwhile, in the second season the highest yield were obtained within the interaction ½ OR + ½ MN x K x S_1 .

Leek plants supplied with mineral fertilizers without inculcation and unsprayed with sulphur gave the lowest values in first season, while in the second season, mineral fertilizer without inoculation and sprayed with sulphur at 0.5g/l gave the lowest values.

The present results are in agreement with previous reports which revealed that the mixture of LEDA (Liquid effluent obtained from cow dung)

and chemical fertilizer gave the best results in terms of leaf number of leek plants compared with chemical fertilization alone or organic fertilizers alone (Serrano *et al.,* 1995). An increase were tabulated on number of leaves/plant, plant height, bulb diameter, bulb weight and yield of onion were recorded with application farmyard manure+ NPK (half rate) compared to NPK (Varu *et al.,*1997). Moreover, slurry (obtained from anaerobic digestion of filter cake) had a positive effect on length and width of leaves as well as fresh and dry weight of leek plants. Increasing production by 64% compared to the control (NPK) (Valdes-Mendez *et al.,* 1999).

It was clear from data presented in Tables (3-6) that using the mixture of nitrogen fixing bacteria and phosphate dissolving bacteria combined with organic manure or mineral fertilizer led to increment in vegetative growth characters compared to mineral fertilizers alone.

In these respect, shoot growth in onion was similar with or without mycorhizae (Am) inoculation when treated with controlled release inorganic fertilizers (CRI), but in general it was only enhanced by organic fertilizers (OR) if inoculated with AM compared to the non-inoculated controls (Linderman and Davis, 2004). Combination of *Azotosprillium sp*. and phosphotika with N, P_2O_5 and K_2O resulted in maximum leaf area, dry matter and yield of onion compared to the recommended rate of N, P_2O_5 and K_2O (Devi and Limi, 2005). Height, leaf broad and yield of leek were increased by 12.2 and 13.32% with the application of microcystis fertilizers when mixed with organic and inorganic fertilizers (Shen *et al.,* 2005). Moreover, he present results are not a surprise because phosphate dissolving bacteria (*Basillus+Pasedomonas*) have the ability to bring insoluble phosphate in soil into soluble forms by producing organic acids such as formic, acetic, propionic, lactic and succinic acids, organic acid especially α – hydroxy and 2- Keto-gluconic acids, which have the capability to reduce the soil pH level and bring about the dissolution of bound forms of phosphate (El Borollosy, 1999). Meanwhile, the use mixture in the present study contains also nitrogen fixing bacteria; belong mainly to *Azotobacter chroocoum* and *Azospirillum lipoferum*. Such bacteria live naturally either free in soil or associated at the root surface (Rhizospher), and also within intercellular spaces of cortex cell (Dobeiner, 1983). Beside the vital role of such bacteria in nitrogen fixation it has been also documented that these sorts of bacteria are able to synthesize and secrete, thiamine, riboflavian pyridoxine, nicotinic, pantothenic indole acetic acids and gibberellins (Subba Rao, 1982).

Organic fertilizer have advantages over mineral nitrogen. It is postulated that they release nutrients slowly, they are source of trace elements as well as they improve soil structure and increasing soil organic matter content.

Furthermore, using sulphur caused also significant simulative effect on vegetative growth and dry matter (Eppendorfer and Eggum, 1996). Onion plants grown under S-deficient condition had fewer leaves (Ajay and Onkar, 1999). Bulb fresh and dry weight was significantly less at low S rates (Hamilton *et al.,* 1997 and Lancaster *et al.,* 2001).

Sulphur fertilizer increased yield by increasing the number of leaves/plant, height diameter of stem, fresh and dry weights of bulb

(Summantra and Tiwari, 1997; Alam *et al.,* 1999; Nagaich *et al.,* 1999; Suman – Smriti *et al.,* 2002; Nagaich *et al*., 2003; Jaggi 2004, 2005 and Jaggi *et al.,* 2006). On the other hand, there was no further increase in vegetative growth of onion when more increasing S rate (Abbey *et al.*, 2002). Higher level of sulphur caused an antagonistic effect (Meena and Singh, 1998).

With regard to the interaction between sulphur and nitrogen, Coolong *et al., (*2004) and Losak (2005) reported that bulb fresh and dry weights were affected by both sulphur and N treatment.

With regard to the interaction between organic manure and sulphur, Khalaf and Taha (1988) working on garlic reported that high rate of S was more beneficial than low one. Values of interaction between organic manure and S showed that S was more effective in the presence than in the absence of organic manure.

Regarding to the yield of leek, the highest yield were obtained with a combination of organic manure with mineral fertilizers compared to organic manure or mineral fertilizers alone, Goto and Kimoto, 1992; Serrano *et al.,* 1995; Singh *et al.,* 1997; Rooster and Devliegher, 1998; Rumpel, 1998 and Zhang *et al.,* (1998) reported that combination of organic manure with NPK fertilizers increased the yield of garlic by 78.4 – 118.4%.

Also, Khalil *et al.,* (2002) and Qiao *et al.,* (2005) reported that the highest marketable yield of onion were recorded for chicken manure and NPK which more effective than FYM.

As mentioned before, biofertilizer in combination with mineral fertilizer and/or organic manure caused the higher yield compared to organic manure or mineral fertilizer alone. Similar results were obtained by Bhonde *et al*, 1997, Agudelo and Casierra, 2004 and Devi and Limi, 2005.However, Lundegardh *et al.,(*2008) reported that yield was increased only at the highest dose of compost and the highest dose of mineral fertilizers.

Concerning the effect of sulpher , both organic manure and S fertilizer were very beneficial for garlic plant growth, total yield. The high S rate was more beneficial than low one. Values of interaction between organic manure and S showed that S was more effective in the presence than in the absence of organic manure. (Khalaf and Taha, 1988). Yield and plant N content significantly increased with increased rate of N. Yield and plant S content significantly increased with increasing rate of S. combined addition of N + S significantly affected yield (Harendra-Singh *et al.,* 1996 and Bybordi *et al.,*1998). Also, Vinay-Singh *et al.,* (1995) Anez *et al.,* (1996) Summantra and Tiwari (1997), Suman-Smriti *et al.,* (2002) Majumdar *et al.,* (2003) and Nagaich *et al.,* (2003) reported that bulb yield of garlic increased significantly with increasing rate of applied S. Jaggi 2004; Jaggi 2005 ; Jaggi *et al.,* 2006 and Sankaran *et al.,*(2005) investigated the effects of S levels on onion. The results showed that bulb yield increased with increasing S rate up to 30 kg/ha and it increased by 105% over no S.

Table 3: Plant height (cm) and number of leaves of leek plant as affected by different fertilizers sources (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Growth character	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s)	Sulphur g/1				Sulphur g/l			
		Biofertilizer (b)	0.0	0.5	1.0	Mean	0.0	0.5	1.0	Mean
Plant Height (cm)	MN	Without	72.1	78.7	70.7	73.8	71.3	72.3	70.6	71.4
		nitrobein	74.7	74.4	76.5	75.2	69.8	72.5	65.7	69.3
		microbein	74.7	77.2	77.1	76.3	74.7	82.5	733	76.9
		Mean	73.8	76.8	74.8	75.1	71.9	75.7	69.9	72.5
	OR	Without	73.8	79.0	71.0	74.6	63.6	62.5	71.3	65.8
		nitrobein	79.8	77.8	71.5	76.4	66.3	73.6	73.3	71.1
		microbein	75.3	78.9	74.3	76.2	62.7	67.4	72.2	67.4
		Mean	76.3	78.5	72.3	75.7	64.1	67.8	72.3	68.1
	1/2 MN + 1/2 (OR)	Without	70.8	71.1	69.5	70.5	70.9	73.8	67.6	70.8
		nitrobein	74.9	75.7	73.1	74.6	69.1	77.6	78.5	75.1
		microbein	75.9	77.3	76.6	76.6	71.7	74.6	75.7	74.0
		Mean	73.6	74.7	73.1	73.8	70.0	75.3	73.9	73.2
	1 1/2 OR	Without	65.8	69.9	66.3	67.3	66.4	69.0	63.0	66.1
		nitrobein	70.2	74.2	70.6	71.7	74.8	68.1	72.5	71.8
		microbein	68.9	80.6	72.3	73.9	70.0	78.1	66.4	71.5
		Mean	68.3	74.9	69.7	70.9	70.4	71.7	67.3	69.8
	Interaction b*s	Without	70.6	74.7	69.4	71.6	68.0	69.4	68.1	68.5
		nitrobein	74.9	75.5	72.9	74.4	70.0	73.0	72.5	71.8
		microbein	73.47	78.4	75.1	75.8	69.8	75.6	71.9	72.4
		Mean	73.1	76.2	72.5		69.3	72.4	70.8	
No. of leaves/plant	MN	Without	9.7	11.3	10.7	10.5	10.4	10.7	11.6	10.9
		nitrobein	10.7	11.1	10.9	10.9	11.8	11.2	10.8	11.3
		microbein	10.9	11.2	10.9	11.0	11.0	11.2	11.4	11.2
		Mean	10.41	11.2	10.7	10.9	11.0	11.0	11.3	11.12
	OR	Without	11.1	11.5	10.6	11.1	11.4	11.4	12.0	11.6
		nitrobein	11.0	11.6	11.0	11.2	11.6	11.8	11.2	11.95
		microbein	11.0	11.8	11.1	11.3	11.9	11.4	10.6	11.23
		Mean	11.0	11.6	10.9	11.2	11.6	11.5	11.3	11.5
	1/2 MN + 1/2 (OR)	Without	11.1	11.3	10.9	11.1	11.4	11.8	12.0	11.7
		nitrobein	12.0	12.2	11.1	11.8	12.1	12.4	12.6	12.4
		microbein	11.7	13.0	12.8	12.5	11.9	11.7	12.2	11.9
		Mean	11.6	12.9	11.6	11.8	11.8	12.0	12.3	12.02
	1 1/2 OR	Without	10.2	11.6	10.0	10.6	11.3	11.6	12.6	11.8
		nitrobein	10.5	11.2	10.4	10.8	11.9	13.4	11.4	12.2
		microbein	10.9	11.0	10.0	10.6	11.8	11.9	11.3	11.7
		Mean	10.6	11.3	10.3	10.7	11.7	12.3	11.8	11.9
	Interation b*s	Without	10.6	11.4	10.5	10.8	11.1	11.4	12.1	11.5
		nitrobein	11.0	11.5	11.0	11.2	11.8	12.2	11.5	11.8
		microbein	11.1	11.8	11.2	11.4	11.7	11.5	11.3	11.5
		Mean	11.0	11.6	10.9		11.5	11.7	11.6	

