ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 42 (3): 1329-1345, (2004).

EFFECT OF MINERAL AND BIOLOGICAL NITROGEN FERTILIZATION ON THOMPSON SEEDLESS GRAPE TRANSPLANTS. I.EFFECT ON VEGETATIVE GROWTH.

BY

Shawky, I. *; EL-Shazly, S. *; EL-Gazzar, A. *; Selim, S. ** and Noha Mansour *

* Dept. of Horticulture, Fac. of Agric., Ain Shams Univ.

** Dept. of Microbiology, Fac. of Agric., Ain Shams Univ.

ABSTRACT

A pot experiment was carried out in 2001 and 2002 seasons on Thompson Seedless grape transplants to study the effect of two sources of nitrogen fertilizers (mineral and biological) on vegetative growth of transplants. The experiment included three levels of mineral nitrogen (M_1=zero, M_2=5 and M_3=10g N / plant / year)and four levels of biological nitrogen (B_1=zero, B_2=50, B_3=100 and B_4=200ml of liquid culture of *Azotobacter chroococcum*). Thus, the study is a factorial experiment in a randomized complete block design. Generally, in both the two seasons fertilizing with medium level of mineral nitrogen M_2(5g N / plant / year) gave the highest significant values of shoot length, number of leaves, total chlorophyll content and fresh & dry weights of whole plant. On the other hand, fertilizing with the third biological nitrogen level (B_3 = 100 ml / plant / year) gave the highest significant values of shoot length, number of leaves and total chlorophyll content in both the two seasons. Regarding the interaction in both the two seasons, fertilizing with mineral nitrogen alone [treatments (M_2 x B_1) and (M_3 x B_1)]increased plant growth (shoot length, number of leaves, leaf area and fresh & dry weights of whole plant) compared with unfertilized transplants [treatment (M_1 x B_1)]. On the other hand, fertilizing with biological nitrogen alone[treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4)] increased plant growth (shoot length, number of leaves, leaf area and fresh & dry weights of whole plant) compared with unfertilized transplants [treatment (M_1 x B_1)] and the promosing biological treatment was (M_1 x B_3) in the two seasons . When combining mineral nitrogen with biological nitrogen, higher values were obtained especially when combining the second rate of mineral nitrogen with any different rate of biological nitrogen. However, the highest values were obtained by treatment (M_2 x B_3) for shoot length, number of leaves, leaf area and chlorophyll content. Moreover, the highest values of fresh and dry weights of whole plant were obtained by treatments (M_2 x B_2) and (M_2 x B_3) In other words, combining mineral with biological nitrogen created more beneficial effect on vegetative growth than adding any form alone and the recommended treatment was (M_2 x B_3)

Key words: Thompson Seedless, grape, mineral nitrogen, biological nitrogen, vegetative growth.

INTRODUCTION

Nitrogen is one of the essential nutrients for plant nutrition, this fact was established in 19th century. The presence of nitrogen is most manifest in the leaves., where amino acids and subsequently proteins are produced from the carbohydrate synthesized from carbon dioxide and the influence of sunlight. Nitrogen role in plant nutrition has been recognized to be connected with the production of vigorous vegetative growth because cells are able to grow from the additional protoplasm (proteins) produced. Nitrogen is a primary component of chlorophyll and leaves are usually dark green if they have a sufficiency of nitrogen and become yellow if they suffer deficiencies. (Follett *et al.* 1981 and Lowrison, 1993).

Nitrogen is generally applied to plants through mineral fertilization and organic manuring. However, part of mineral fertilizers used in crop production escape to water causing disturbance in the biological balance and contaminate under-ground water which in turn causes hazardous effects for humans and animals. (Postgate, 1978).

Recently, research work is oriented to evaluate biofertilization as a new method for plant nutrition . In biofertilization, some living microorganisms such as bacteria, fungi and blue- green algae are used to improve soil fertility (Marschner, 1988).

In this respect, Swarupa (1996), observed that application of *Azospirillum brasilense* + phosphobacteria (*Bacillus sp.*) + VAM fungi (*Gigaspora margarita*) significantly increased vegetative growth of the C X R coffee seedlings.

Sharma and Bhutani (1998)found that, dual inoculation with *Glomus fasciculatum* and *Azotobacter chroococcum* produced larger apple seedlings which had a higher leaf area, a greater biomass and a higher chlorophyll content than control .

On the contrary Alwar *et el.* (1994) found that using *Azotobacter* (N-fixing) and a commercial biofertilizer formulation (including a phosphorus solubilizer)did not increase growth of coffee seedlings.

Therefore, it seems that biological fertilization is a virgin field, and more research work should be carried out to evaluate biofertilizers as a source for plant nutrition.

Thus, the main goal of this research is to study the effect of two sources of nitrogen fertilizer (mineral and biological) on vegetative growth of Thompson Seedless grape transplants .

MATERIALS AND METHODS

The present study was conducted throughout two successive seasons (2001 and 2002) to study the effect of two sources of nitrogen (mineral and biological) on growth of Thompson Seedless grape transplants .All transplants were grown in a saran green house, Faculty of Agriculture, Ain Shams Univ., Shoubra EL- Kheima, Egypt .

In each season, one-year-old Thompson Seedless grape transplants were planted in the first week of February in plastic containers (35 cm in diameter and 30cm in length). One transplant was planted in a container filled with sandy loam soil (about 22 kg / container).

The soil analysis indicated that the percentage (coarse sand, fine sand, silt, and clay were 3.7, 81.8, 3.2 and 11.4 %, respectively in the first season and 70.5, 11.2, 3.4 and 15.0 %, respectively in the second season). Thus, the soil texture in the two seasons was sandy loam.

Ammonium sulphate (20.5%) was used as mineral nitrogen fertilizer . Mineral nitrogen treatments included three levels of nitrogen namely (M_1=zero, M_2=5 and M_3= 10g N / plant / year). Each nitrogen level was added at 20 applications at ten days intervals during the growing season from March to September in each season .

