# EFFECT OF SOME ISOLATES OF *AZOSPIRILLUM LIPOFERUM L* ON CARROT AND TURNIP PLANTS GROWTH UNDER LOW NITROGEN FERTILIZER CONDITIONS.

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***Abstract***

*Azospirillum lipoferum* isolates were kindly obtained from Genetic department, Faculty of Agriculture, Minia University. Determination of nitrite (NO2) and nitrate (NO3) was carried out at Central Lab of Organic Agriculture. Two field experiments were carried out in 2001/2002 and 2002/2003 at experimental farm El-Sabahia Research Station, Hort. Res. Institute to study the growth, yield and quality of Carrots and Turnip plants as effected by inoculation with three isolates of *Azospirillum lipoferum* ether as single or in mixture. Bio-fertilizer, were added either as sub treatment or in combination with 50.0% recommended dose of mineral nitrogen fertilizer, plots received 100% of recommended mineral nitrogen fertilizer (without bio-fertilizer) were act as a control treatment.The obtained results showed that, vegetative growth and yield components were improved in both two crops after inoculation with *Azospirillum lipoferum* isolate as single treatment or with combination 50% of recommended dose of chemical nitrogen fertilizer. Both nitrite (NO2) and nitrate (NO3) were drastically reduced (about 50%) in roots of both crops after using the bio-fertilizer in comparison with using 100% mineral nitrogen fertilizer.

Data also, showed that there were differences among *Azospirillum lipoferum* isolates in their effects on total yield of both crops, the best treatment was when the mixture of isolates ("A"+"B"+"C") isolate was used. In addition, the both two crops (carrot and turnip) differed from each other in their response to inoculation process, the carrot plant showed higher response compare with turnip plant.

The present investigation recommend inoculating carrot and turnip plants with *Azospirillum* isolate to improve their growth and yield as well as to reduce the rate of chemical nitrogen fertilizer to 50% of recommended dose under similar conditions of the present study.

## INTRODUCTION

Carrot plant is one of the important vegetable crops in Egypt. It's greatly demanded for local markets and export. The area planted with carrot was increased particularly since last ten years. Turnip plant became now one of the most popular vegetable crops and demand for this crops for local consumption. Soil nutrient content or soil fertility is a main factor which has a major role on mineral uptake.

Mineral fertilizer is considered as major part in plant production budget. These fertilizes pollute environment elements as well as it contaminates the underground water (Fisher and Richter, 1984). Great efforts have been done recently to use bio-fertilizers to replace or reduce chemical fertilizer doses in order to produce healthy vegetable crops. It was recorded that bio-fertilizers improve growth, yield and characters of nutrient of many vegetable crops through increase the availability of nutrient ins in soil to be easily assimilated by plants (Subba Rao 1984). El- Haddad *et al.* (1993) mentioned that using, an bio-fertilizers, is considered promising alternative for chemical fertilizers in Egyptian soils.

Growth and yield of potato plants were improved after inoculation with using bio-fertilizer, *Azosperillum* (Abd el-Ati *et al., 1996*) and *Azotobacter* on squash (Hassan *et al.*2000). Gurubatham *et al.* (1989) and Foly *et al.* (2002) reported that inoculated onion and garlic plants lead to high yield and showed much better growth. Nitrite and nitrate contents in edible parts were negatively affected as reported by Foly *et al.* (2002), when bio-fertilizers were inoculated in some vegetable crops compare with non inoculated plants.

The objective of this study is to investigate the response of both carrot and turnip plants to inoculation with different isolates of *Azosperillum* without or with 50% of recommended chemical nitrogen fertilizer compare with plants received 100 % of recommended chemical nitrogen fertilizer dose without bio-fertilizer.

## MATERIALS AND METHODS

*Azospirillum lipoferum* isolates were obtained from Genetic department, Faculty of Agriculture, Miania University, and the determination of nitrite ($NO_2$) and nitrate ($NO_3$) were carried out at Central Lab of Organic Agriculture. Two field experiments were carried out in the winter seasons of 2001/2002 and 2002/2003 at experimental

farm of El-Sabahia Research Station, Hort. Res. Institute to study the effects of using these isolates of *Azospirillum lipoferum* as bio-fertilizer to replace part of recommended nitrogen chemical fertilizer on turnip and carrot plants.

**Bacterial strains:**

Three conjugate isolates ("A", "B" and "C") and mixture of isolates ("A"+"B"+"C") of *Azospirillum lipoferum* were provided and used in the field experiments.

**Media :**

Liquid complete medium (CM) Etienne *et al.* (1990) was used to grow *Azospirillum lipoferum* isolates.