LSD 0.05

Growth character	Season	f	b	S	f*b	f*s	b*s	f*b*s
Plant Height (cm)	1st	1.52	1.60	1.40	3.20	2.90	2.50	4.95
	2nd	3.60	2.50	1.90	4.90	3.83	3.30	6.65
No. of leaves	1st	0.48	0.37	0.3	0.74	0.61	0.53	1.06
	2nd	0.48	0.25	NS	0.51	0.61	0.53	1.07

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. . 1/2 MN + 1/2 OR(1:1)

Table 4: Plant and leaves fresh weights (g) of leek plant as affected by different fertilizers sources (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Growth character	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s) Biofertilizer(b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
Plant fresh Weight (g)	MN	Without	217.8	306.0	265.5	263.0	191.3	183.8	245.2	206.8
		nitrobein	231.3	304.2	270.0	268.5	223.3	242.5	266.7	244.2
		microbein	252.0	342.0	310.5	301.0	261.7	282.0	244.2	262.6
		Mean	233.7	317.0	282.0	277.7	225.4	236.1	252.0	237.8
	OR	Without	243.0	308.7	270.0	273.9	263.3	245.9	281.5	263.6
		nitrobein	262.8	307.8	303.8	291.5	205.8	235.8	245.8	229.1
		microbein	277.2	315.0	310.5	300.9	255	280.5	228.2	254.5
		Mean	261.0	310.5	294.8	288.5	241.4	254.1	251.8	249.1
	1/2 MN + 1/2 (OR)	Without	283.5	310.5	306.0	300.1	267.8	280.0	313.8	287.2
		nitrobein	307.8	351.0	328.5	329.1	290.8	331.6	295.0	305.8
		microbein	310.5	353.7	351.0	338.4	298.3	335.0	295.9	309.5
		Mean	300.6	338.4	328.6	322.5	285.6	315.5	301.5	300.9
	1 ½ OR	Without	263.7	279.9	274.5	272.7	270.9	250.0	224.2	248.3
		nitrobein	285.3	329.4	324.0	312.9	260.8	304.2	240.9	268.6
		microbein	270.0	364.5	325.8	320.0	248.4	327.6	243.4	273.1
		Mean	273.0	324.6	308.1	301.9	260.0	293.9	236.2	263.3
	b*S interaction	Without	252.0	301.2	279.1	277.5	248.3	239.9	266.1	251.5
		nitrobein	271.8	323.1	306.6	300.5	245.2	278.5	262.1	261.9
		microbein	277.4	343.8	324.5	315.2	265.9	306.2	252.9	275.0
		Mean	267.1	322.7	303.4		253.1	274.9	260.4	
Leaves fresh weight (g)	MN	Without	144.7	280.9	157.5	194.4	169.4	176.5	205.9	183.9
		nitrobein	144.4	194.9	167.4	168.9	181.6	196.7	177.5	185.3
		microbein	163.8	203.4	198.4	188.5	189.5	212.9	195.8	199.4
		Mean	151.0	226.0	174.4	183.9	180.1	195.4	193.0	189.5
	OR	Without	146.6	205.2	170.7	174.2	165.4	155.5	171.5	164.7
		nitrobein	162.0	198.0	177.0	179.0	125.0	140.4	153.3	140.7
		microbein	164.6	181.6	182.3	176.2	157.5	173.0	136.5	155.7
		Mean	157.7	194.9	176.7	176.7	153.7	156.3	153.6	154.3
	1/2 MN + 1/2 (OR)	Without	189.0	216.1	198.0	201.0	170.9	146.7	132.5	150.0
		nitrobein	202.9	234.4	214.7	217.3	167.9	200.7	150.5	173.0
		microbein	190.8	231.4	234.3	218.8	149.7	202.2	153.9	168.6
		Mean	194.3	227.3	215.6	212.4	162.8	183.2	145.6	163.9
	1 ½ OR	Without	162.4	168.8	177.1	169.5	123.4	125.0	125.6	124.7
		nitrobein	175.9	198.0	214.9	196.3	135.0	155.4	186.7	159.3
		microbein	156.4	234.4	209.3	200.0	177.5	170.4	155.9	167.9
		Mean	164.9	200.4	200.5	188.8	145.3	150.2	156.1	160.5
	b*S interaction	Without	160.7	217.8	175.9	184.8	157.2	150.9	158.8	155.7
		nitrobein	171.3	206.3	193.5	190.4	153.2	173.3	167.0	164.5
		microbein	168.9	212.7	206.1	195.9	168.5	189.6	160.5	172.9
		Mean	167.0	212.3	191.0		159.7	171.3	162.1	

LSD 5%

Growth character	Season	f	b	S	f*b	f*s	b*s	f*b*s
Plant fresh weight	1st	4.80	3.20	2.70	6.30	5.40	4.76	9.34
	2nd	8.20	7.80	9.90	15.50	19.90	17.20	34.1
Leaves fresh weight	1st	1.90	1.20	1.30	2.40	2.60	2.30	4.52
	2nd	4.40	4.60	7.10	9.20	14.30	12.40	24.80

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. . 1/2 MN + 1/2 OR(1:1)

Table 5: Diameter of pseudo-stem) and Pseudo stem height (cm) of leek plant as affected by different fertilizers source (minerals and organic), biofertilizers (nitrobien and microbien) and sulphur fertilizer

Growth character	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s) Biofertilizer(b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
pseudo-stem diameter (c.m)	MN	without	3.1	3.8	3.5	3.4	3.1	3.4	3.8	3.4
		Nitrobien	4.2	5.0	5.2	4.8	3.5	3.4	3.4	3.5
		Microbien	3.8	4.0	3.9	3.9	3.6	3.7	3.9	3.8
		Mean	3.7	4.3	4.2	4.0	3.4	3.5	3.7	3.5
	OR	without	4.4	4.9	4.7	4.7	3.3	3.8	3.8	3.6
		nitrobein	4.2	5.1	4.9	4.7	3.5	3.5	3.4	3.4
		microbein	4.6	4.8	4.8	4.7	4.0	3.6	3.5	3.7
		Mean	4.4	5.0	4.8	4.7	3.6	3.6	3.6	3.6
	1/2 MN + 1/2 (OR)	without	4.9	5.0	4.7	4.9	3.8	3.6	3.5	3.6
		nitrobein	5.1	5.5	5.2	5.3	3.9	4.1	4.1	4.0
		microbein	5.2	5.3	5.1	5.2	3.9	4.1	3.7	3.9
		Mean	5.1	5.3	5.0	5.1	3.9	3.9	3.8	3.9
	1 1/2 OR	without	4.2	4.9	4.5	4.6	3.8	3.9	3.6	3.8
		nitrobein	4.7	5.0	4.7	4.8	4.3	3.8	3.8	3.9
		microbein	4.8	5.2	5.1	5.0	4.2	3.9	3.7	3.9
		Mean	4.6	5.0	4.8	4.8	4.1	3.9	3.7	3.9
	interaction b*S	without	4.2	4.7	4.3	4.4	3.6	3.9	3.5	3.6
		nitrobein	4.5	5.2	4.9	4.9	3.8	3.7	3.7	3.7
		microbein	4.6	4.8	4.7	4.7	3.9	3.6	3.8	3.8
		Mean	4.4	5.0	4.7		3.7	3.7	3.7	
Pseudo stem height (cm)	MN	without	9.3	9.8	9.6	9.6	10.8	10.8	10.4	10.7
		nitrobein	8.8	10.3	9.4	9.5	10.8	10.1	10.6	10.5
		microbein	10.0	11.0	9.7	10.2	11.3	12.0	10.4	11.3
		Mean	9.4	10.4	9.6	9.8	11.0	11.0	10.4	10.8
	OR	without	9.9	10.4	9.4	9.9	9.6	10.0	10.3	10.0
		nitrobein	10.1	10.3	10.7	10.4	10.8	11.4	10.5	10.9
		microbein	11.2	12.0	10.4	11.2	10.5	10.8	10.1	10.5
		Mean	10.4	10.9	10.2	10.5	10.3	10.7	10.3	10.4
	1/2 MN + 1/2 (OR)	without	9.5	10.3	10.1	9.9	9.3	11.3	10.4	10.3
		nitrobein	10.5	11.9	10.8	11.1	11.1	9.8	10.1	10.3
		microbein	11.6	12.0	11.2	11.6	9.9	11.1	10.7	10.6
		Mean	10.6	11.4	10.7	10.9	10.1	10.7	10.4	10.4
	1 1/2 OR	without	8.5	10.05	8.9	9.2	10.9	9.2	9.7	9.9
		nitrobein	9.6	11.6	10.4	10.6	10.2	11.3	12.6	11.3
		microbein	8.4	11.03	9.7	9.7	10.1	11.4	9.7	10.4
		Mean	8.9	10.9	9.7	9.8	10.4	10.6	10.6	10.5
	interaction b*S	without	9.3	10.2	9.5	9.7	10.1	10.3	10.1	10.2
		nitrobein	9.8	11.0	10.4	10.8	10.7	10.6	10.9	10.8
		microbein	10.3	11.5	10.3	10.7	10.5	11.3	10.2	10.7
		Mean	9.8	10.9	10.0		10.5	10.8	10.4	

