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# EFFECT OF NITROGEN SOURCES AND RATES ON GROWTH AND YIELD OF POTATO CROP.

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## ABSTRACT

This trials were carried out during the two successive winter seasons of 2008/2009 and 2009/ 2010 at the Experimental Farm, Sids Horticulture Research Station, Agriculture Research Center, Giza, Egypt, To study the effect of the nitrogen sources and rates of anhydrous ammonium sulphate and ammonium nitrate at (30, 60 and 90 kg / fed.) and their combined application, on growth and yield of potato crop.

The highest values of tested parameters were recorded by using anhydrous ammonia at rate of 180 kg N/fed. in both seasons.

## INTRODUCTION

Nitrogen is considered as an essential element for both growth and reproduction of all plants (Russell 1950). There are many sources of nitrogen. Cost and form of nitrogen dictate which, of these sources, should be used in a given situation. Anhydrous ammonia readly combines with water in the soil to from ammonia ions which tend to remain as ammonium for a longer time (Shutske 2005). Generally the inorganic sources provide the plants with N-elements in the proper time and it can quickly recover the deficiency of nitrogen in plant. Nitrogen is important factor influencing potato tuber growth and yield (Vos, 1997 ; Errebhi *et al.*, 1998 and Belanger *et al.* (2000 and 2002) reported that nitrogen fertilization increased the average fresh tuber weight , number of tuber per plant.

Miller and Rosen (2005) found that yields increased with increasing N rates (170, 250 and 340 kg / ha). Love *et al.* (2005) showed that maximum total yield of potato was produced with 278 kg / ha. Kumar *et al.* (2007) showed that high yield with optimum tuber size were obtained from potato plant wish received high nitrogen levels.

Therefore the aim of this research was to study the effect of nitrogen sources, rates and their combined on growth and yield of potato crop.

## MATERIALS AND METHODS

Two field trials were carried out during the two winter seasons 2008/2009 and 2009/2010 at Sids Horticultural – Research Station - Beni-Suif Governorate, Egypt, to study the response of Sanuora potato cultivar to nitrogen sources and levels as follows:- Two levels from anhydrous ammonia gas 82%N (90 and 180 kg N/fed.) and three levels from ammonium sulphate 20.6% N and ammonium nitrate 35.5% N (30,60 and 90 kg N/fed.) and their combination under alluvial soil condition. The physical and chemical properties of this soil are presented in Table 1.

**Table 1: Some physical and chemical properties of the experimental soil site.**

| properties | 2009 | 2010 |
|---|---|---|
| Coarse sand | 0.63 | 0.77 |
| Fine sand | 8.50 | 10.19 |
| Silt % | 24.38 | 19.21 |
| Clay % | 66.49 | 69.83 |
| Texture | Clay | Clay |
| pH (1:2.5 soil water ratio) | 7.7 | 7.3 |
| E.C.(1:2.5 extract) m mohos /cm | 0.6 | 0.8 |
| $CaCo_3$ | 2.6 | 2.9 |
| Organic matter% | 1.90 | 2.02 |
| Total N ppm | 15.0 | 23.8 |
| Available P ppm | 7.7 | 5.8 |
| Available K ppm | 341.3 | 355.8 |

The experimental design was a randomized complete blocks (RCB) with three replicates. Each plot was compared of 4 rides ,5 m long and 75 cm wide at 25 cm spacing between plants. Each individual plot was 15 $m^2$ . Potatoes seed tubers of the cultivar Sanuora were obtained from potato produced co- operative Society of Beni- Suif Governorate. Planting dates were 26 and 29 of September in the two seasons 2008 / 2009 and 2009 / 2010.

The experimental treatments of nitrogen sources and rates single and / or combined addition were conducted as follows:

1-Anhydrous ammonia at rate of ( 90 and 180 kg N / fed.).

2-Ammonium sulphate and Ammonium nitrate at rates of 30 , 60 and 90 kg N /fed.) and their combined.

The ten nitrogen treatments were distributed randomly in each block.

Ammonia gas levels was injected during the soil preparation and before rowing while the other nitrogen sources were applied as aside dressing on two equal rates after 4 and 6 weeks from planting date respectively.

**Data recorded**

**A- Vegetative growth**

At 80 days after planting, ten plants were randomly pulled out from each plot to estimate:-

1- Average plant height (cm.).
2- Average number of main stems/ plant
3- Average shoot fresh weight (g)
4- Shoot dry weight percentage. The samples were dried at 70 $^{0}$C up to constant weight

**B- Yield and its components**

At harvest (110 days from planting) the following traits were determined:

C- Average number of tuber / plant.
D- Total yield of tuber (ton/fed.)

E- Average weight of marketable tuber > 85 (g), grade A, ton/ fed.
F- Average weight of marketable tuber < 85(g), grade B, ton / fed.
G- Tuber dry weight percentage. Samples (10 plants) were oven dried at 70 $^{0}$C up to constant weight to determine.
H- Average weight unmarketable tuber (ton/fed.).
I- Percentage of marketable tuber yield (ton/fed.).
J- Percentage of unmarketable tuber yield (ton/fed.).

**The cost of nitrogen sources (180 kg N / fed.).**

| N. sources | Cost L.E | Total cost L.E |
|---|---|---|
| Ammonia gas | 3.12 | 561.6 |
| Ammonium nitrate | 6.06 | 1090 |
| Ammonium sulphate | 7.5 | 1350 |

**Statistical analysis**

Data from each season were subjected to the analysis of variance and Duncan's Multiple Range test at 0.05 level means tests was estimated using MSTST(1985) Software to compare the collected data.