**Field experiment:**

Turnip or carrot seeds were inoculated with each isolate of *Azospirillum lipoferum* befor sowing as follows:

1-Seeds were inoculated with isolate "A".

2-Seeds were inoculated with isolate "B".

3-Seeds were inoculated with isolate "C".

4-Seeds were inoculated with mixture of isolates "A+B+C".

5-Seeds were inoculated with isolate "A" and plants received 50%. of recommended mineral nitrogen fertilizer dose.

6-Seeds were inoculated with isolate "B" and plants received 50%. of recommended mineral nitrogen fertilizer dose.

7-Seeds were inoculated with isolate "C" and plants received 50%. of recommended mineral nitrogen fertilizer dose.

8-Seeds were inoculated with mixture of isolates "A+B+C" and plants received 50%. of recommended mineral nitrogen fertilizer dose.

9-Plants fertilized with 100%. of recommended mineral nitrogen fertilizer dose (200 Kg Ammonium nitrate) without any inoculation were act as control treatment.

Each experimental plot contained three rows, each rows 3m. long and 0.7m. width. Distance between two plants was 10cm. in cure of turnip and 5cm.in cure of carrots. Complete randomized design with three replicates was used. Nitrogen fertilizer was two equal parts, one part was added two weeks after sowing turnip seeds while the other part added four weeks after sowing turnip seeds. In carrots plants nitrogen fertilizer were also divided to two equal parts, one part was added 45 days while the other was added 75 days after the sowing. All plots received K (100 kg/fed as potassium sulfate 48% $K_2O$) and P (100 kg/fed Calcium supper phosphate 15.5 % $P_2O_5$). The other standard agriculture practices for both turnip and carrot were followed.

Ten plants from each plot were taken random at harvesting time (60 and 120 days from sowing for turnip and carrot respectively). The following parameter were determined in carrot plants as, plant length (cm), number of leaves/plant and the plant fresh and dry weights (g), root length (cm), root diameter (cm), root fresh and dry weight / plant (g),the total yield (ton/Fed). Regarding turnip plant length, leaflet number/plant, leaf area/plant, root length, root diameter, dry matter and total yield in both season were determine. The contents of edible part from nitrite and nitrate were determined (as mg/100 g of dry weight) according to method described by Saad, (1991).

Data were subjected to the analysis of variance procedures and treatments means were compared using the L.S.D. test according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### I- Carrot plant:

**Plant growth characters :**

Data presented in Table 1 indicate that no significant difference in plant height of carrot plants were noticed between different treatments in the two seasons. These results disagree with Dakhly and Abd El- Mageed (1997) who found that inoculation carrot plants c.v" Balady" with some *Azotobacter* transformants significantly increased plant height.

Data in Table 1 also indict that number of leaves per plant, was differed through using chemical, bio nitrogen or chemical and bio nitrogen fertilizer together in both seasons. The highest numbers of leaves / plant in both season were obtained when

carrot seeds were inoculated with isolate "B" and plants received with 50% of recommended dose of chemical nitrogen fertilizer. The differences were significantly in the second season only. The similar results were reported by Hassan *et al.*(2000) on squash plants.

Table 1. Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on some vegetative characters of carrot plant.

| Treatment | First season (2002) | | | | Second season (2003) | | | |
|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Number of leaves / plant | Fresh weight / plant (g) | Dry weight/ plant (g) | Plant height (cm) | Number of leaves /plant | Fresh weight /plant (g) | Dry weight /plant (g) |
| Isolate "A" | 23.107 | 8.900 | 91.833 | 15.100 | 24.633 | 7.500 | 89.833 | 15.367 |
| "B" | 24.000 | 9.700 | 96.833 | 15.167 | 23.900 | 9.000 | 91.633 | 15.367 |
| "C" | 23.433 | 9.567 | 100.333 | 15.133 | 22.800 | 8.433 | 94.900 | 15.733 |
| "A+B+C" | 23.767 | 9.833 | 112.000 | 16.367 | 23.167 | 9.233 | 103.00 | 16.367 |
| "A"+50%N | 25.367 | 10.500 | 94.100 | 16.000 | 25.800 | 8.900 | 84.433 | 14.867 |
| "B"+50%N | 22.876 | 10.867 | 97.500 | 16.067 | 24.733 | 9.800 | 94.533 | 16.200 |
| "C"+ 50%N | 26.333 | 9.967 | 103.333 | 14.767 | 26.300 | 8.800 | 100.66 | 14.567 |
| A+B+C+50%N | 25.400 | 10.133 | 77.500 | 15.833 | 25.033 | 8.133 | 7 | 14.800 |
| 100 % N | 25.700 | 9.700 | 85.333 | 15.033 | 23.033 | 9.033 | 88.967 | 15.633 |
| | | | | | | | 87.267 | |
| Mean | 24.448 | 9.907 | 95.419 | 15.496 | 24.373 | 8.769 | 92.804 | 15.433 |
| L.S.D. 5% | n.s | n.s | 9.396 | n.s. | n.s. | 1.066 | n.s. | n.s. |