LSD 5%

Growth character	Season	f	b	s	f*b	f*s	b*s	f*b*s
Diameter of pseudo-stem	1st	0.30	0.2	0.18	0.42	0.36	0.31	0.62
	2nd	0.12	0.14	NS	0.27	0.24	0.21	0.51
Pseudo stem height	1st	0.38	0.38	0.36	0.77	0.72	0.62	1.25
	2nd	0.37	0.33	NS	0.67	0.70	0.61	1.22

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 6: Pseudo stem fresh weight and total yield (tons/fed) of leek plant as affected by different fertilizers source (minerals and organic), biofertilizers (nitrobien and microbien) and sulphur fertilizer

Growth character	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s)	Sulphur g/1				Sulphur g/1			
		Biofertilizer(b)	0.0	0.5	1.0	Mean	0.0	0.5	1.0	Mean
Pseudo stem fresh weight (g)	MN	without	73.3	114.0	108.3	98.5	67.9	58.8	84.5	70.4
		nitrobien	86.9	109.6	102.6	99.7	88.3	87.1	80.0	85.1
		microbien	90.0	122.4	112.1	108.2	84.2	106.7	88.3	93.0
		Mean	83.4	115.4	107.6	102.1	80.0	84.2	84.3	82.8
	OR	without	99.63	104.4	99.3	101.1	98.0	90.4	110.0	99.5
		nitrobien	100.8	109.8	126.71	112.4	80.9	95.4	92.5	89.6
		microbien	96.4	133.3	28.0	119.3	97.5	107.5	91.7	98.9
		Mean	98.9	115.8	118.0	110.9	92.0	97.8	98.2	96.0
	1/2 MN + 1/2 (OR)	without	94.5	94.1	108.0	98.9	98.4	103.5	107.9	103.3
		nitrobien	104.8	116.6	113.8	111.7	109.2	135.0	117.5	120.6
		microbien	114.3	138.2	116.6	123.0	108.8	122.1	100.0	110.3
		Mean	104.6	116.4	112.8	111.2	105.5	120.2	108.5	111.4
	1 1/2 OR	without	100.8	111.0	96.7	102.8	100.0	103.3	91.6	98.3
		nitrobien	109.9	131.4	109.1	117.1	93.0	103.3	90.4	95.6
		microbien	113.6	130.1	116.5	120.1	98.3	125.2	89.2	104.2
		Mean	108.1	124.2	107.7	113.3	97.1	110.6	90.4	99.4
	interaction b*S	without	92.1	105.9	103.1	10.3	91.1	88.8	98.6	92.9
		nitrobien	100.6	116.9	113.2	110.2	92.8	105.2	95.1	97.7
		microbien	103.5	130.2	118.3	117.3	97.2	115.4	92.3	101.6
		Mean	98.7	117.6	111.5		93.7	103.2	95.3	
Total Yield (tons/fed)	MN	without	14.520	20.400	17.700	17.540	12.753	12.253	16.347	13.780
		nitrobien	15.420	20.280	18.000	17.900	14.887	16.167	17.780	16.280
		microbien	16.800	22.800	20.700	20.100	17.447	18.800	16.280	17.510
		Mean	15.580	21.160	18.8	18.513	15.03	15.740	16.800	15.860
	OR	without	16.200	20.580	18.000	18.260	17.553	16.393	18.767	17.570
		nitrobien	17.520	20.520	20.250	19.430	13.720	15.720	16.387	15.280
		microbien	18.480	21.00	20.700	20.060	17.000	18.700	15.213	16.970
		Mean	17.400	20.700	19.690	19.260	16.090	16.940	16.790	16.610
	1/2 MN + 1/2 (OR)	without	18.902	20.700	20.400	20.000	17.853	18.667	20.920	19.140
		nitrobien	20.520	23.400	21.900	21.940	19.387	22.107	20.92	20.650
		microbien	20.700	23.580	23.400	22.56	19.887	22.333	19.727	20.650
		Mean	20.040	22.560	21.900	21.500	19.040	21.030	20.370	20.15
	1 1/2 OR	without	17.580	18.660	18.300	18.180	18.060	16.667	14.947	16.560
		nitrobien	19.019	21.960	21.600	20.860	17.387	20.280	16.060	17.920
		microbien	18.000	24.300	21.720	21.340	16.415	21.840	16.227	16.160
		Mean	18.200	21.640	20.540	20.127	17.290	19.590	15.750	17.550
	interaction b*S	without	16.800	20.080	18.600	18.500	16.550	15.990	17.740	16.760
		nitrobien	18.125	21.540	20.440	20.030	16.345	18.570	17.680	17.530
		microbien	18.490	22.920	21.630	21.010	17.690	20.420	16.860	18.332
		Mean	17.810	21.510	20.230		16.860	18.330	17.430	

LSD 5%

Growth character	Season	f	b	s	f*b	f*s	b*s	f*b*s
Pseudo stem fresh weight	1st	3.50	2.80	2.00	5.60	3.90	3.39	6.80
	2nd	8.90	3.80	3.70	7.50	7.40	6.46	12.19
Total Yield	1st	0.321	0.212	0.179	0.424	0.359	0.312	0.624
	2nd	1.641	0.524	0.669	1.048	1.339	1.160	2.323

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed
MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 7: Pseudo stem dry matter% of leek plant as affected by different fertilizers sources (minerals and organic),biofertilizers (nitrobein and microbein)and sulphur fertilizers

Nutritive characte	Season		2003-2004				2004-2005			
	Fertilizers sources (F)	Sulphur(s) Biofertilizer (b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
Dry matter % Pseudo stem	MN	without	22.81	24.22	22.50	23.18	23.24	24.18	22.00	23.14
		nitrobein	23.32	25.71	24.40	24.48	22.24	25.52	24.25	24.00
		microbein	22.57	24.80	23.76	23.71	21.96	24.67	23.61	23.41
		Mean	22.90	24.91	23.55	23.79	22.48	24.79	23.29	23.52
	OR	without	22.42	25.81	23.52	23.92	22.34	25.14	23.00	23.49
		nitrobein	25.83	27.91	24.95	26.23	25.61	27.60	24.80	26.00
		microbein	24.13	26.89	23.88	25.00	23.74	27.15	23.95	24.95
		Mean	24.13	26.87	24.12	25.04	23.9	26.63	23.92	24.81
	1/2 MN + 1/2 (OR)	without	21.10	23.90	22.77	22.60	20.67	24.02	23.40	22.69
		nitrobein	21.82	26.08	24.42	24.11	21.42	25.62	24.68	23.91
		microbein	23.97	25.40	23.00	24.12	24.21	25.21	22.90	24.11
		Mean	22.3	25.13	23.4	23.61	22.1	24.95	23.68	23.57
	1 1/2 OR	without	23.02	26.73	22.18	24.00	22.52	25.84	21.66	23.34
		nitrobein	25.92	26.31	26.50	26.24	25.74	25.80	26.30	25.95
		microbein	21.59	25.7	25.70	24.33	21.23	25.62	24.67	23.84
		Mean	23.51	26.25	24.70	24.85	23.16	25.75	24.21	24.38
	Interaction b*S	without	22.34	25.16	22.74	23.42	22.19	24.80	22.51	23.17
		nitrobein	24.22	26.50	25.07	25.26	23.75	26.14	25.01	24.97
		microbein	23.07	25.70	24.08	24.28	22.78	25.66	23.78	24.08
		Mean	23.21	25.79	23.96		22.91	25.53	23.77	

LSD 5%

Growth character	Season	f	B	s	f*b	f*s	b*s	F*b*s
Dry matter%	1st	0.90	0.37	0.43	0.74	0.86	0.75	1.50
	2nd	0.19	0.23	0.17	0.46	0.35	0.31	0.61

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed
MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

3-Nutritive values of leek pseudostem :

3-1 Effects of the sources and levels of fertilizers:

Data presented in Tables (7-11), indicated that the effects of the sources and levels of nutritive values i.e., dry matter, total carbohydrates, volatile oil , protein, nitrogen , phosphorus, potassium and sulphur percentage and nitrate accumulation were significant in both seasons. The highest values of dry matter and total carbohydrates percentage were obtained with application organic manure (OR) followed by full and half dose of organic manure (1½ OR), whereas the lowest values were obtained in plants received the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) followed by those treated with mineral fertilizers (MN) in both seasons.