Biological nitrogen fertilizer involved a mixture of two local strains (L_4 and L_6) of non symbiotic nitrogen fixers " *Azotobacter chroococcum*". This culture was kindly provided from the Unit of Biofertilizers, Faculty of Agriculture, Ain Shams University. The biological nitrogen treatments included four levels of nitrogen biofertilizer, namely (B_1=zero, B_2=50,B_3=100 and B_4=200ml of liquid culture / plant/ year).The concentration of liquid culture was ca. 16.0 x 10^8 cell / ml . Before applying biological nitrogen fertilizer and to secure covering the soil rhizosphere with the bacteria, four holes (each of 15 cm length x 1.5 cm diameter) were dug in the soil of each pot, then the given amount of each level was applied to the surface of each pot . All biological nitrogen treatments were applied in the first week of April in each season.
Accordingly, the study involved three levels of mineral nitrogen and four levels of biological nitrogen in a factorial experiment in a randomized complete block design. Each treatment was replicated five times and each replicate was represented by two plants

For all plants, phosphorus and potassium fertilizers were mixed with the soil before planting at a rate of 10 g / plant / year for superphosphate (15.5% P_2O_5) and 10 g / plant / year for potassium sulphate (48-52%K_2O).

At planting time in February, stem of transplant was shortened to 2-3 buds. Thereafter, plants were trained to one shoot per plant and supported with a wooden stick. All transplants were irrigated twice every week with tap water at a rate of one liter per transplant each time.

Growth measurements:-

Plants were measured for length and number of leaves from May to October at monthly intervals in each season

Two fully expanded leaves from the 5-7th nodes from plant top (Shawky *et al.*, 1996) were monthly collected (2 leaves from each replicate) from July to October in each season. The area of leaf blades was measured by a LI – COR – Portable area meter, Model $L_1 - 300$. Area was expressed as cm^2. In the second season, the same leaf samples were used to measure total chlorophyll content by using a SPAD – 502 MINOLTA chlorophyll meter. The SPAD – 502 meter determines the relative amount of chlorophyll present by measuring the transmittance of the leaf in two wave length regions (the red and near-infrared). Using these two transmittance, the meter calculates a numerical SPAD value which is proportional to the amount of chlorophyll present in the leaf.

At the end of each season (December), the whole plant was taken out carefully and each of fresh and dry weights of whole plant were determined.

Data obtained were statistically analyzed by using the analysis of variance as reported by (Snedecor and Cochran, 1980) . Means were differentiated by using Duncan's multiple range test at 5 % (Duncan, 1955).

RESULTS AND DISCUSSION

1- Effect on shoot length:

Results in Table 1 show that shoot length was affected significantly by levels of mineral, biological nitrogen, and their interaction in the two seasons

Effect of mineral nitrogen levels:

In the first season, level M_2 (5 g N/ plant / year) gave the highest significant value of shoot length when compared with any other level. This was true in any given month during the growing season. On the contrary, increasing nitrogen rate up to 10 g N/ plant / year) level (M_3) gave more or less similar values as those of level M_1 (0 g N/ plant / year) especially in May, June and July. However, in the second half of the growing season (August, September and October) level (M_3) significantly reduced shoot length than that of level (M_1).

In the second season, results proved that the medium level (M_2) gave the highest significant value for shoot length in any given month except in May. However, the high level (M_3) gave significant lower values than those of level (M_1) in any given month during the growing season.

Thus, it seems that fertilizing with the medium level (M_2) of mineral nitrogen (5 g N/ plant / year) gave the highest value of shoot length of Thompson Seedless grape transplants in the two seasons.

Table (1): Effect of mineral and biological nitrogen fertilization on shoot length (cm) of Thompson Seedless grape transplants during 2001 and 2002 seasons .

Treat.of bio. N* (ml/plant)	Treatments of mineral nitrogen (g N / plant)											
	0(M1)	5(M2)	10(M3)	Mean	0(M1)	5(M2)	10(M3)	Mean	0(M1)	5(M2)	10(M3)	Mean
	2001 season											
	May				**June**				**July**			
0 (B1)	18.0 cd	19.4 c	19.2 c	**18.9 C'**	44.0 fg	49.0 ef	47.0 e-g	**46.7 D'**	65.6 g	84.4 b	72.8 f	**74.3 B'**
50 (B2)	16.2d	16.2 d	15.8 d	**16.1 D'**	49.0 ef	56.0 d	43.2 g	**49.4 C'**	69.0 fg	75.0 e	68.4 fg	**70.8 C'**
100 (B3)	20.2 c	26.0 b	31.8 a	**26.0 A'**	49.6 e	61.0 bc	65.8 a	**58.8 A'**	79.8 cd	88.8 a	79.4 cd	**82.7 A'**
200 (B4)	26.6 b	26.4 b	15.2 d	**22.7 B'**	47.6 e-g	62.0ab	57.2 cd	**55.6 B'**	82.0 bc	85.4 b	77.0 de	**81.5 A'**
Mean	**20.3B**	**22.0 A**	**20.5 B**		47.6 C	**57.0 A**	**53.3 B**		**74.1 B**	**83.4 A**	**74.4B**	
	Aug.				**Sept.**				**Oct.**			
0 (B1)	81.8 f	90.0 d	90.8 d	**87.5 B'**	84.2 d	94.0 c	91.4 c	**89.9C'**	95.0 e	99.8 de	95.2 e	96.7C'
50 (B2)	99.2 c	104. ab	85.0 ef	**96.1 A'**	99.6 b	104.2ab	85.6 d	**96.5 B'**	109.2 b	106.4bc.	85.8 f	**100.5 B'**
100 (B3)	96.2 c	107.2 a	84.8 ef	**96.1 A'**	102.6ab	108.4 a	100.2 b	**103.7A'**	103.6b-d	120.8 a	101.6cd	**108.7A'**
200 (B4)	98.6 c	100.4bc	88.4 de	**95.8 A'**	100.2 b	100.4b	93.0 c	**97.9 B'**	101.4cd	100.6de	100.6 c-e	**100.9 B'**
Mean	**94.0 B**	**100.4 A**	**87.3C**		**96.7 B**	**101.8A**	**92.6C**		**102.3 B**	**106.9 A**	**95.8 C**	
	2002 season											
	May				**June**				**July**			
0 (B1)	22.6e	22.6e	25.8d	**23.7C'**	42.4g	56.6d	43.8fg	**47.6C'**	50.2f	61.4d	56.8e	56.1D'
50 (B2)	33.0ab	33.4a	29.2c	**31.9A'**	47.0e	58.8cd	44.4e-g	**50.1B'**	57.6e	63.2cd	57.8e	59.5C'
100 (B3)	33.6a	33.4a	23.4de	**30.1AB'**	58.4cd	64.2a	60.2bc	**60.9A'**	64.2c	83.6a	63.0cd	70.3A'
200 (B4)	33.0ab	30.4bc	24.4de	**29.3B'**	62.4ab	43.2g	46.0ef	**50.5B'**	74.4b	73.8b	52.0f	66.7B'
Mean •	**30.6A**	**30.0A**	**25.7B**		**52.6B**	**55.7A**	**48.6C**		**61.6B**	**70.5A**	**57.4C**	
	Aug.				**Sept.**				**Oct.**			
0 (B1)	60.4e	69.6d	64.2e	**64.7D'**	62.2g	69.8ef	65.6fg	**65.9C'**	62.6h	71.0g	72.2fg	**68.6C'**
50 (B2)	79.0b	85.4a	62.4e	**75.6B'**	91.0bc	91.8bc	70.6e	**84.5B'**	94.6cd	102.6ab	76.6ef	**91.2B'**
100 (B3)	79.8b	88.8a	78.2b	**82.3A'**	88.8c	94.0b	81.4d	**88.1A'**	97.6bc	103.4a	90.6d	**97.2A'**
200 (B4)	76.2bc	73.8cd	61.6e	**70.5C'**	91.2bc	99.8a	66.2fg	**85.7AB'**	96.0c	101.4ab	78.4e	**91.9B'**
Mean	**73.9B**	**79.4A**	**66.6C**		**83.3B**	**88.9A**	**70.9C**		**87.7B**	**94.6A**	**79.4C**	