Data in Table 1 show that inoculation carrot plants with different isolates of *Azosperillum* as alone or plants received with 50% of recommended dose of chemical nitrogen fertilizer were increased fresh weight plant, compared to using recommended dose (100%) of chemical fertilizer without inoculation of *Azosperillum* isolate but the differences were significant in the first season only. The highest values of fresh weight / plant (112.0 and 103 g) in the first and second season respectively were obtained after seeds were inoculated with mixture of isolates ("A"+"B"+"C") without chemical nitrogen fertilizer. The increasing in plant fresh weight after using bio-fertilizer was reported by jagnow *et al.* (1991).

The differences in plant dry weight trait was insignificant in both seasons. This mean that the fertilization with either chemical or bio- nitrogen fertilizers had the same effects on this trait.

**Root measurements :**

Regarding to the root characters of carrot plants i.e. root length and diameter, fresh weight and dry matter percentage, data in Table 2 show that these characters were differed after inoculation with *Azosperillum* isolate treatments. All, these characters except the root length in both seasons and root dry weight in the second season were significantly differed depended on the type of using fertilizer i.e. bio, chemical or bio and chemical fertilizer.

Table 2. Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on some root characters of carrot plant.

| Treatment | First season (2002) | | | | Second season (2003) | | | |
|---|---|---|---|---|---|---|---|---|
| | Root length (cm) | Root diameter (cm) | Root fresh weight (g) | Root dry weight (g) | Root length (cm) | Root diameter (cm) | Root fresh weight (g) | Root dry weight (g) |
| Isolate "A" | 10.200 | 3.033 | 80.167 | 8.100 | 8.800 | 2.667 | 70.833 | 8.033 |
| "B" | 10.976 | 3.033 | 74.500 | 7.227 | 9.400 | 2.700 | 76.767 | 7.667 |
| "C" | 10.700 | 2.831 | 78.500 | 9.533 | 9.433 | 2.300 | 73.800 | 8.567 |
| "A+B+C" | 11.700 | 3.967 | 84.833 | 7.900 | 10.467 | 2.700 | 85.533 | 8.667 |
| "A"+50%N | 11.600 | 2.967 | 76.967 | 9.300 | 9.833 | 2.500 | 75.133 | 8.867 |
| "B"+50%N | 11.300 | 2.933 | 70.333 | 9.200 | 10.467 | 2.690 | 81.200 | 9.200 |
| "C"+ 50%N | 10.700 | 3.967 | 81.833 | 9.567 | 8.267 | 2.400 | 79.600 | 8.800 |
| A+B+C+50%N | 11.233 | 2.800 | 58.833 | 10.333 | 9.833 | 2.367 | 59.433 | 9.307 |
| 100 % N | 9.733 | 2.700 | 61.000 | 10.167 | 9.300 | 2.233 | 60.233 | 9.200 |
| Mean | 10.759 | 2.981 | 74.052 | 9.025 | 9.422 | 2.452 | 73.615 | 8.690 |
| L.S.D. 5% | n.s. | 0.309 | 8.557 | 1.917 | n.s. | 0.2998 | 8.539 | n.s. |

Generally, the heights values of root characters of carrot plants were obtained with those plants which seeds were inoculated with mixture of isolates "A+B+C" without any chemical nitrogen fertilizers. The highest value of root diameter was obtained when seeds were inoculated with the mixture isolate "A+B+C" (3.967 cm in

the first season and 2.700 cm. in the second season) without chemical nitrogen fertilizers. The inoculation seeds with isolate "B" or mixture of isolate "A+B+C" without using any chemical nitrogen fertilizer gave the seam value of root diameter (2.7cm.) in the second season as shown in Table 2.

Data also, in Table 2 show that inoculation carrot plants with the mixture of isolate "A"+"B"+"C" without chemical nitrogen fertilizers gave the highest values of root fresh weight (84.833 and 85.533 g/ plant) in the first and second season respectively.

Inoculation plants with this mixture of isolate "A"+"B"+"C" in addition to received those plants with 50 % of mineral nitrogen recommended dose gave the highest values of root dry weight in both seasons but the differences were significant in the first season only as shown in Table 2.