The highest values of volatile oil, sulphur, phosphorus and potassium percentage, were obtained by applying the mixture of organic manure and mineral fertilizers (½OR + ½ MN) in both seasons as well as nitrogen percentage in the first season. While, the highest values of protein percentage and nitrate accumulation were recorded by plants received mineral fertilizers (MN) in both seasons as well as nitrogen percentage in the second season. The lowest values of phosphorus, nitrogen, and protein

percentage and nitrate accumulation were obtained with application full and half dose of organic manure (1½OR) in both seasons as well as potassium percentage in the first season. On the other hand, leek plants received organic manure (OR) gave the lowest values of sulphur percentage in both seasons as well as potassium percentage in the second season. The lowest values of volatile oil were obtained with application mineral fertilizers (MN) in both seasons.

From the present results, it is clear that addition of organic manure to mineral fertilizes led to increasing the most nutritive values than applying mineral or organic fertilizers alone. In contrary, application of organic manure alone led to the highest values of dry matter and total carbohydrates as well as the lowest value of nitrate accumulation.

3-2Effects of biofertilizers:

Data presented in Tables (7-11) indicated that the effect of biofertilizers on nutritive values were significant in both seasons. Leek plants inoculated with nitrobien (T) had the highest values of protein, nitrogen and potassium percentages in both seasons as well as nitrate accumulation in the first season, while microbein (K) caused the highest values of nitrate in the second season.

Leek plants inoculated with microbein (K) had the highest values of sulphur and phosphorus percentage in both seasons. On the other hand, the highest values of dry matter, total carbohydrates and volatile oil were recorded by plants inoculated with microbien (K) or nitrobien (T) in the first and second seasons, respectively. Non inoculated plant had the lowest nutritive values.

3-3Effects of foliar spraying with sulphur:

The nutritive values of pseudostem significantly affected by spraying sulphur rates in both seasons(Tables 7-11). Leek plants sprayed with 0.5 g/l (S_1) had the highest values of dry matter, total carbohydrates and potassium percentages in both seasons. On the other hand, the highest values of nitrogen, phosphorus, sulphur, protein and volatile oil percentage as well as accumulation of nitrate were obtained with spraying sulphur at 1.0 gm/l compared to plants not sprayed with sulphur which gave the lowest values, in both seasons.

3-4Effect of the interaction between sources and levels of fertilizers and biofertiliers :

Data presented in Tables (7-11) indicated that significant differences were observed between sources and levels X biofertilizers on nutrative values in both seasons. The highest values of dry matter and total carbohydrates percentages were obtained in leek plants received organic manure (OR) or full and half dose of organic manure (1½ OR) and inoculated with nitrobein (T) in both seasons. On the other hand, the highest values of volatile oil percentage was recorded by the plants supplied with organic manure (OR), full dose and half organic manure (1½ OR) or the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and inoculated with microbein (K) in both seasons. The highest values of nitrate accumulation, protein and nitrogen percentages were found in leek plants fertilized with mineral fertilized and inoculated with nitrobien in both seasons.

However, application of organic manure (OR) without inoculation with biofertilizers caused the lowest values of nitrate accumulation in both seasons. Regarding mineral elements, i.e., sulphur, phosphorus and potassium percentages, the highest values of S and P percentages were found in plants supplied with (½ OR + ½ MN) and inoculated with microbein (K) in both seasons as well as potassium in the first season, while the highest values of potassium percentage recorded by plants received MN or ½ OR + ½ MN and inoculated with nitrobien (T) in the first season.

It was observed that leek plants received organic fertilizers or full and half dose of organic fertilizers and inoculation with nitrobien led to incearment on the values of organic matter, total carbohydrate percentage as well as volatile oil when inoculation with microbien. Meanwhile, supplement leek plants with organic manure without inoculation caused decreasing on accumulation of nitrate in pseudostem.

3-5 Effect of the interaction of sources and levels and sulphur spraying:

Data presented in Tables (7-11) indicated that the interaction between sources and levels of fertilizers x sulphur spraying were significant in both seasons. Application of organic manure (OR) and foliar spraying with sulphur at the rate of 0.5 g/l caused the highest values of dry matter and total carbohydrates percentages in pesudostem in both seasons or first season, respectively. Whereas, total carbohydrates were the highest with the application of full and half dose of organic manure (1½ OR) without spraying sulphur in the second season.

Leek plants received mineral fertilizers and sprayed with sulphur at the rate of 1g/l or 0.5g/l resulted in the highest values of nitrogen, protein percentage and accumulation of nitrate in the pseudostem in the first and second seasons, respectively. The lowest values of nitrate were obtained with the application of full and half dose of organic fertilizer (1½ OR) or organic fertilizers without spraying sulphur, in both seasons.

On the other hand, the highest values of volatile oil, sulphur, phosphorus and potassium percentages in pseudostem were the highest when leeks plants fertilized with the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and spraying with sulphur at the rate of 1 g/l in both seasons.

3-6Effect of the interactions between biofertilizers and sulphur spraying:

Data presented in Tables (7-11) indicated that, significant difference were obtained in the interaction between biofertilizers x sulphur on nutritive values in both seasons. Inoculation leek plants with nitrobien (T) and spraying sulphur at the rate of 0.5 g/l caused the highest values of dry matter and total carbohydrates percentages in pseudostem in both seasons. On the other hand, the highest values of potassium, nitrogen and protein percentages as well as nitrate accumulation in pseudostem of plants inoculation with nitrobien (T) and spraying with sulphur at the rate of 1 gm/l in both seasons.

3-7Effects of the interaction between sources and levels of fertilizers x biofertilizers x sulphur:

Data presented in Tables (7-11) indicated that the interactions between f x b x s were significant on nutritive values in both seasons. The highest values of dry matter and total carbohydrates percentages in the pseudostem were obtained with application of organic manure (OR) inoculation with nitrobien and spraying with sulphur at the rate of 0.5 gm/l (for dry matter in both seasons and for total carbohydrates in the first seasons). In the second season total carbohydrates were obtained with applying 1½ OR x T x So.

The highest values of nitrogen, protein and nitrate accumulation in pseudostem were recorded by leek plants supplied with mineral fertilizers(MN) ,inoculated with nitrobien (T) and sprayed with sulphur at the rate of 1 g/l in both seasons. Meanwhile, the lowest values of nitrate accumulation were obtained with applying organic manure (OR) or ½OR+½MN without inoculation biofertilizers or inoculation with nitrobein and without or sulphur spraying at the rate of 0.5g/l in both seasons.

The highest values of volatile oil were obtained with applying the combination of the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) or mineral fertilizer (MN) followed by organic manure (OR) and inoculation plants with nitrobien (T) and sprayed plants with sulphur at the rate of 1 gm/l in the first and second seasons, respectively.

Application of the mixture of organic manure and mineral fertilizer (½ OR + ½ MN) and inoculation with microbien (K) and spraying with sulphur at the rate of 1g/l resulted in the highest values of sulphur percentage as well as phosphorus percentage when spraying sulphur at the rate of 0.5 gm/l in both seasons. The highest values of potassium percentage were recorded by plants received organic manure (OR) and inoculated with microbein (K) or the mixture of organic manure and mineral fertilizers (½ OR + ½ MN) and inoculated with nitrobein (T) and spraying with sulphur at the rate of 1 g/l in the first and second seasons, respectively.

The effect of different sources of fertilizers (minerals, organic, bio and sulphur fertilization) on amino acids components (essential, non-essential, total as well as its individual), it is clear from the results in Table (12-13) that the plants supplied with mineral fertilizes by the recommended dose of NPK tended to recorded the highest values of amino acids (essential, non-essential, total and individual) when compared with those supplied with different does of organic fertilizer (half, complete as well as the one and half complete organic dose), with some exceptions.

Moreover, the data in Tables (12-13) indicated that under mineral fertilization, the concentrations of essential, non-essinitial, total and individual amino acids were increased by the plants supplied with the different two doses of sulphur, nitrobein or microbien either alone or in combination, with some exceptions. However, low values of total and individual essential amino acids were detected by the plants treated with sulphur 1.0g/l + microben as well as non essential amino acids when the plants supplied with microbein alone due to decreases in Aspertic, Serine, Glutamic and Proline.

Concerning the effect of complete organic fertilizer dose on amino acids components, data presented in (Tables 12-13) reveal that sulphure, nitrobein and microbein treatments either alone or in combinations increased essential amino acids, expect plants treated with nitrobein combined with sulphur 0.5gm/l as a result of especially decreases on individual amino acids valin, isolenine, leucine, phenylalanine, lysine. Moreover, increased in total and individual non-essential amino acids were obtained by the plants treated with nitrobein or microbein either alone or combined with sulphur, however, low values of non-essential amino acids were recorded by the plants treated with sulphur at the two different rates (1.0 and 0.5gm/l) as well as treated with sulphur at 1.0mg/l combined with microbein mainly due to decreases in Glutamic synthesis.

Concerning the effect of sulphur, nitrobein or microbein either alone or in combination under half dose of organic fertilizer combined with the half dose of recommended NPK(½ OR + ½ MN) on different amino acids components, the data in Tables (12-13) indicated that, high values of essential, non essential, total and individual amino acids were recorded by all treatments, with some exceptions of the plants treated with sulphur at the rate of 0.5gm/l or microbein alone, a reverse trend was obtained by these two treatments. In furthermore, it is clear from the results in Tables (12-13) that under one and half dose organic fertilizer treatment, the application of sulphur, nitrobein or microbein either alone or in combination tended to decrease total and individual essential amino acids when compared with those treated with one and half dose of organic fertilizer alone. While, a reverse tend was recorded by the plants treated with nitrobein combined with sulphur at the rate of 0.5g/l or those treated with microbein combined with sulphur at the rate of 1.0g/l. On the other hand, high values of total and individual non-essential amino acids were obtained by the plants treated with nitrobein combined with either 0.5 or 1.0 g/l of sulphur or treated with microbein combined with 1.0 g/l of sulphur, however, low values of total and individual non-essential amino acids were detected by the plants supplied with the higher rate of sulphur (1.0mg/l).