* biological nitrogen = nitrogen fixation bacteria (*Azotobacter chroococcum)*

In each month in each season, means of each of mineral and biological nitrogen levels or their interactions having the same letters are not significantly different at 5 % level .

Effect of biological nitrogen levels:

In the two seasons, fertilizing with level B_3 (100 ml / plant) gave the highest value of shoot length in any given month except May and September in the second season. Reducing or increasing the rate of biological nitrogen (levels B_2 and B_4) gave more or less similar values but level B_1 (0 ml / plant) gave the least significant values in any given month except in May and July in the first season.

The interaction between mineral and biological nitrogen:

In the two seasons, unfertilized transplants [treatment (M_1 x B_1)] in most cases gave lower values of shoot length.

Generally in both the two seasons, fertilization with mineral nitrogen alone[treatments(M_2 x B_1) and (M_3 x B_1) in the first row of Table 1] increased shoot length especially treatment (M_2 x B_1) but more increase in mineral nitrogen treatment (M_3 x B_1) tended to reduce shoot length.

On the other hand in both the two seasons, biological nitrogen alone [treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4) in the first column of Table 1] increased shoot length gradually as the rates of biological nitrogen increased compared with the unfertilized plants [treatment (M_1 x B_1)]. Almost the highest values were obtained by treatments(M_1 x B_3) and (M_1 x B_4) especially in the second season.

However, other combinations created more stimulative effect on shoot length. The highest values were obtained by treatments(M_2 x B_3) in July, August, September and October in the first season. In the second season, treatment (M_2 x B_3) gave the highest values in all months except September.

Therefore, it seems that treatment (M_2 x B_3) gave the highest value of shoot length of Thompson Seedless grape transplants in the two seasons.

In this respect, Kumari and Balasubramanian (1993), found that shoot length of coffee seedlings increased significantly by inoculation with (VAM) fungi and *Azospirillum brasilense* compared with untreated seedlings .

Bavaresco *et al* . (2001) carried out a pot experiment on *Vitis vinifera* cv. Cabernet Sauvignon plants. They, found that shoot growth was increased by increasing mineral nitrogen rate up to 16 g N / pot / year .

2-Effect on number of leaves / plant:

Results in Table 2 show that number of leaves / plant was affected significantly by levels of mineral, biological nitrogen, and their interaction in the two seasons.

Effect of mineral nitrogen levels:

In the two seasons, number of leaves / plant was affected significantly by levels of mineral nitrogen in all months except in May in the second season.

Level M_2 (5 g N/ plant / year) gave the highest significant value for number of leaves / plant in any given month except in May. The high nitrogen level (M_3) gave lower values than those of the preceding treatment. Whereas, level M_1 (0 g N/ plant / year) gave the least significant values in any given month except in May and October in the second season.

Thus, it seems that the second level of mineral nitrogen (5 g N/ plant / year) gave the highest value of number of leaves / plant of Thompson Seedless grape transplants in the two seasons .

Effect of biological nitrogen levels:

In the two seasons, fertilizing with level B_3 (100 ml / plant) gave the highest significant values for number of leaves / plant in any given month except May and June in the first season and June in the second season. Levels (B_1, B_2 and B_4) gave more or less similar values in all months but level B_1 gave the least significant values especially at the end of the growing seasons (September and October).

Therefore, it seems that the third level of biological fertilization (100 ml / plant) gave the highest values of number of leaves / plant in the two seasons.

The interaction between mineral and biological nitrogen:

In the two seasons, unfertilized transplants [treatment (M_1 x B_1)] gave lower values of number of leaves / plant than other studies treatments.

Fertilizing with mineral nitrogen alone [treatments (M_2 x B_1) and (M_3 x B_1)] increased number of leaves / plant significantly compared with unfertilized treatment (M_1 x B_1) and treatment (M_2 x B_1) gave the highest values in the two seasons.