The improving in some carrot root characters after inoculation with bio-organisms i.e. wild and mutant or transformants was reported by Jagnew *et al.* (1991) and Dakhly and Abd El-Mageed (1997).

**Total yield (Ton/fed.) :**

Data, presented in Table 3 show that total yield of carrot was significantly affected with inoculation plants by isolates of *Azosperillum*. Inoculation seeds of carrot plants with mixture isolates "A+B+C" without mineral nitrogen fertilizer gave the highest value of total yield (10.98Ton/Fed. in the first and 9.984 ton/Fed in the second season). The differences between inoculation with isolate "A", "C" and mixture of isolates "A+B+C" or inoculation with isolate "A" or "B" or "C" and plants received with 50 % of mineral nitrogen rate were insignificant in this character in the second season. The increase in total yield of carrot plants after inoculation seeds with *Azosperillum* isolates may be due to improving plant growth as a result for some growth substances which occurring by micro organisms in the soil as reported by Shallaby *et al.* (2000). The variation between strains of *Azotobacter* in their effects on total yield of carrot was reported by Hassan *et al.* (2000). Also, Dakly and Abd El-Mageed (1997) found that the total yield of carrot were significantly differed depended on *Azotobacter* transformants type. Hassan *et al.* (2000) reported that, the bio-fertilization with isolates of *Azotobacter* had significantly improve the yield of squash plants more than chemical nitrogen fertilizer.

Table 3. Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on total yield and content of nitrite and nitrate of carrot plant.

| Treatment | First season (2002) | | | Second season (2003) | | |
|---|---|---|---|---|---|---|
| | Total yield (ton/fed) | Nitrite (mg/100g dry weight) | Nitrate (mg/100g dry weight) | Total yield (ton/fed) | Nitrite (mg/100g dry weight) | Nitrate (mg/100g dry weight) |
| Isolate "A" | 9.487 | 14.25 | 632.79 | 8.944 | 13.85 | 605.24 |
| "B" | 8.940 | 12.69 | 562.48 | 8.345 | 12.16 | 532.41 |
| "C" | 9.020 | 12.80 | 639.55 | 9.056 | 13.17 | 656.43 |
| "A+B+C" | 10.980 | 13.64 | 631.77 | 9.984 | 13.00 | 658.43 |
| "A"+50%N | 9.443 | 17.30 | 770.94 | 8.816 | 15.93 | 799.44 |
| "B"+50%N | 9.573 | 16.94 | 737.40 | 9.100 | 16.27 | 844.28 |
| "C"+ 50%N | 10.020 | 16.55 | 80820 | 9.952 | 15.67 | 848.97 |
| A+B+C+50%N | 7.960 | 17.63 | 854.43 | 7.666 | 16.48 | 871.66 |
| 100 % N | 6.920 | 21.08 | 1106.23 | 7.695 | 19.98 | 1126.36 |
| Mean | 9.205 | 15.87 | 749.31 | 8.751 | 15.17 | 664.98 |
| L.S.D. 5% | 1.669 | 0.39 | 2.12 | 1.281 | 0.41 | 11.58 |

Finally, increasing growth parameters, root quality and total yield of carrot plants after inoculation with *Azosperillum* isolates may be due to increasing the bio nitrogen fixation and/or by production of phyto-hormones (Jagnow *et al.*, 1991 and Dakhly Abd El-Mageed, 1997).

**II-Turnip plant :**

**Plant growth characters :**

Data presented in Table 4 show that plant length was significantly differed in both seasons depend on the source of nitrogen fertilizer ( i.e., bio, chemical or bio with chemical nitrogen fertilizer). The highest values of this character were obtained when seeds were inoculated with isolate "C" and plants received with half of chemical nitrogen fertilizer (56.30 cm) in the first season and isolate "B" without mineral nitrogen fertilizer (49.90 cm) in the second season.

Regarding the leaflet number per plant, data in Table 4 show that this character was differed depend on the source of fertilizer, but the differences were significant in the first season only. The highest value of leaflet number per plant (11.23) was

observed when seeds were inoculated with isolate "A" and plants received with 50 % of mineral nitrogen recommended dose in the first season.