The present results are in agreement with those obtained by Mallanagouda *et al*. (1995) and Khalil *et al.* (2002) they reported that onion plants had the highest K and P contents when application mineral fertilizers plus farmyard manure, while N content was the highest with inorganic fertilizers application. Elfstrand *et al*. (2007) indicated that there were no differences in leek harvest yield, but the nitrogen (N), phosphorus (P) and sulfur (S) concentrations in the leek crop at harvest increased in response to higher amounts of slurry and compost amendment. Lundegardh *et al*.(2008) working on leek reported that sulphur uptake and sulfur levels were increased only by the mineral fertilizer and by the compost. Farmyard manure and rock phosphate application caused the highest protein content of radish plant compared with NPK fertilizer (Singh and Singh, 2001).

Table 8: Sulphur and the nitrogen% of leek plant as affected by different fertilizers sources (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Nutritive characte	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s) Biofertilizer (b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
Sulphur %	MN	without	0.250	0.312	0.328	0.297	0.302	0.316	0.314	0.311
		nitrobein	0.279	0.320	0.343	0.314	0.280	0.313	0.330	0.308
		microbein	0.285	0.354	0.375	0.338	0.225	0.372	0.324	0.307
		Mean	0.271	0.328	0.349	0.316	0.269	0.334	0.323	0.308
	OR	without	0.190	0.243	0.277	0.237	0.185	0.251	0.297	0.244
		nitrobein	0.225	0.303	0.336	0.288	0.215	0.280	0.343	0.280
		microbein	0.227	0.239	0.291	0.252	0.224	0.238	0.241	0.234
		Mean	0.214	0.262	0.301	0.259	0.210	0.256	0.294	0.253
	1/2 MN + 1/2 (OR)	without	0.225	0.324	0.358	0.302	0.219	0.222	0.387	0.276
		nitrobein	0.300	0.332	0.364	0.332	0.288	0.348	0.352	0.329
		microbein	0.320	0.361	0.372	0.351	0.303	0.350	0.388	0.347
		Mean	0.282	0.339	0.365	0.328	0.270	0.307	0.375	0.317
	1 1/2 OR	without	0.210	0.275	0.315	0.267	0.183	0.284	0.329	0.265
		nitrobein	0.230	0.287	0.322	0.279	0.219	0.299	0.314	0.277
		microbein	0.279	0.310	0.335	0.307	0.281	0.329	0.331	0.314
		Mean	0.239	0.291	0.324	0.284	0.228	0.304	0.325	0.285
	Interaction b*S	without	0.219	0.289	0.319	0.276	0.222	0.268	0.332	0.274
		nitrobein	0.259	0.311	0.341	0.303	0.251	0.310	0.335	0.298
		microbein	0.278	0.316	0.343	0.312	0.258	0.322	0.321	0.301
		Mean	0.252	0.305	0.335		0.245	0.300	0.329	
Nitrogen %	MN	without	1.249	1.336	1.344	1.309	1.222	1.346	1.298	1.288
		nitrobein	1.266	1.725	1.816	1.602	1.166	1.738	1.826	1.576
		microbein	1.267	1.554	1.520	1.447	1.275	1.622	1.350	1.416
		Mean	1.261	1.538	1.560	1.453	1.221	1.568	1.491	1.427
	OR	without	0.848	0.915	0.926	0.896	0.822	0.904	0.906	0.877
		nitrobein	0.994	1.104	1.581	1.226	0.973	1.085	1.568	1.208
		microbein	1.027	1.136	1.608	1.257	1.034	1.096	1.616	1.248
		Mean	0.956	1.053	1.372	1.126	0.942	1.029	1.363	1.110
	1/2 MN + 1/2 (OR)	without	0.899	1.093	1.266	1.086	0.953	1.098	1.285	1.102
		nitrobein	1.328	1.400	1.437	1.388	1.315	1.397	1.408	1.373
		microbein	1.362	1.478	1.573	1.471	1.291	1.488	1.568	1.449
		Mean	1.196	1.324	1.425	1.315	1.176	1.326	1.421	1.308
	1 1/2 OR	without	0.696	1.104	1.011	0.937	0.736	1.096	0.978	0.936
		nitrobein	0.992	1.200	1.472	1.221	0.960	1.536	1.136	1.211
		microbein	0.960	1.011	1.312	1.094	0.960	1.024	1.360	1.115
		Mean	0.883	1.105	1.265	1.084	0.885	1.219	1.158	1.087
	Interaction b*S	without	0.923	1.112	1.137	1.057	0.925	1.111	1.117	1.051
		nitrobein	1.145	1.357	1.576	1.360	1.104	1.439	1.484	1.342
		microbein	1.154	1.295	1.503	1.317	1.140	1.308	1.474	1.307
		Mean	1.074	1.255	1.405		1.056	1.286	1.358	

LSD 5%

Chemical component	Season	f	B	s	f*b	f*s	b*s	f*b*s
Sulphur %	1st	0.021	0.016	0.015	0.0316	0.099	0.026	0.052
	2nd	0.015	0.009	0.015	0.019	0.029	0.026	0.052
Nitrogen %	1st	0.037	0.022	0.015	0.045	0.029	0.026	0.052
	2nd	0.021	0.022	0.015	0.045	0.029	0.026	0.052

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 9: Phosphorus and potassium% of leek plant as affected by different fertilizers source (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Nutritive characte	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s) Biofertilizer(b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
Phosphorus %	MN	without	0.279	0.292	0.320	0.297	0.265	0.268	0.235	0.256
		nitrobein	0.285	0.315	0.341	0.313	0.269	0.251	0.283	0.268
		microbein	0.294	0.320	0.300	0.305	0.288	0.281	0.255	0.275
		Mean	0.286	0.309	0.320	0.305	0.274	0.267	0.258	0.266
	OR	without	0.247	0.279	0.281	0.269	0.236	0.253	0.243	0.244
		nitrobein	0.250	0.299	0.310	0.286	0.246	0.287	0.217	0.250
		microbein	0.282	0.325	0.313	0.307	0.263	0.312	0.287	0.287
		Mean	0.259	0.301	0.301	0.287	0.248	0.284	0.249	0.260
	1/2 MN + 1/2 (OR)	without	0.289	0.311	0.350	0.317	0.282	0.297	0.372	0.317
		nitrobein	0.355	0.349	0.382	0.362	0.377	0.314	0.382	0.358
		microbein	0.380	0.471	0.435	0.429	0.390	0.455	0.427	0.424
		Mean	0.341	0.377	0.389	0.369	0.350	0.355	0.394	0.366
	1 1/2 OR	without	0.230	0.245	0.264	0.246	0.239	0.238	0.208	0.228
		nitrobein	0.260	0.280	0.295	0.278	0.258	0.274	0.266	0.266
		microbein	0.277	0.291	0.320	0.296	0.264	0.251	0.284	0.266
		Mean	0.256	0.272	0.293	0.273	0.254	0.254	0.253	0.253
	Interaction b*S	without	0.261	0.282	0.304	0.282	0.256	0.264	0.265	0.262
		nitrobein	0.288	0.311	0.332	0.310	0.288	0.282	0.287	0.285
		microbein	0.308	0.352	0.342	0.334	0.301	0.325	0.313	0.313
		Mean	0.286	0.315	0.326		0.282	0.290	0.288	
Potassium %	MN	without	2.125	2.679	2.291	2.365	2.162	2.088	1.685	1.978
		nitrobein	2.331	2.615	2.310	2.419	2.351	2.688	2.789	2.609
		microbein	2.145	2.200	2.190	2.178	1.672	2.201	2.005	1.959
		Mean	2.200	2.498	2.264	2.321	2.062	2.326	2.160	2.182
	OR	without	2.271	2.10	1.905	2.092	1.845	1.852	1.892	1.863
		nitrobein	2.400	2.695	2.881	2.659	1.995	2.569	1.970	8.178
		microbein	1.779	2.254	3.140	2.054	1.880	1.800	1.780	1.820
		Mean	2.150	2.349	2.305	2.268	1.907	2.074	1.881	1.954
	1/2 MN + 1/2 (OR)	without	2.143	2.574	2.436	2.384	2.155	2.557	2.345	2.352
		nitrobein	2.132	2.297	3.000	2.476	2.058	2.263	2.876	2.399
		microbein	2.22	3.10	2.740	2.687	2.189	2.413	2.544	2.382
		Mean	2.165	2.657	2.725	2.516	2.134	2.411	2.589	2.378
	1 1/2 OR	without	2.296	2.261	2.00	2.186	2.385	2.337	1.989	2.237
		nitrobein	2.200	2.000	1.890	2.030	2.108	2.200	2.00	2.103
		microbein	2.000	1.999	2.100	2.033	1.929	1.847	2.131	1.969
		Mean	2.165	2.087	1.997	2.083	2.141	2.128	2.040	2.103
	Interaction b*S	without	2.209	2.404	2.158	2.257	2.137	2.208	1.978	2.108
		nitrobein	2.266	2.402	2.520	2.396	2.128	2.430	2.409	2.322
		microbein	2.036	2.388	2.290	2.238	1.918	2.065	2.115	2.033
		Mean	2.170	2.398	2.323		2.061	2.235	2.167	