Fertilizing with biological nitrogen alone[treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4)] increased number of leaves / plant as the concentration of biological nitrogen increased up to 100 ml / plant [treatment (M_1 x B_3)]. More increase in biological nitrogen [treatment (M_1 x B_4)] led to reduce number of leaves / plant especially in the first season. However, in the second season adding biological nitrogen alone [treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4)] gave similar values but these values were higher than that of the unfertilized plants [treatment (M_1 x B_1)].

Nevertheless, in both the two seasons, it is observed that under any given level of mineral treatments, increasing the level of biological nitrogen up to 100 ml / plant increased number of leaves / plant but more increase in biological nitrogen reduced number of leaves / plant except in May in the first season only.
Consequently, it could be concluded that during the two seasons and in all the considered months except in May, treatment (M_2 x B_3) gave the highest values of number of leaves /plant.

Table (2): Effect of mineral and biological nitrogen fertilization on number of leaves / plant of Thompson Seedless grape transplants during 2001 and 2002 seasons .

Treat. of bio. N* (ml/plant)	Treatments of mineral nitrogen (g N / plant)											
	0(M_1)	5(M_2)	10(M_3)	Mean	0(M_1)	5(M_2)	10(M_3)	Mean	0(M_1)	5(M_2)	10(M_3)	Mean
2001 season												
	May				**June**				**July**			
0 (B_1)	5.6f	10.4ab	10.8a	8.9B'	17.4e	22.4a-c	20.8d	20.2B'	23.6e	29.2c	24.2e	25.7C'
50 (B_2)	6.8e	11.2a	10.4ab	9.5A'	21.0cd	22.0b-d	23.8a	22.3A'	26.4d	34.4a	26.8d	29.2B'
100 (B_3)	7.6de	8.2cd	7.6de	7.8C'	22.4a-c	23.6a	22.4a-c	22.8A'	27.2d	33.8a	33.8a	31.6A'
200 (B_4)	10.4ab	8.6c	9.8b	9.6A'	22.0b-d	23.2ab	16.6e	20.6B'	28.8c	30.2b	27.0d	28.7B'
Mean	7.6B	9.6A	9.7A		20.7B	22.8A	20.9B		26.5C	31.9A	28.0B	
	Aug.				**Sept.**				**Oct.**			
0 (B_1)	28.4e	39.0a	30.2de	32.5B'	29.0g	41.8de	30.2g	33.7D'	30.0f	43.8c	32.6e	35.5D'
50 (B_2)	28.0e	38.0ab	32.8cd	32.9B'	29.0g	42.8cd	40.6e	37.5C'	29.4f	44.4bc	42.0d	38.6C'
100 (B_3)	35.0bc	38.2ab	37.6ab	36.9A'	44.0c	50.8a	41.8de	45.5A'	44.0 c	53.6a	43.0cd	46.9A'
200 (B_4)	31.2de	37.8ab	29.0e	32.7B'	42.2de	45.8b	33.8f	40.6B'	43.8 c	45.8b	34.0e	41.2B'
Mean	30.7C	38.3A	32.4B		36.1B	45.3A	36.6B		36.8C	46.9A	37.9B	
2002 season												
	May				**June**				**July**			
0 (B_1)	11.2c	13.6ab	12.8bc	12.5B'	12.8g	19.0ef	18.0f	16.6C'	22.2h	25.8g	27.2fg	25.1C'
50 (B_2)	14.6ab	15.0a	14.4ab	14.7A'	23.0cd	25.4a	25.0ab	24.5A'	29.0ef	33.6cd	31.0de	31.2B'
100 (B_3)	14.4ab	14.8a	15.2a	14.8A'	22.6d	25.6a	24.4a-c	24.2A'	30.2e	41.0a	36.0bc	35.7A'
200 (B_4)	13.6ab	10.4d	11.6c	11.9C'	23.6b-d	25.2a	19.8e	22.9B'	35.4bc	36.6b	32.0de	34.7A'
Mean	13.5A	13.5A	13.5A		20.5C	23.8A	21.8B		29.2C	34.3A	31.6B	
	Aug.				**Sept.**				**Oct.**			
0 (B_1)	28.6d	34.4c	32.8c	31.9D'	29.6g	42.6de	39.0e	37.1D'	35.8d	42.8c	39.2d	39.3C'
50 (B_2)	29.2d	43.0b	31.2cd	34.5C'	41.6de	44.4b-d	47.4b	44.5B'	46.6bc	52.8a	47.6b	49.0A'
100 (B_3)	31.6cd	52.0a	45.2b	42.9A'	41.4de	52.0a	47.0bc	46.8A'	47.4b	55.2a	47.4b	50.0A'
200 (B_4)	42.2b	42.0b	32.6c	38.9B'	43.4c-e	42.2de	35.2f	40.3C'	45.8bc	46.4bc	38.0d	43.4B'
Mean	32.9C	43.6A	35.5B		39.0C	45.3A	42.2B		43.9B	49.3A	43.1B	

* biological nitrogen = nitrogen fixation bacteria (*Azotobacter chroococcum*)

In each month in each season, means of each of mineral and biological nitrogen levels or their interactions having the same letters are not significantly different at 5 % level

Alvarez *et al.* (1996) indicated that inoculation of banana cvs Giant Cavendish and Burro with *Azotobacter chroococcum* stimulated number of leaves /plant.

3-Effect on leaf area:

Results in Table 3 show the effect of mineral and biological nitrogen fertilization and their interaction on leaf area in 2001 and 2002 seasons. Generally, leaf area varied from month to another where leaves area at the beginning of the season (sampled in July or August) were bigger than those developed later and sampled in September and October. This trend was the same in the two seasons.

Effect of mineral nitrogen levels:

In the first season, leaf area was not affected significantly by mineral nitrogen levels in July. However, in August, level M_1 (0 g N / plant) gave the highest significant value but in September and October, the highest significant value was obtained by level M_3 (10 g N / plant) followed in a decreasing order by levels (M_1) and (M_2), respectively.

In the second season, similar trend as that of the first season was obtained.