Table 4 . Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on some vegetative characters of turnip plant.

| Treatment | First season (2002) | | | Second season (2003) | | |
|---|---|---|---|---|---|---|
| | Plant length (cm) | Leaflet number / plant | Leaf area / plant ($cm^2$) | Plant length (cm) | Leaflet number / plant | Leaf area / plant ($cm^2$) |
| Isolate "A" | 52.70 | 7.66 | 4374.13 | 40.10 | 8.77 | 3649.33 |
| "B" | 53.10 | 9.00 | 5195.17 | 49.90 | 9.07 | 4190.40 |
| "C" | 51.80 | 7.73 | 6111.00 | 44.00 | 9.03 | 3703.07 |
| "A+B+C" | 52.70 | 9.63 | 4156.03 | 44.80 | 8.70 | 4510.07 |
| "A"+50%N | 54.60 | 11.23 | 5257.43 | 48.40 | 8.73 | 4539.57 |
| "B"+50%N | 53.10 | 9.07 | 4860.50 | 48.80 | 8.63 | 3953.70 |
| "C"+ 50%N | 56.30 | 9.83 | 6117.37 | 47.40 | 9.63 | 5468.83 |
| A+B+C+50%N | 54.70 | 10.10 | 5410.47 | 44.10 | 9.07 | 4974.13 |
| 100 % N | 55.20 | 10.17 | 5710.77 | 45.50 | 9.53 | 4034.05 |
| Mean | 53.90 | 9.38 | 5243.32 | 46.20 | 9.02 | 4335.90 |
| L.S.D. 5% | 2.011 | 2.03 | 689.00 | 1.865 | n.s. | 672.90 |

The leaf area per plant was significant affected with bio-inoculation in both seasons as data shown in Table 4. The highest values of this character was obtained in both season after seeds were inoculated with isolate "C" and plants received with the half quantity of mineral nitrogen recommended dose (6117.37 and 5468.83 $cm^2$ in the first and second seasons respectively).

**The root characters:**

Both, root length and root diameter were differed significantly as a result for source of nitrogen fertilizer in the second season, but in the first season the root length character only was significant as shown in Table 5. Data showed that to obtain the highest values of root length must be inoculate seeds with mixture of isolates "A+B+C" and plants received with 50 % of recommended mineral nitrogen dose (8.23 cm) in the first season, and (8.67 cm) in the second season. These results showed clearly the importance of both chemical and bio nitrogen fertilizers to improved some of turnip root characters.

Regarding to root diameter, data show that, turnip seeds were inoculated with mixture of isolate "A+B+C" and plants received with 50 % of recommended mineral

nitrogen dose was the best treatment to obtain the highest values of root diameter (7.78 cm in the first season and 7.87 cm in the second season) but the difference was insignificant in the first season. These results showed that inoculation turnip plants with mixture of different isolates had a major role to increased size of plant root, which considered as economic character at turnip plants. This result were inagreement with those obtained by Dakhly and Abd El-Mageed ( 1997 ), who found that diameter of potato tuber was increased after inoculation plant with *Azotobacter*.

The dry matter percentage of turnip plants was differed significantly, depend on the type of fertilizer in the second season only. The highest values of this character were obtained when seeds were inoculated with isolate "A" without chemical nitrogen fertilizer (4.60) in first and (4.73) in second seasons (Table 5). These results inagreement with those obtained by Abd El-Ati *et al.* (1996) who found that dry matter content of potato plants was increased with *Azosperillum* inoculation. Also, with Foly *et al.* (2002) who reported that highest values of dry mutter percentage of garlic bulb was observed with fertilizing garlic plant with cattle poultry manure + Bio-fertilizer + K.

Table 5. Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on some root characters of turnip plant.

| Treatment | First season (2002) | | | Second season (2003) | | |
|---|---|---|---|---|---|---|
| | Root length (cm) | Root diameter (cm) | Dry matter percentage | Root length (cm) | Root diameter (cm) | Dry matter percentage |
| Isolate "A" | 6.93 | 7.23 | 4.60 | 6.67 | 6.87 | 4.73 |
| "B" | 6.70 | 7.17 | 4.33 | 7.27 | 7.20 | 3.70 |
| "C" | 7.83 | 7.30 | 3.53 | 7.10 | 6.50 | 3.80 |
| "A+B+C" | 7.37 | 7.10 | 4.30 | 7.20 | 7.83 | 4.07 |
| "A"+50%N | 6.83 | 7.53 | 3.93 | 6.93 | 7.08 | 4.37 |
| "B"+50%N | 8.10 | 7.77 | 4.13 | 6.63 | 6.60 | 4.47 |
| "C"+ 50%N | 7.37 | 6.90 | 3.67 | 8.17 | 7.30 | 3.40 |
| A+B+C+50%N | 8.23 | 7.78 | 4.00 | 8.67 | 7.87 | 3.47 |
| 100 % N | 6.77 | 7.70 | 4.08 | 7.33 | 7.43 | 4.53 |
| Mean | 7.24 | 7.34 | 4.06 | 7.22 | 7.12 | 4.06 |
| L.S.D. 5% | 0.89 | n.s. | n.s. | 0.87 | 1.022 | 1.12 |