LSD 5%

Chemical component	Season	f	b	s	f*b	f*s	b*s	f*b*s
Phosphorus %	1st	0.021	0.016	0.015	0.032	0.029	0.026	0.052
	2nd	0.007	0.005	NS	0.01	0.01	0.009	0.016
Potassium %	1st	0.021	0.022	0.021	0.044	0.042	0.037	0.073
	2nd	0.070	0.050	0.050	0.100	0.100	0.100	0.200

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 10: Carbohydrate and Volatile oil %of leek plant as affected by different fertilizers source (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Nutritive characte	Season		2003-2004				2004-2005			
	Fertilizers sources(F)	Sulphur(s) Biofertilizer(b)	Sulphur g/1 0.0	0.5	1.0	Mean	Sulphur g/1 0.0	0.5	1.0	Mean
Carbohydrates %	MN	without	18.22	19.44	19.35	19.00	18.01	19.25	16.03	17.76
		nitrobein	20.25	21.93	21.10	21.09	20.75	22.09	17.22	20.02
		microbein	20.84	21.79	21.47	21.37	21.08	22.71	17.25	20.35
		Mean	19.77	21.05	20.64	20.49	19.95	21.35	16.83	19.37
	OR	without	21.58	22.84	21.30	21.91	21.62	21.93	21.56	21.70
		nitrobein	22.92	23.53	22.14	22.86	20.56	21.45	19.33	20.45
		microbein	22.51	22.75	21.97	22.41	21.56	20.07	19.98	20.54
		Mean	22.34	23.04	21.80	22.39	21.25	21.15	20.29	20.94
	1/2 MN + 1/2 (OR)	without	18.98	21.00	18.2	19.39	19.33	21.32	17.21	19.29
		nitrobein	18.23	20.15	19.36	19.25	17.68	19.90	17.27	18.28
		microbein	19.41	19.82	20.15	19.79	19.46	19.26	18.77	19.16
		Mean	18.87	20.32	19.24	19.48	18.82	20.16	17.75	18.91
	1 1/2 OR	without	20.94	21.81	20.67	21.14	21.22	19.80	16.6	19.21
		nitrobein	23.00	22.15	20.70	21.95	23.13	22.76	20.64	22.18
		microbein	22.23	22.95	21.83	22.34	20.46	20.0	19.83	20.09
		Mean	22.06	22.30	21.07	21.8	21.60	20.85	19.02	20.49
	Interaction b*S	without	19.93	21.27	19.88	20.36	20.04	20.57	17.85	19.49
		nitrobein	21.1	21.94	20.83	21.29	20.53	21.55	18.61	20.23
		microbein	21.25	21.83	21.35	21.48	20.64	20.51	18.96	20.04
		Mean	20.76	21.68	20.69		20.4	20.88	18.47	
Volatile oil %	MN	without	0.40	0.42	0.45	0.423	0.280	0.360	0.280	0.307
		nitrobein	0.430	0.45	0.46	0.447	0.515	0.320	0.540	0.457
		microbein	0.44	0.45	0.50	0.463	0.410	0.480	0.440	0.443
		Mean	0.423	0.440	0.470	0.444	0.400	0.387	0.420	0.402
	OR	without	0.420	0.460	0.480	0.453	0.470	0.500	0.500	0.490
		nitrobein	0.450	0.520	0.530	0.50	0.410	0.410	0.500	0.400
		microbein	0.510	0.520	0.520	0.517	0.300	0.320	0.330	0.317
		Mean	0.46	0.500	0.51	0.49	0.393	0.410	0.443	0.416
	1/2 MN + 1/2 (OR)	without	0.47	0.48	0.50	0.483	0.510	0.440	0.510	0.487
		nitrobein	0.49	0.5	0.52	0.503	0.410	0.490	0.510	0.470
		microbein	0.50	0.51	0.51	0.507	0.510	0.500	0.510	0.507
		Mean	0.487	0.497	0.51	0.498	0.477	0.480	0.510	0.488
	1 1/2 OR	without	0.43	0.45	0.46	0.447	0.280	0.32	0.330	0.310
		nitrobein	0.46	0.48	0.50	0.480	0.450	0.530	0.495	0.490
		microbein	0.5	0.52	0.53	0.517	0.510	0.50	0.500	0.503
		Mean	0.463	0.483	0.497	0.481	0.413	0.450	0.400	0.434
	Interaction b*S	without	0.430	0.453	0.473	0.452	0.385	0.405	0.405	0.398
		nitrobein	0.458	0.488	0.50	0.483	0.445	0.438	0.510	0.464
		microbein	0.488	0.500	0.515	0.500	0.433	0.450	0.445	0.443
		Mean	0.458	0.480	0.497		0.421	0.431	0.453	

LSD 5%

chamical component	Season	f	b	s	f*b	f*s	b*s	f*b*s
Carbohydrate	1st	1.49	0.79	0.61	1.58	1.22	1.06	2.12
	2nd	0.35	0.23	0.28	0.46	0.56	0.48	0.97
Volatile oil	1st	0.021	0.022	0.015	0.045	0.029	0.026	0.052
	2nd	0.005	0.004	0.008	0.008	0.010	0.010	0.015

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 11: Nitrate(mg/kg f.w) and protein% of leek plant as affected by different fertilizers sources (minerals and organic), biofertilizers (nitrobein and microbein) and sulphur fertilizer

Nutritive	Season		2003-2004				2004-2005			
	Fertilizers	Sulphur(s)	Sulphur g/1				Sulphur g/1			
characte	sources (F)	Biofertilizer (b)	0.0	0.5	1.0	Mean	0.0	0.5	1.0	Mean
Nitrate (mg/Kg f.w)	MN	without	739.0	820.0	843.0	800.7	720.0	792.0	812.0	774.7
		nitrobein	620.0	1455.0	1570.0	1215.0	611.0	1469.0	1504.0	1194.7
		microbein	741.0	1200.0	1315.0	1085.3	732.0	1160.0	1300.0	1064.0
		Mean	700.0	1158.0	1243.0	1033.7	687.7	1140.3	1205.3	1011.1
	OR	without	275.0	320.0	301.0	298.7	255.0	314.0	292.0	287.0
		nitrobein	300.0	295.0	645.0	413.3	243.0	238.0	733.0	404.7
		microbein	365.0	642.0	778.0	595.0	360.0	618.0	782.0	586.7
		Mean	313.3	419.0	574.7	435.7	286.0	390.0	602.3	486.1
	1/2 MN + 1/2 (OR)	without	420.0	677.0	532.0	543.0	340.0	638.0	514.0	497.3
		nitrobein	635.0	1225.0	1455	1105.0	607.0	1210.0	1441.0	1086.0
		microbein	597.0	949.0	1110.0	885.3	817.0	986.0	1341.0	1048.0
		Mean	550.7	950.3	1032.0	844.4	588.0	944.7	1098.7	877.1
	1 1/2 OR	without	275.0	336.0	500.0	370.3	283.0	344.0	519.0	382.0
		nitrobein	260.0	278.0	569.0	369.0	246.0	262.0	583.0	363.7
		microbein	348.0	520.0	601.0	489.7	357.0	516.0	609.0	494.0
		Mean	294.4	378.0	556.7	459.7	295.3	374.0	570.3	413.2
	b*S interaction	without	427.3	538.3	544.0	503.2	399.5	522	534.3	485.3
		nitrobein	453.8	813.3	1060.0	775.6	426.8	794.8	1065.3	762.3
		microbein	512.8	827.8	951.0	763.8	566.5	820.0	1008.0	798.2
		Mean	464.6	726.5	851.6		464.3	712.2	869.2	
Protein %	MN	without	7.81	8.35	8.40	8.19	7.64	8.41	8.11	8.05
		nitrobein	7.91	10.78	11.35	10.01	7.29	10.86	11.41	9.85
		microbein	7.92	9.71	9.677	9.13	7.97	10.14	8.44	8.85
		Mean	7.88	9.61	9.84	9.11	7.63	9.80	9.32	8.92
	OR	without	5.30	5.72	5.79	5.603	5.14	5.67	5.66	5.48
		nitrobein	6.21	6.90	9.88	7.66	6.08	6.78	9.8	7.55
		microbein	6.49	7.10	10.05	7.88	6.46	6.85	10.1	7.80
		Mean	6.00	6.57	8.57	7.05	5.89	6.43	8.52	6.94
	1/2 MN + 1/2 (OR)	without	5.620	6.83	7.91	6.79	5.77	6.86	8.03	6.89
		nitrobein	8.30	8.75	8.98	8.68	8.22	8.73	8.8	8.58
		microbein	8.51	9.24	9.83	9.19	8.07	9.3	9.8	9.06
		Mean	7.48	8.27	8.91	8.22	7.35	8.29	8.88	8.18
	1 1/2 OR	without	4.35	6.90	6.32	5.86	4.60	6.85	6.11	5.85
		nitrobein	6.20	7.50	9.20	7.63	6.0	9.6	7.10	7.57
		microbein	6.0	6.31	8.2	6.84	6.0	6.4	8.5	6.96
		Mean	5.52	6.90	7.91	6.78	5.53	7.62	7.24	6.79
	b*S interaction	without	5.77	6.95	7.105	6.61	5.787	6.947	6.987	6.57
		nitrobein	7.15	8.48	9.85	8.49	6.89	8.99	9.29	8.39
		microbein	7.23	8.09	9.46	8.26	7.13	8.17	9.21	8.1
		Mean	6.72	7.84	8.81		6.603	8.037	8.494	

LSD 5%

chemical component	Season	f	b	s	f*b	f*s	b*s	f*b*s
Nitrate	1st	24.720	9.6	12.43	19.2	24.86	21.53	43.12
	2nd	20.09	18.37	19.6	36.74	39.19	33.94	67.99
Protein	1st	0.200	0.080	0.097	0.164	0.194	0.168	0.337
	2nd	0.322	0.146	0.139	0.293	0.279	0.242	0.485

OR:3 tons cattle+1.5 tons chicken manure/fed. 1 1/2 OR:4.5tons cattle+2.25ton chicken manure/fed

MN:90kgN+60P2O5+60K2O/fed. 1/2 MN + 1/2 OR(1:1)

Table 12 : Essential amino acids of leek plant as affected by different fertilizers source (mineralsand organic), biofertilizers (nitrobien and microbien) and sulphur fertilizer ,as average of both seasons, 2003-2004 and 2004-2005.