Therefore, it seems that it was hard to detect any particular trend for the different mineral levels on leaf area.

Effect of biological nitrogen levels:

Leaf area in the two seasons was affected significantly by biological nitrogen levels.

In the first season, all levels of biological nitrogen gave similar effect and increased leaf area significantly than level B_1 (0 ml / plant) especially at the beginning of the growing season (July and August) and the highest value was obtained by level B_3 (100 ml / plant) followed in a decreasing order by B_4, B_2 and B_1, respectively. In September and October, the highest values were obtained by levels B_4 and B_3, respectively.

In the second season, in July all biological nitrogen levels increased leaf area significantly when compared with that of level B_1 (0 ml / plant). In August a reverse trend was obtained. However, in September and October all levels of biological nitrogen increased leaf area when compared with that of level B_1 especially level B_3 which ranked first compared with other levels.

Consequently, it could be concluded that all biological nitrogen levels (B_2, B_3 and B_4) increased leaf area when compared with level B_1(0 ml / plant) in the two seasons.

The interaction between mineral and biological nitrogen:

Leaf area was affected significantly by the interaction between mineral and biological nitrogen in the two seasons.

Table (3): Effect of mineral and biological nitrogen fertilization on leaf area (cm^2) of Thompson Seedless grape transplants during 2001 and 2002 seasons.

Treat. of bio. N* (ml/plant)	July 0(M_1)	July 5(M_2)	July 10(M_3)	July Mean	August 0(M_1)	August 5(M_2)	August 10(M_3)	August Mean	September 0(M_1)	September 5(M_2)	September 10(M_3)	September Mean	October 0(M_1)	October 5(M_2)	October 10(M_3)	October Mean
2001 season																
0(B_1)	68.5cd	78.1bc	69.4cd	72.0B	51.9f	66.6e	68.2e	62.2D	47.2f	62.0cd	79.0a	62.7B	48.4i	61.6g	77.6b	62.5C
50 (B_2)	79.2 bc	78.6 bc	79.9bc	79.2A	79.7cd	75.8d	79.7cd	78.4C	59.4c-e	63.9c	56.1e	59.8C	63.4f	67.8e	55.8h	62.3C
100(B_3)	62.6d	82.7b	99.4 a	81.6A	105.4a	82.9 bc	75.9 d	88.1A	62.2cd	57.6de	64.4c	61.4BC	70.0d	61.2g	78.2b	69.8B
200(B_4)	87.8b	79.1bc	71.0cd	79.0A	86.8b	76.4d	82.0c	81.7B	83.0a	58.5de	73.3b	71.6A	94.0a	63.6f	71.8c	76.5A
Mean	74.5A	79.6A	79.9A		81.0A	75.4B	76.5B		63.0B	60.5C	68.2A		69.0B	63.6C	70.9A	
2002 season																
0(B_1)	49.2i	59.1gh	64.5de	57.6D	63.1g	108.5a	93.8c	88.5A	34.4g	44.7de	39.5f	39.5C	33.9 f	47.7c	43.4 de	43.7D
50 (B_2)	63.6ef	70.7c	71.5bc	68.6B	98.1b	94.8c	70.1f	87.7A	46.8b-d	44.4de	45.7c-e	45.6B	45.7 cd	63.9 a	43.7d	51.1 B
100(B_3)	[illegible]	73.8ab	75.7a	70.5A	80.5e	77.8e	99.6b	86.0B	50.9b	62.3a	62.8a	58.7A	61.0ab	41.4ef	58.8b	53.7A
200(B_4)	[illegible]	61.4fg	58.2h	62.0C	100.9b	88.1d	58.7h	85.6C	49.6bc	50.7b	47.0ef	47.4B	64.0a	47.7c	32.3g	48.0C
Mean	60.3C	66.3B	67.5A		85.7B	92.3A	80.6C		45.4C	50.5A	47.5B		52.7A	50.2B	44.6C	

Treatments of mineral nitrogen (g N / plant)

* biological nitrogen = nitrogen fixation bacteria (*Azotobacter chroococcum*).

In each month in each season, means of each of mineral and biological nitrogen levels or their interactions having the same letters are not significantly different at 5% level

In the two seasons, unfertilized plants [treatment (M_1 x B_1)] almost gave the lowest values of leaf area.

Fertilizing with mineral nitrogen alone[treatments (M_2 x B_1) and (M_3 x B_1)] increased leaf area compared with the unfertilized plant [treatment (M_1 x B_1)]. Treatment (M_3 x B_1) gave the highest value in the first season except in July and treatment (M_2 x B_1) gave the highest value in the second season except in July.

Fertilizing with biological nitrogen alone [treatments(M_1 x B_2), (M_1 x B_3)] and (M_1 x B_4)] increased leaf area and the increment was increased by increasing the rate of biological nitrogen.

When combining other rates of mineral and biological nitrogen, leaf area was affected significantly in the first season and the highest significant values were obtained by treatments (M_3 x B_3) in July, (M_1 x B_3) in August and (M_1 x B_4) in September and October.

In the second season, the highest values were obtained by treatment (M_3 x B_3) in July & September, treatment (M_2 x B_1) in August and (M_1 x B_4) in October.

Consequently, it is quite evident that in any given month in the two seasons, under zero mineral nitrogen level, leaf area was increased by increasing the level of biological nitrogen. However, the highest values of leaf area were achieved by variable treatments in different months. Thus no clear trend could be detected.

Darwish and Ahmed (1993) fertilized one-year-old Red Roomy vine seedlings with different sources of mineral nitrogen at a rate of 25 g N / seedling. They found that leaf area could be arranged in the following descending order,, calcium nitrate, ammonium sulphate, ammonium nitrate, urea- formaldehyde, urea and potassium nitrate, respectively

Ahmed *et al.* (1997) found that supplying Red Roomy grapes with four biological nitrogens [dry yeast, phosphorene (p-soluber), rhizobacterine (N_2 – fixer) and nitrobeine (N_2 – fixer)] significantly improved leaf area compared with unbiological nitrogen.