**Total yield :**

Data presented in Table 6 show that total yield (Ton/fed) of turnip was significantly improved with inoculation seeds with *Azosperillum* isolates in both seasons. The highest values of total yield (16.970 and 17.800 ton/fed) in the first and second season respectively were obtained when seeds were inoculated with the mixture of isolates "A+B+C" and plants received 50 % of recommended mineral

nitrogen dose in both seasons. Total yield was increased with this treatment (mixture "A+B+C" +50% N) by about (3.01 and 4.47 ton/fed ) in the first and second season respectively compared to plants received with 100 % recommended mineral nitrogen dose. This increasing in total yield after inoculation with *Azosperillum* isolate particularly the mixture of isolates could be resulted from the role of bio-fertilizer in nitrogen fixing and producing phyto-hormones which play an important role in improving growth character such as leaf area, plant fresh weight and dry mutter percentage. This improve in growth and root characters were caused the increase in total yield. The increase in total yield of some vegetable crops after inoculation with *Azosperillum* were reported by many investigators such as Fayez *et al.*(1988) on broad bean, Ranganathan *et al.* (1995) on tomato, Gurubatham *et al.* (1989) on onion. Amara and Nasr (1995) demonstrated that *Azosperillum* increased seed yield of soybean. As well as, Kruthamani *et al.* (1995) found that *Azosperillum* gave the highest fruit yields of pumpkin. Wange (1995) illustrated that when cloves of garlic were inoculated with *Azosperillum*, bulb yield was increased and the greatest average number of cloves per bulb was obtained. Mahendran and Kumar (1998) found that *Azosperillum* gave the highest tuber yield of potatoes. Also, Saad *et al.* (1999) reported that plants inoculated with *Azosperillum* produced higher root yield of sweet potato. Hassan *et al.* (2000) observed that the inoculation by mutants and hybrids of two *Azotobacter* species increased yield of squash.

Table 6. Effect of inoculation with *Azosperillum* isolates and chemical nitrogen fertilizer on total yield and content of nitrite and nitrate of turnip plant.

| Treatment | First season (2002) | | | Second season (2003) | | |
|---|---|---|---|---|---|---|
| | Total yield (Ton/fed) | Nitrite (mg/100g dry weight) | Nitrate (mg/100g dry weight) | Total yield (Ton/fed) | Nitrite (mg/100g dry weight) | Nitrate (mg/100g dry weight) |
| Isolate "A" | 14.26 | 12.42 | 688.03 | 13.00 | 12.64 | 664.83 |
| "B" | 13.54 | 12.14 | 528.43 | 13.73 | 12.44 | 563.00 |
| "C" | 15.12 | 11.86 | 492.14 | 14.20 | 12.03 | 501.21 |
| "A+B+C" | 13.86 | 13.02 | 510.96 | 13.93 | 13.43 | 522.50 |
| "A"+50%N | 14.74 | 15.25 | 762.29 | 14.60 | 15.59 | 775.79 |
| "B"+50%N | 16.83 | 16.61 | 889.57 | 15.97 | 16.28 | 839.81 |
| "C"+ 50%N | 13.90 | 16.21 | 961.26 | 14.27 | 16.07 | 953.31 |
| A+B+C+50%N | 16.97 | 16.85 | 935.97 | 17.80 | 16.65 | 982.97 |
| 100 % N | 13.96 | 19.75 | 1191.76 | 13.33 | 20.28 | 1123.10 |
| Mean | 14.80 | 14.90 | 773.33 | 14.54 | 15.05 | 767.39 |
| L.S.D. 5% | 0.11 | 0.24 | 7.51 | 0.80 | 0.60 | 11.49 |

**Nitrite and Nitrate content:**

Results in Tables (3 & 6 ) showed that, both nitrite and nitrate content in the root of either carrot or turnip were significantly decreased with using bio-fertilizer treatments particularly with individual isolate compared to the mixture isolate or received mineral nitrogen with 50% or 100% of recommended mineral nitrogen dose. Whereas the lowest quantity of nitrite (12.69) and nitrate (562.48) in the first season and (12.16) nitrite and (532.41) nitrate in the second season for carrot plant were obtained when seeds were inoculated with isolate "B" without mineral nitrogen fertilizer. While, the lowest quantity of nitrite (11.86) and nitrate (492.14) in the first season and nitrite (12.03) and nitrate (501.21) in the second season for turnip plant were obtained when seeds were inoculated with isolate "C" without mineral nitrogen fertilizer. This meaning that the clean products of carrot and turnip roots were obtained with using bio-fertilizers. On the other hand the highest values of nitrite and nitrate content were observed after using mineral nitrogen with complete recommended mineral nitrogen dose. This reduction in both nitrite and nitrate content in the carrot and turnip when seeds were inoculated with *Azosperillum* isolates and plants received with 50% of recommended mineral nitrogen dose is considered a great aim in present time specially with obtained the same quantity or more of total yield. The reduction of nitrate content with using bio-fertilizer were also reported by Shalaby *et al.* (2000) and Foly *et al.* (2002) on garlic.