Treatments		Essential Amino Acid%							
		Thr	Cyst Meth	Val	Iso leu	Leu.	Phe.	Lys	T.E. A.A.
Mineral MN	Only	0.176	0.183	0.220	0.167	0.315	0.194	0.315	1.57
	Sulphur 0.5	0.183	0.18	0.210	0.168	0.298	0.185	0.282	1.506
	Sulphur 1.0	0.196	0.18	0.203	0.178	0.323	0.193	0.333	1.606
	Nitrobein	0.247	0.19	0.214	0.182	0.319	0.166	0.334	1.59
	Nitrobein + Sulphur 0.5	0.185	0.23	0.278	0.228	0.419	0.206	0.397	2.005
	Nitrobein +Sulphur 1.0	0.252	0.21	0.262	0.212	0.408	0.188	0.399	1.931
	Microbein	0.205	0.19	0.229	0.184	0.337	0.167	0.341	1.653
	Microbein + Sulphur 0.5	0.260	0.24	0.305	0.234	0.418	0.202	0.437	2.096
	Microbein +Sulphur 1.0	0.181	0.17	0.184	0.167	0.309	0.148	0.286	1.445
Organic OR	Only	0.144	0.147	0.241	0.134	0.241	0.129	0.264	1.30
	Sulphur 0.5	0.171	0.180	0.191	0.143	0.255	0.124	0.234	1.298
	Sulphur 1.0	0.178	0.170	0.218	0.167	0.292	0.145	0.260	1.43
	Nitrobein	0.136	0.15	0.176	0.127	0.238	0.119	0.211	1.157
	Nitrobein + Sulphur 0.5	0.141	0.14	0.153	0.111	0.214	0.098	0.201	1.058
	Nitrobein +Sulphur 1.0	0.214	0.22	0.266	0.196	0.362	0.168	0.342	1.768
	Microbein	0.165	0.20	0.216	0.157	0.272	0.122	0.223	1.355
	Microbein + Sulphur 0.5	0.268	0.28	0.343	0.252	0.471	0.227	0.395	2.236
	Microbein +Sulphur 1.0	0.151	0.13	0.176	0.133	0.247	0.115	0.351	1.303
1/2M N + 1/2 OR	Only	0.161	0.165	0.226	0.126	0.253	0.166	0.254	1.351
	Sulphur 0.5	0.123	0.126	0.214	0.132	0.234	0.170	0.209	1.208
	Sulphur 1.0	0.163	0.182	0.257	0.146	0.279	0.214	0.285	1.526
	Nitrobein	0.175	0.163	0.269	0.160	0.293	0.217	0.275	1.552
	Nitrobein + Sulphur 0.5	0.188	0.163	0.247	0.178	0.305	0.175	0.288	1.544
	Nitrobein +Sulphur 1.0	0.198	0.120	0.256	0.194	0.318	0.189	0.313	1.588
	Microbein	0.152	0.141	0.202	0.147	0.241	0.137	0.239	1.259
	Microbein + Sulphur 0.5	0.188	0.164	0.247	0.178	0.295	0.183	0.320	1.575
	Microbein +Sulphur 1.0	0.210	0.169	0.274	0.207	0.335	0.207	0.292	1.694
1 1/2 Organic	Only	0.177	0.18	0.213	0.152	0.295	0.184	0.302	1.503
	Sulphur 0.5	0.170	0.17	0.228	0.152	0.289	0.184	0.306	1.499
	Sulphur 1.0	0.113	0.106	0.146	0.084	0.160	0.112	0.183	0.904
	Nitrobein	0.170	0.168	0.190	0.137	0.271	0.172	0.28	1.388
	Nitrobein + Sulphur 0.5	0.208	0.175	0.300	0.190	0.348	0.216	0.351	1.788
	Nitrobein +Sulphur 1.0	0.159	0.160	0.188	0.142	0.266	0.176	0.246	1.337
	Microbein	0.156	0.144	0.219	0.146	0.263	0.172	0.271	1.371
	Microbein + Sulphur 0.5	0.156	0.152	0.229	0.131	0.256	0.175	0.286	1.385
	Microbein +Sulphur 1.0	0.176	0.18	0.250	0.153	0.303	0.209	0.340	1.611

Thr;Threonine**;cys**:cystine**;meth**:methionin**;iso**:isolyecine;**leu**:leucine**;lys**:lysine**;phe**:phenylalnin

Leek nitrate content was significantly lower with farmyard manure or wood chip compost application than blood meal or mineral fertilizers application. The nitrate accumulation is dependent on they type of fertilizers used, those fertilizers with readily available nitrogen (Termine *et al.,* 1987; Lindner, 1996 and Guerrero *et al.,* 2002).

The NPK fertilizers resulted in the highest nitrate content in radish plants compared with a combined of farmyard manure, oil seed cake and Azotobacter (Sing and Sing, 2001).Uptake and concentration of N, P, K and S in garlic or onion significantly increased with increasing rate of applied sulphur (Vinay-Singh *et al.,* 1999; Nagaich *et al.,* 1999; Coolong *et al.,* 2004 and Sankaran *et al.,* 2005). Nitrogen, phosphorus and potassium content on garlic bulbs were the highest with spraying of 2.5 g sulphur/l (Wang *et al.,* 2004). Combination of organic manure and sulphur were very beneficial for N, P, K content in garlic plant tissues (Khalaf and Taha, 1988). Nutrient uptake and protein content of garlic increased significantly with increasing level of sulphur application (Nagaich *et al.* 2003). As for experiments on leek, Eppendorfer and Eggum (1996) reported with greatly differing rates of N, P, S and K. Total NO_3-N concentration ranged from 10 to 1515 ppm in dry matter. On the other hand, the application of N and increasing the level of sulphur reduced the nitrate content of bulbs by 10.8-25.2% over the control (Losak, 2005). Increasing sulphur levels increased the sulphur uptake and content (Hamilton *et al.,* 1997; Coolong *et al.,* 2004; Jaggi 2004; Shaminma and Hug ,2005).

Pengency content of onion increased with increased S application (Smittle, 1984 and Randle *et al.,* 1994). Application of S results in further increase in volatile sulphur compounds (Aoyama *et al.,* 2000 and Mc-Callum *et al.,* 2005) . Both organic manure and sulphur fertilizer resulted in considerable increases in the volatile components of garlic. The high rate was more beneficial than the low one. Values of the interaction between organic manure and S showed that S was more effective in the present than in the absence of organic manure (Khalaf and Taha, 1998).

N fertilizer application significantly reduced onion bulb pyruvic acid (flavour), S fertilizer application increased pyruvic concentration significantly. N and S fertilizer application significantly increased pungency (Abbey *et al.*, 2004 and Coolong *et al.*, 2004). The *S*-alk(en)yl-L-cysteine sulfoxides (ACSO) level was increased by 37% by the mineral fertilizer. Whereas direct incorporation of red clover, mulch, and red clover biodigestate had no influence on the ACSO level, the highest dose of compost increased the ACSO level by 55%(Lundegardh *et al*.,2008)

In a crop rotation, onion grown after legumes as preceding crop had significantly higher pungency compared to onions grown after cereals. This effect is assumed to be a result of enhanced mineralization of organic N and S source. A combined N and S application increased pungency and showed a significant NxS interaction for pungency. S application of 100 kg S/ha vs. 0S kg/ha had no qualitative impact in terms of relative composition of major onion oil compounds but caused a marketable increase of absolute amounts of volatiles, aroma precursors and industrially produced onion oil (Resemann *et al.*, 2004).

Eppendorfer and Eggum (1996) reported leek plants grown in pot experiments with greatly differing rates of N, P, S and K. increasing N concentration, whether due to N application or P and K deficiency, decreased the concentration of all essential and some other amino acids in crude protein. Both S and severed P deficiency had a pronounced negative effect

on amino acid composition and chemical score. Only glutamic acid (glutamine) and arginine were increased by increasing N concentration. S application increased total S concentration from 0.047 to 0.359% in DM of which between ~ 25 and 100% was found in methionine + cystin. Hamilton et al (1997) observed that onion bulb grown under the low-S treatment (0.1 meq/liter or 2 ppm) contained 1.9 micro mol pyruvic acid/g fresh weight, while those under the high – S treatment (7.7 meq/liter or 123 ppm S) contained 5.5 micro mol pyruvic /g fresh weight. There was passive affect on the flavour quality (allicin) along with the increase of S levels (Wang *et al*., 2004).

Therefore, it can be suggested that organic, biofertilizers and sulphur are very important sources for providing leek plant with its nutritional requirements without having an undesirable impact on environment, reducing nitrate accumulation in plants.