4-Effect on chlorophyll content in leaves:

Results in Table 4 show the effect of mineral and biological nitrogen and their interaction on chlorophyll content in leaves in 2002 season.

Effect of mineral nitrogen levels:

Chlorophyll content was affected significantly by levels of mineral nitrogen in any given month except in September The highest values were obtained by level M_3 in

Table (4): Effect of mineral and biological nitrogen fertilization on total chlorophyll in leaves (SPAD values) of Thompson Seedless grape transplants during 2002 season.

Treat. of Bio. N* (ml / plant)	Treatments of mineral nitrogen (g N / plant)							
	0 (M_1)	5 (M_2)	10 (M_3)	Mean	0 (M_1)	5 (M_2)	10 (M_3)	Mean
	July				August			
0 (B_1)	24.8g	29.5f	31.8de	**28.7C'**	27.2d	31.0c	27.5d	**28.6C'**
50 (B_2)	34.0c	34.4c	35.0bc	**34.5A'**	31.7c	34.2b	33.2c	**33.0B'**
100 (B_3)	31.5e	35.6ab	36.1a	**34.4A'**	32.0c	36.1a	36.4a	**34.9A'**
200 (B_4)	32.4de	32.9d	32.3de	**32.5B'**	33.5b	34.0b	35.7a	**34.4A'**
Mean	**30.7C**	**33.1B**	**33.8A**		**31.1C**	**33.8A**	**33.2B**	
	Sept.				Oct.			
0 (B_1)	29.3f	32.0e	40.5b	**33.9B'**	27.3i	38.1cd	36.3fg	**33.9C'**
50 (B_2)	40.7b	40.3b	41.1b	**40.7AB**	37.5de	40.8b	36.5f	**38.3A'**
100 (B_3)	38.1c	43.0a	43.2a	**41.5A'**	36.9ef	44.0a	34.9h	**38.6A'**
200 (B_4)	37.8c	43.0a	33.9d	**38.2AB**	37.7de	38.6c	35.5gh	**37.3B'**
Mean	**36.5B**	**39.6A**	**39.7A**		**34.9C**	**40.4A**	**35.8B**	

*biological nitrogen = nitrogen fixation bacteria (*Azotobacter chroococcum*).
In each month, means of each of mineral and biological nitrogen levels or their interactions having the same letters are not significantly different at 5% level.

July & September and level M_2 in August & October. On the other hand, the low nitrogen level M_1 gave the least values in any given month during the growing season.

Consequently, it seems that levels M_2 and M_3 increased chlorophyll content in leaves when compared with level M_1 .

Effect of biological nitrogen levels:

Chlorophyll content in leaves was affected significantly by levels of biological nitrogen. Level B_3 gave the highest values of chlorophyll content in any given month during the growing season except in July. Level B_2 gave slight lesser values than that of the preceding level. On the contrary, Level B_1 gave the least values in any given month.

Thus, it seems that Level B_3 (100 ml / plant) gave the highest value of chlorophyll content in leaves.

The interaction between mineral and biological nitrogen:

In the two seasons, unfertilized plants [treatment (M_1 x B_1)] gave the least values of chlorophyll content in any given month during the growing season. Fertilizing with mineral nitrogen alone increased chlorophyll content compared with the unfertilized plants [treatment (M_1 x B_1)]. However, treatment (M_3 x B_1) gave the highest significant values in July & September and treatment (M_2 x B_1) gave the highest significant values in August & October.

Fertilizing with biological nitrogen alone[treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4)] increased chlorophyll content compared with the unfertilized plant [treatment (M_1 x B_1)]. However, the concentration of the biological nitrogen did not show any particular trend.

Other combinations affected chlorophyll content significantly. The high values were obtained by some different treatments during the growing season, but treatment (M_2 x B_3) in all tested months and treatment (M_3 x B_3) in July, August and September gave the highest values.

Therefore, it seems that treatments(M_2 x B_3) and (M_3 x B_3) gave the highest values of chlorophyll content in leaves.

Kerni and Anil (1986) carried out a pot experiment on one-year-old mango seedlings. They found that the greatest percentage of increase in chlorophyll content (compared with control) was obtained with (48 g N / plant, *Azotobacter chroococcum* + 48 g N/ plant, 32 g N / plant or *Azotobacter chroococcum* alone), respectively.

5-Effect on fresh weight and dry weight of whole plant:-

Results in Table 5 show the effect of mineral and biological nitrogen fertilization and their interaction on fresh and dry weights of whole plant of Thompson Seedless grape transplants in 2001 and 2002 seasons.

5 – 1 Fresh weight

Effect of mineral nitrogen levels:

In the two seasons, the second level of mineral nitrogen (M_2) gave the highest significant value of whole plant fresh weight when compared with other levels.

Thus, it seems that fertilizing with medium level M_2 (5 g N/ plant / year) gave the highest value of whole plant fresh weight in the two seasons.

Effect of biological nitrogen levels:

In the first season, the highest significant values were obtained by levels B_3 and B_2, respectively. However, level B_1 gave the lowest value of whole plant fresh weight.

In the second season, all biological nitrogen levels increased whole plant weight significantly compared with level B_1. Level B_2 ranked first compared with other levels.

Thus, from the results of the two seasons, level B_2 (50 ml / plant) seems to have a promising effect on fresh weight of whole transplant.

The interaction between mineral and biological nitrogen:

In the two seasons, unfertilized plants [treatment (M_1 x B_1)] gave the least values of fresh weight.

Table (5): Effect of mineral and biological nitrogen fertilization on fresh and dry weight of whole transplant of Thompson Seedless grape during 2001 and 2002 seasons.