In general, inoculation either carrot or turnip plants with some isolate of *Azosperillum* had to improve some characters such as plant fresh weight, root diameter, root fresh and dry weights addition to total yield of carrot plants. Also, improved leaf area, root length and diameter and total yield of turnip plants.

In the mean time, reducing the contains of edible part (roots) of both nitrite and nitrate which considered the important goals in now days. It was clearing observed in our study after inoculation with *Azosperillum* isolates.

## REFERENCES

1. Abd El-Ati Y. Y., A. M. M. Hammed and M. Z. H. Ali. 1996. Nitrogen fixing and phosphate solubilizing bacteria as bio-fertilizer for potato plants under Minia conditions. 1st Egyptian Hung. Hort. Conf. Kafr El-Sheikh, Egypt, 15-17 Spet.

2. Amara M. A. and S. A. Nasr. 1995. Impact of foliar application with bio-fertilizers and micro nutrients on growth and yield of brabyrhizobium inoculation soybean plants. Annals Agric. Sci., Ain Shams Univ., Cairo,40 (2): 567- 578.

3. Bouton J. H., S. L. Albrecht and Zuberer. 1985. Screening and selection of plants for root associated bacteria nitrogen fixation. Field Crop. Res., 11(2):131-140.

4. Dakhly O. F. and Abd El-Mageed. 1997. Estimation of effectiveness of Azotobacter chroococcum transformation on growth and yield of some vegetable crops. Egypt J. Genet. Cytol. 26:73-88.

5. El-Haddad M. E., Y. Z. Ishac and M. I. Mostafa. 1993. The role of bio-fertilizers in reducing agricultural costs, decreasing environmental pollution raising crop yield. Arab Univ. J. Agric. Sci. Ain Shams Univ. Cairo,1(1):147-195.

6. Etienne P., D. Mulard, P. Blanc, J. Fages, G. Goma and A. P. Ureilleua. 1990. Effects of partial O2 pressure, partial CO2 pressure, and agitation on growth kinetics of Azospirillum lipoferum under fermentor conditions. Appl. and Envir., Microbiol., (56): 3235-3239.

7. Fayez M., N. F. Emam and H. E. Makboul. 1988. Interaction between Azosperillum brasilense and Rhizobium leguminosarum biovar viciae and their influence on nodulation and growth of broad bean (Vicia faba). Proc. of the Second Conf. Agric. Dev. Res., Cario. 17-19 Dec., Vol.II. Food Sci. & Microb. Undated, 253-261.

8. Fisher A. and C. Richter. 1984. Influence of organic and mineral fertilizer on yield and quality of potatoes. The Fifth IFOAM International Scientific Conference at the University of Kassel Germany, p.37.

9. Foly H. M. H., O. F. Dakhly, E. L. M. Awad, Y. T. Abd El-Mageed and E. A. Hassan. 2002. Using some isolates and transformants of Azotobacter to reduce chemical nitrogen fertilizer rates in garlic production. J. Agric. Sci. Mansoura Univ., 27(11):7667-7684.

10. Gomez K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. John Willy and Sons. New York pp. 680.

11. Gurubatham J. R. J., S. Thamburaj and D. Kandasamy. 1989. Studies on the effect of bio-fertilizers on the bulb yield in Bellary onion (Allium capa L.). South Indian Hort., 37(3):150-153.

12. Hassan E. A., O. F. Dakhly and F. A. S. Nassif. 2000. Increasing yield of squash plants through inoculation by mutants and hybrids of two Azotobacter species.

Proceedings of the Second Arab Congress of Genetics and Biotechnology (October 23—26, 2000): 131-150.

13. Jagnow G., G. Hoflich and K. H. Hoffmann. 1991. Inoculation of non-symbiotic rhizosphere bacteria: Possibilities of increasing and stabilizing yields. Angew Botanik, 65:97-128.