In conclusion, The best yield and quality were obtained in the present study with applying obtained with application one dose and half of organic manure (1½ OR) or the mixture of organic manure and mineral fertilizers (½ MN + ½ OR), inoculation with microbein or nitrobein and spraying plants with sulphur at the rate of 0.5 g/l

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أستجابة الكرات للتسميد العضوى والحيوى والرش بالكبريت كبديل كلى أو جزئى للتسميد المعدنى وتاثيره على القيمة الغذائية

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*** المعمل المركزي للأغذية والأعلاف-مركز البحوث الزراعية-الجيزة

أجريت تجربتين حقليتين على نبات الكرات أبو شوشة صنف بلوستار لدراسة تأثير السماد العضوى (٣ طن / فدان سماد ماشية و ١,٥ طن / فدان سماد كتكوت ١:١) والسماد المعدنى الموصى به (٩٠ كجم ن + ٦٠ كجم فو٢أ٥ + ٥٠ كجم بو٢ أ / فدان) وخليط من السماد العضوى والكيماوى (½ MN + ½ OR) ; مرة ونصف من السماد العضوى (1½ OR) مع عدم تلقيح النباتات أو التلقيح بالميكروبين أو النتروبين ورش النباتات بالكبريت بمعدل صفر أو ٠,٥ أو ١ جم / لتر كل عشرة أيام على صفات النمو الخضرى للنبات والمحصول الكلى وصفات الخضرية والقيمة الغذائية للساق الكاذبة. تشير النتائج إلى أن استعمال خليط من الاسمدة العضوية والسماد المعدنى (½ MN + ½ OR) أدت إلى الحصول على أعلى القيم لصفات النمو الخضرى مثل الوزن الطازج للنبات وعدد ووزن الأوراق للنبات ووزن وقطر الساق الكاذبة والمحصول الكلى فى الموسمين.

تلقيح نباتات الكرات بالميكروبين يليه النيتروبين أدى للحصول على أعلى القيم فى معظم صفات النمو الخضرى فى الموسمين مقارنة بعدم التلقيح. رش النباتات بالكبريت بمعدل ٠,٥ جم/لتر يليه ١ جم/لتر أدى للحصول على أعلى القيم لصفات النمو الخضرى مقارنة بعدم الرش. أعلى محصول كلى أمكن الحصول عليه باستعمال مقدار مرة ونصف من السماد العضوى (1½ OR) أو خليط من السماد العضوى والمعدنى (½ MN + ½ OR) والتلقيح بالميكروبين ورش النباتات بالكبريت بمعدل ٠,٥ جم / لتر فى الموسمين.أعلى وزن طازج للساق الكاذبة تم الحصول عليها بتسميد خليط من السماد العضوى والكيماوى (½ MN + ½ OR) مع تلقيح النباتات بالميكروبين أو النتروبين فى الموسم الاول والثانى على التوالى ورش النباتات بالكبريت بمعدل ٠,٥ جم/لتر. أما أعلى القيم الغذائية للساق الكاذبة للكرات أبو شوشة فقد سجلت فى النسبة المئوية للمادة الجافة والكربوهيدرات الكلية بالسماد العضوى (OR) والتلقيح بالنتروبين والرش بالكبريت بمعدل ٠,٥ جم/لتر. أما أعلى نسبة مئوية للكبريت والزيوت الطيارة أمكن الحصول عليها باستعمال خليط من السماد العضوى والكيماوى أو مرة ونصف من السماد العضوى والتلقيح بالميكروبين أو النتروبين مع رش النباتات بالكبريت بمعدل ١جم/لتر. أعلى نسبة مئوية للبروتين وتراكم النترات أمكن الحصول عليها بتسميد نبات الكرات بالسماد المعدنى والتلقيح بالنتروبين ورش النباتات بالكبريت بمعدل ١ جم/لتر أما أقل قيم لتراكم للنترات فى الساق الكاذبة. فقد تم الحصول عليها بالتسميد بالسماد العضوى أو خليط من السماد العضوى والكيماوى بدون تلقيح النباتات أو التلقيح النيتروبين بدون رش بالكبريت أو الرش بمعدل ٠,٥ جم/لتر. سجلت أعلى القيم فى الاحماض الامينية الكلية والاساسية وغير الاساسية والمفردة بالنباتات المعاملة بالسماد المعدنى الموصى به عند مقارنتها بتلك التى أمدت بالمقادير المختلفة من الاسمدة العضوية. وكذلك سجلت قيم أعلى فى الأحماض الامينية للنباتات المعاملة بالكبريت و الميكروبين و النيتروبين سواء بمفردها أو معا عند مقارنتها بالنباتات الغير معاملة.

Table13:Non-Essential amino acids of leek plant as affected by different fertilizers source (minerals and organic), biofertilizers (nitrobien and microbien) and sulphur fertilizer , as aveaage of seasons 2003-2004 and 2004-2005.

Treatments		Non-Essential Amino Acid%									TOTAL AMINO ACID%
		Asperatic	Serine	Glutamic	Proline	Glycine	Alanine	Histidine	Argginine	T.N.E. A.A.	T.A. A.
Mineral MN	Only	0.515	0.178	2.228	0.161	0.184	0.252	0.220	0.440	4.178	5.748
	Sulphur 0.5	0.590	0.171	2.598	0.167	0.186	0.335	0258	0.418	4.723	6.229
	Sulphur 1	0.504	0.202	2.174	0.164	0.208	0.259	0.228	0.425	4.164	5.77
	Nitrobein	0.488	0.163	1.711	0.154	0.213	0.328	0.303	0.481	3.841	5.431
	Nitrobein + Sulphur 0.5	0.511	0.238	3.169	0.166	0.262	0.411	0.365	0.474	5.596	7.601
	Nitrobein +Sulphur 1.0	0.615	0.260	3.711	0.191	0.246	0.417	0.302	0.509	6.251	8.182
	Microbein	0.614	0.206	2.637	0.157	0.218	0.362	0.268	0.629	5.091	6.744
	Microbein + Sulphur 0.5	0.626	0.279	2.310	0.195	0.273	0.356	0.255	0.647	4.941	7.037
	Microbein +Sulphur 1.0	0.585	0.159	2.369	0.149	0.189	0.334	0.243	0.410	4.438	5.883
Organic OR	Only	0.454	0.144	1.450	0.139	0.155	0.223	0.175	0.380	3.12	4.421
	Sulphur 0.5	0.453	0.179	1.000	0.150	0.168	0.266	0.209	0.390	2.815	4.114
	Sulphur 1.0	0.417	0.165	0.917	0.161	0.185	0.290	0.240	0.359	2.734	4.166
	Nitrobein	0.411	0.124	1.726	0.113	0.144	0.300	0.221	0.366	3.405	4.563
	Nitrobein + Sulphur 0.5	0.499	0.156	1.474	0.100	0.132	0.293	0.233	0.493	3.38	4.436
	Nitrobein +Sulphur 1.0	0.747	0.204	2.172	0.183	0.214	0.232	0.318	0.508	5.118	6.886
	Microbein	0.355	0.146	1.655	0.130	0.168	0.203	0.303	0.436	3.396	4.751
	Microbein + Sulphur 0.5	0.440	0.261	2.966	0.128	0.169	0.397	0.438	0.500	5.299	7.535
	Microbein +Sulphur 1.0	0.387	0.157	1.068	0.123	0.148	0.288	0.201	0.351	2.723	4.026
1/2MN + 1/2 OR	Only	0.747	0.153	2.572	0.137	0.151	0.259	0.210	0.503	4.732	6.084
	Sulphur 0.5	0.405	0.101	1.769	0.125	0.145	0.234	0.219	0.339	3.34	4.548
	Sulphur 1.0	0.606	0.157	2.543	0.149	0.166	0.297	0.243	0.475	4.636	6.162
	Nitrobein	0.549	0.157	2.523	0.158	0.184	0.343	0.304	0.514	4.732	6.284
	Nitrobein + Sulphur 0.5	0.726	0.179	2.415	.162	0.202	0.391	0.216	0.501	4.792	6.335
	Nitrobein +Sulphur 1.0	0.665	0.178	2.883	0.177	0.219	0.367	0.292	0.469	5.25	6.838
	Microbein	1.458	0.133	1.846	0.18	0.166	0.357	0.288	0.468	3.896	5.155
	Microbein + Sulphur 0.5	0.806	0.173	2.587	0.138	0.207	0.309	0.265	0.463	4.948	6.524
	Microbein +Sulphur 1.0	0.596	0.186	2.611	0.185	0.237	0.388	0.316	0.442	4.961	6.655
11/2 Organic	Only	0.512	0.190	1.482	0.172	0.179	0.265	0.241	0.389	3.43	4.932
	Sulphur 0.5	0.612	0.157	2.006	0.150	0.173	0.284	0.196	0.387	3.965	5.464
	Sulphur 1.0	0.296	0.118	0.881	0.083	0.093	0.171	0.140	0.331	2.116	3.02
	Nitrobein	0.511	0.177	1.748	0.137	0.161	0.266	0.205	0.418	3.623	5.011
	Nitrobein + Sulphur 0.5	0.618	0.199	3.384	0.184	0.227	0.365	0.323	0.545	5.845	7.634
	Nitrobein +Sulphur 1.0	0.472	0.154	2.287	0.133	0.164	0.253	0.300	0.399	4.162	5.499
	Microbein	0.450	0.150	1.496	0.139	0.170	0.315	0.203	0.329	3.252	4.623
	Microbein + Sulphur 0.5	1.428	0.164	1.686	0.126	0.151	0.264	0.206	0.404	3.429	4.185
	Microbein +Sulphur 1.0	0.559	0.166	2.388	0.137	0.176	0.287	0.279	0.448	4.44	6.05