Treat. of Bio. N*(ml / plant)	Treatments of mineral nitrogen (g N / plant)							
	Fresh weight (g)				Dry weight (g)			
	0 (M_1)	5 (M_2)	10 (M_3)	Mean	0 (M_1)	5 (M_2)	10 (M_3)	Mean
	2001 season							
0 (B_1)	62.2 e	69.2cd	66.4d	**65.9C'**	28.1f	35.7b-d	33.4c-e	**32.4B'**
50 (B_2)	71.8c	72.6c	78.0b	**74.1A'**	36.4bc	32.5e	35.1b-e	**34.6A'**
100 (B_3)	71.7c	81.8a	70.1c	**74.5A'**	35.5b-d	39.5a	33.2de	**36.1A'**
200 (B_4)	79.0ab	79.2ab	57.8f	**72.0B'**	39.2a	37.2ab	28.5f	**35.0A'**
Mean	**71.2B**	**75.7A**	**68.1C**		**34.8B**	**36.2A**	**32.6C**	
	2002 season							
0 (B_1)	52.9d	67.8cd	72.3c	**64.4B'**	23.3d	27.8cd	29.3b-d	**26.8B'**
50 (B_2)	71.1c	102.3a	63.1cd	**78.8A'**	33.5bc	40.5a	27.6cd	**33.9A'**
100 (B_3)	76.5bc	70.8c	74.5bc	**73.9A'**	31.6bc	30.8bc	31.8bc	**31.4A'**
200 (B_4)	77.9bc	88.8ab	67.1cd	**77.3A'**	29.0bc	35.9ab	26.7cd	**30.5A'**
Mean	**69.6B**	**82.4A**	**69.3B**		**29.4B**	**33.8A**	**28.8B**	

*biological nitrogen = nitrogen fixation bacteria (*Azotobacter chroococcum*).
In each season and for each character, means of each of mineral and biological nitrogen levels or their interactions having the same letters are not significantly different at 5% level.

In the two seasons, fertilizing with mineral nitrogen alone increased fresh weight of whole plant compared with the unfertilized plants [treatment (M_1 x B_1)]. However, treatments (M_2 x B_1) and (M_3 x B_1) were similar from the statistical stand point.

Fertilizing with biological nitrogen alone increased fresh weight of whole plant significantly than the unfertilized plants [treatment (M_1 x B_1)]. However, the concentration of biological nitrogen did not show any significant effect. This was true in the two seasons.

Other combinations showed, high values especially when combining the various rates of the second level of mineral nitrogen with the different rates of biological nitrogen. The highest values were obtained by treatments (M_2 x B_3), (M_2 x B_4) and (M_1 x B_4) in the first season. Whereas the highest values were obtained by treatments (M_2 x B_2) and (M_2 x B_4) in the second season.

From the obtained results of the two seasons, it is obvious that treatment (M_2 x B_4) gave the highest value of whole plant fresh weight in the two seasons.

5 – 2 Dry weight

Dry weight of whole plant was affected significantly by treatments of mineral, biological nitrogen and their interaction in the two seasons.

Effect of mineral nitrogen levels:

In the two seasons, level (M_2) gave the highest significant value followed in a decreasing order by M_1 and M_3, respectively.

Effect of biological nitrogen levels:

In both the two seasons, B_2, B_3 and B_4 levels gave more or less similar values which were higher than that of the control

The interaction between mineral and biological nitrogen:

In the two seasons, unfertilized transplants [treatment (M_1 x B_1)] gave lower values of total dry weight of plant.

In the two seasons, fertilizing with mineral nitrogen alone increased total dry weight of whole plant and treatments (M_2 x B_1) and (M_3 x B_1) gave more or less similar values.

In the two seasons, fertilizing with biological nitrogen alone increased total dry weight of plant significantly compared with unfertilized plants [treatment (M_1 x B_1)]. However, the differences between different biological nitrogen treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4) were not significant especially in the second season.

Other combinations, gave variable results in the two seasons. However, the highest values were obtained by treatments (M_2 x B_3), (M_1 x B_4) and (M_2 x B_4) in the first season and treatments (M_2 x B_2) and (M_2 x B_4) in the second one.

GENERAL CONCLUSION

From the foregoing results, it could be concluded that unfertilized transplants [treatment (M_1 x B_1)] gave lower values than those of other treatments in all vegetative growth characters . Mineral fertilization alone[treatments (M_2 x B_1) and (M_3 x B_1)] increased vegetative growth especially treatment (M_2 x B_1) but more increase in mineral nitrogen treatment (M_3 x B_1) tented to reduce vegetative growth of transplants. Similarly, biological nitrogen alone[treatments (M_1 x B_2), (M_1 x B_3) and (M_1 x B_4)] increased vegetative growth of transplants as the concentration of biological nitrogen increased up to 100 ml / plant [treatment (M_1 x B_3)]. More increase in biological nitrogen [treatment (M_1 x B_4)] led to reduce vegetative growth of transplants. Other combinations gave more increase in vegetative growth and treatment (M_2 x B_3) gave the highest values of shoot length, number of leaves and chlorophyll content. Accordingly, it seems that combining mineral with biological nitrogen create more beneficial effect on growth of Thompson Seedless transplants than adding each form alone.

REFERENCES

Ahmed, F.F; Akl, A.M.; Morsy, F.M. and Ragab, M.A. (1997): The beneficial effects of biological nitrogens on Red Roomy grapevines (*vitis vinifera* L.) I – The effect on growth and vine nutritional status. Annals of Agric. Sci., Moshtohor 35 (1): 489 – 495 . Egypt

Alvarez, B.; Rodriguez, A.; Perez, A. and Martinez, R. (1996): The effect of Azotoryza; double function on banana (*Musa spp.*). Infamuse 5 (1): 20 – 23 (c.f. Record 10 of 16 CAB Abstracts 1996 - 1998).

Alwar, R.P.A; Jayarama; Shankar, B.N. and Nagaraj, J.S. (1994): Biological nitrogens and their possible role in coffee plantations. Indian – Coffee 58 (9):27 – 28(c.f. Record 66 of 71 CAB Abstracts 1995).

Bavaresco, L; Pezzutto, S.; Ragga, A.; Ferrari, M. and Trevisan, M. (2001): Effect of nitrogen supply on trans – resveratrol concentration in berries of *vitis vinifera* L. cv. Cabernet Sauvignon. Vitis 40 (4): 229 – 230 (c.f. Hort. Abst. Vol (72) No. 6).