14. Karuthamani, M., S. Natarajan and S. Thamburaj. 1995. Effect of inorganic and bio-fertilizers on growth and yield of pumpkin (Cucarbita moschata). South-Indian – Hort.,43(5-6): 134-136.

15. Mahendrum P. P. and N. Kumar. 1996. A note on the effect of bio-fertilizer in garlic (Allum sativum L.). South Indian Hort. 44(5-6):170-171.

16. Mahendram P. P. and N. Kumar. 1998. Effect of bio-fertilizers on tuber yield and certain quality parameters of potato cv. Kufri Jyoti. South Indian Hort., 46(1/2):97-98.

17. Ranganathan D. S. and R. Perumal. 1995. Effect of micro-nutrients with /without organics and bio-fertilizers on growth and development of tomato in inceptisol and alfisol. South India. Hort.,43(3-4):89-92.

18. Saad, O. A. 1991. Influence of soil temperature on the microbial population metabolizing nitric oxide. Ph.D. Thesis, Faculty of Agriculture, Minia University.

19. Saad M. S., A. S. A. Sabuddin, A. G. Yunus and Z, H. Shamsuddia. 1999. Effect of Azospirillum inoculation on sweet potato grown on sandy tintailing soil . Communic . in Soil Sci . & Plant Analysis, 30 (11/12): 1583 - 1592 .

20. Shalaby G. I., N. M. Kandeel, A. Z. Osman, A. S. Badawy and H. El-Badry. 2000. Effect of organic, inorganic and bio-fertilizers on yield, quality and storability of garlic grown in new-reclaimed soil. Proc. of the third Sci. Conf. of Agric. Sci. Assuit Oct. 2000, 229-244.

21. Subba Rao N. S. 1984. Bio-fertilizers in Agriculture. Oxford & IBH Publishing CO. New Delhi India.

22. Tien T. M., M. H. Gaskins and D. H. Hubble. 1979. Plant growth substances produced by Azospirllum barasilense and their effect on the growth of plant. App. Environ Microbiol, 37: 1016-1024.

23. Wange, S. S. 1995. Response of garlic to combined application of bio-fertilizers and nitrogen fertilizer. J. Soils and Crops, 5 (2): 115-116.

# تأثير التلقيح ببعض عزلات من الأزوسبريليم على نمو وصفات نباتات الجزر واللفت تحت ظروف خفض كمية النيتروجيني المعدني.

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تـم الحصول على عزلات من بكتريا *Azosperillum* من قسم الوراثة بكلية الزراعة جامعة المنـيا بينما تمت التحليلات الكيماوية بالمعمل المركزي للزراعة العضوية أما الدراسة الحقلية فكانت بمحطـة بحـوث البساتين بالصباحية لمدة موسمين متتالين (٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ ) وذلك بهـدف دراسـة تأثـير التلقيح ببعض العزلات من *Azosperillum* (هي أ، ب ، ج) والخليط بينهما (أ+ب+ج) بدون تسميد كيماوي آزوتي أو مع التسميد بمعدل ٥٠% من الجرعة الموصى بها ومقارنة صـفات النمو والمحصول لنباتات الجزر واللفت وكذلك نسبة المحتوى من النترات والنيتريت في كل مـنهما مـع النباتات المعاملة بجرعة ١٠٠ % من السماد الكيماوي الآزوتي الموصي به وكانت أهم النتائج المتحصل عليها :

١- أن التلقـيح بهذه العزلات *Azosperillum* بدون أو مع ٥٠% من السماد الكيماوي الآزوتي أدى إلى تحسين بعض صفات النمو في كلا المحصولين (الجزر واللفت) وكذلك المحصول الكلي مقارنة بالنباتات الغير ملقحة .

٢- اختلفت هذه العزلات فيما بينها في تأثيرها على بعض صفات النمو والمحصول وكان أفضل تأثير عند استخدام مخلوط العزلات (أ+ب+ج) على محصول كلا النباتين الجزر واللفت.

٣- اختلف كلا المحصولين عن بعضهما في استجابتهما وتأثرهما بالتلقيح بهذه العزلات .

٤- انخفـض المحـتوى مـن النترات والنتريت في النباتات الملقحة بالعزلات مقارنة بالمسمدة بالجرعة الموصى بها من السماد الكيماوي الآزوتي.

مـن هـذه الدراسة يمكن التوصية بأهمية تلقيح هذين المحصولين بهذه العزلات من *Azosperillum* لتحسـين نموها ومحصولها وكذلك تقليل الجرعة المستخدمة من الأسمدة الآزوتية مما يقلل من الآثار الضارة لها على الإنسان والبيئة لتخفيض نسبة النترات والنتريت في المحصول .