Darwish, O.H. and Ahmed, F.F. (1993): Growth aspects of Red Roomy vine seedlings as affected by nitrogen sources. J. Agric. Res. Tanta Univ., 19 (1): 171 – 178 . Egypt

Duncan, D.B (1955). Multiple range and multiple F tests. Biometrics, 11:1-24

Follett, R.H.; Murphy, L.S. and Donahue, R.l. (1981): Fertilizers and soil amendments. 1st ed. Prentice - Hall, Inc. Englewood .pp 47 – 52.

Kerni, P.N. and Anil, G. (1986): Growth parameters affected by azotobacterization of mango seedlings in comparison to different nitrogen doses. Res. and Dev. Reporter 3 (2): 77 – 79 (c.f . Record 52of 71 CAB Abstracts 1987 - 1989).

Kumari, S.M.P and Balasubramanian, A. (1993): Effect of combined inoculation of VAM and *Azospirillum* on the growth and nutrient uptake by coffee seedlings. Indian – Coffee. 57 (12):5 – 11(c.f. Record 57 of 71 CAB Abstracts 1993 - 1994).

Lowrison, G.C. (1993): Fertilizer technology . 2 nd ed. Ellis Limited, England. pp543.

Marschner, H. (1988): Mineral nutrition of higher plants . 2 nd ed . University Printing House, Inc. Cambridge.pp 898.

Postagate, J. (1978): Nitrogen Fixation 1st ed. Edward Arnold, Inc.London pp. 64

Sharma, S.D and Bhutani, V. P. (1998): Response of apple seedlings to VAM, *Azotobacter* and inorganic fertilizers. Hort. J. 11 (1): 1 – 8(c.f. Record 6 of 6 CAB Abstracts 1998 - 1999).

Shawky, I.; Abou Rawash, M.; Zeinab Behairy; Salama, M. and Maryam Mostafa (1996): Growth and chemical composition of grape transplants as affected by some irrigation regimes. 6th Conf. Agric. Dev. Res., Ain Shams Univ., Cairo, Dec. 17-19. Annals Agric. Sci.., Sp. Issue, 187-201.

Snedecor, G.W. and Cochran, W.G. (1980): Statistical methods. 7th ed. Iowa state, Univ. Press Ames. Iowa, U.S.A. pp. 507

Swarupa, S.G. (1996): Study on the effect of biological nitrogens on the growth of C X R coffee seedlings. J. of Coffee Res. 26 (2): 62 – 66 (c.f . Record 15 of 71 CAB Abstracts 1998)

تأثير التسميد النتروجينى المعدنى والحيوى على شتلات العنب البناتى صنف طومسون سيدلس

I – التأثير على النمو الخضرى

إبراهيم شوقى* – سعيد الشاذلى* – أحمد الجزار* – شوقى سليم** –نهى منصور*

* قسم البساتين – كلية الزراعة – عين شمس

** قسم الميكروبيولوجى – كلية الزراعة – عين شمس

أجريت تجربة إصص خلال موسمي ٢٠٠١ – ٢٠٠٢ على شتلات العنب البناتى " صنف طومسون سيدلس " لدراسة تأثير مصدرين من التسميد النتروجينى (معدنى و حيوى) على النمو الخضرى للشتلات وقد اشتملت التجربة على ثلاثة مستويات من التسميد النتروجينى المعدنى (م١ = صفر، م٢ =٥، م٣ =١٠ جم ن / نبات / سنة) وأربعة مستويات من التسميد النتروجينى الحيوى (ح١ = صفر، ح٢=٥٠، ح٣= ١٠٠، ح٤=٢٠٠ مل من المزرعة السائلة ل *Azotobacter chroococcum*) فى تجربة عاملية فى تصميم قطاعات كاملة العشوائية.

و قد أوضحت النتائج أن التسميد بالمستوى الثانى من السماد المعدنى(م٢ =٥ جم ن / نبات / سنة)أو بالمستوى الثالث من السماد الحيوى (ح٣= ١٠٠ مل / نبات) أعطيا أعلى زيادة معنوية فى طول الساق، عدد الأوراق و المحتوى الكلى من الكلوروفيل و الوزن الطازج و الجاف للنبات .

وبالنسبة للتفاعل وجد أن التسميد بمعاملات السماد المعدنى بمفرده](م٢ × ح١)، (م٣ × ح١) [أعطت أعلى زيادة فى نمو النباتات مقارنة بالمعاملة غير المسمدة (م١ × ح١). ومن جهة أخرى وجد أن التسميد بمعاملات السماد الحيوى بمفرده](م١ × ح٢)، (م١ × ح٣)، (م١ × ح٤) [أدت الى زيادة النمو الخضرى مقارنة بالنباتات غير المعاملة(م١ × ح١) وكانت المعاملة(م١ × ح٣) هى الأفضل خلال الموسمين. وقد حدثت أكبر زيادة للنمو الخضرى من خلال التركيبات المختلفة بين السماد المعدنى و الحيوى وبخاصة عند تداخل المستوى الثانى من المعدنى مع مستويات التسميد الحيوى المختلفة حيث أعطت المعاملة (م٢ × ح٣) أعلى القيم لطول الساق، عدد الأوراق، المحتوى الكلى من الكلوروفيل فى حين أعطت المعاملتان (م٢ × ح٢)، (م٢ × ح٣) أعلى القيم للوزن الكلى (طازج & جاف) للنبات .

وعلى ذلك يتضح أن التسميد بالسماد النتروجينى المعدنى بمفرده أو بالسماد البيولوجى بمفرده سبب زيادة النمو الخضرى لشتلات العنب البناتى مقارنة بالشتلات غير المعاملة. فى حين أن التسميد بخليط منهما سبب زيادة أكبر فى النمو الخضرى عن التسميد بأى صورة بمفردها. و من ثم فان أفضل المعاملات الموصى بها هى التسميد بالمستوى الثانى معدنى مع الثالث حيوى (م٢ × ح٣).