## RESULTS AND DISCUSSION

**A- Growth characters**

**1- plant height(cm):**

Data in Table (2) showed the response of plant height of potato plants Cv. " Sanuora" to nitrogen sources and rates in the winter seasons of 2009 and 2010. Results obtained from the treatments varied significantly from each other with respect to plant height, in both seasons. The highest values were recorded with treatment AG 180 at the rate of 180 kg N / fed. followed by treatments (AN 90 + AG 90 or AS 90 + AG 90) with insignificant differences between their mean values, in both seasons. The shortest plant were recorded from treatment (by 90 kg N / fed.),. These results are in line with those observed in sweet potato growth as reported by Hartemink *et al.* (2001) and Afaf *et al.* (2005).and Kumar *et al.* (2007), Zelalam *et al.* (2009).

**2- Number of main stems / plant.**

Number of main stems per plant potato Cv. potato " Sanuora " as affected by N sources and rates in winter seasons of 2008/2009 and 2009/2010 are shown in Table 2. The data indicated that the treatments was significant, in both seasons. The highest values were recorded with treatment ammonia gas at the rate of 180 kg / fed. Followed by treatments (AN 90 + AG 90, AS 90 + AG 90, AN 180and AS 180). The lowest values were obtained from treatment by using ammonium gas at rate of ( 90 kg N / fed.). These results are quite similar with those obtained by El- Banna *et al.* (2001) ,Hassan (2002) and Zelalam *et al.* (2009).

**Table 2: Plant height and number of main stems/plant of as affected by application of different nitrogen sources in the two winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N kg / fed.) | Plant height (cm) | | Number of main Stems/ plant | |
|---|---|---|---|---|
| | First Season | Second Season | First Season | Second Season |
| 1-AG 90 | 45.03 D | 47.78 G | 2.15F | 2.27 F |
| 2-AG 180 | 71.63 A | 72.87A | 3.55 A | 4.32 A |
| 3-AN 30 + AG 90 | 46.50 F | 51.32 F | 2.32 EF | 2.50 D |
| 4-AN 60 + AG 90 | 57.50C | 63.30 E | 2.75 CDE | 3.12 C |
| 5-AN 90 + AG 90 | 67.75AB | 70.52 ABC | 3.25 ABC | 4.00 AB |
| 6-AS 30 + AG 90 | 48.97D | 53.57 F | 2.55 DEF | 2.72 CD |
| 7-AS 60 + AG 90 | 59.6C | 65.8 DE | 3.00 BCD | 3.17 C |
| 8-AS 90 + AG 90 | 68.82AB | 71.70AB | 3.42AB | 4.20 A |
| 9-AN 180 | 65.2 B | 68.1CD | 3.15 ABC | 3.67 B |
| 10-AS 180 | 66.18B | 69.20 BC | 3.35 AB | 3.90 AB |

**Means within each column followed by the same letter are not statistically different at 0.05 level (Duncan's range test).**
**AG: Anhydrous ammonia**
**AN: Ammonium nitrate**
**AS: Ammonium sulphate**

### 3- Shoot fresh weight (g).

The results of average fresh weight of potato as affected by nitrogen sources and rates in winter seasons of 2008/2009 and 2009/2010 are shown in Table (3). The effects of treatments from N sources and levels were significant. The highest value of average fresh weight (g / plant) were obtained from the application of ammonia gas at rate of 180 kg / fed. as well as treatments (AN 90 + AG 90 or AS 90 + AG 90), with while not significant differences between their mean values, in the second season only. On the other hand the lowest value was obtained from treatment using ammonia gas at the rate of 90 kg / fed. Nitrogen is used in large amounts by plants to build up many compounds essential for plant growth and development such as proteins and chlorophyll( Millard and Marshal, 1986). These results are quite similar with those obtained by Santosa (1992), Karadogan (1995), El-Banna and Tolba (2000) and Kumar *et al.* (2007).

### 4-Shoot dry weight percentage.

Effect of various N source and rates on shoot dry matter percentage in potato plants Cv. "Sanuora" in winter seasons 2008/2009 and 2009/2010 are shown in Table 3. The results obtained from the tested treatments varied significantly with respect to shoot dry weight percentage, in both seasons. The highest values were recorded with treatment application ammonia gas at the rate of 180 kg / fed. followed by treatments (AN 90 + AG 90, AS 90 + AG 90 , AN 180 or AS 180) with insignificant differences among their mean values, in both seasons. The lowest values were recorded from treatment using ammonia gas at the rate of 90 kg/fed.. These results are in line with those observed in potato as reported by Barakate *et al.* (`1994).

**Table 3: Shoot fresh weight (g) and shoot dry weight percentage as affected by application of different nitrogen sources in the two winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N/ fed kg.) | Average shoot fresh weight (g/plant) | | Shoot dry matter percentage | |
|---|---|---|---|---|
| | First Season | Second Season | First Season | Second Season |
| 1-AG 90 | 99.00 H | 107.5 G | 17.38C | 15.87 D |
| 2-AG 180 | 218.8 A | 225.3 A | 20.25 A | 20.80 A |
| 3-AN 30 + AG 90 | 159.3 G | 133.3 F | 17.20 C | 16.52 D |
| 4-AN 60 + AG 90 | 174.5 EF | 179.5 D | 18.12 ABC | 17.00 CD |
| 5-AN 90 + AG 90 | 200.5 C | 222.4 A | 19.75 ABC | 19.82 AB |
| 6-AS 30 + AG 90 | 167.8 F | 139.9 E | 17.62 BC | 16.92 CD |
| 7-AS 60 + AG 90 | 178.8 F | 186.2 C | 18.50 ABC | 17.77 C |
| 8-AS 90 + AG 90 | 209.8 B | 224.7 A | 20.00 AB | 20.70 A |
| 9-AN 180 | 187.0 D | 210.1 B | 19.00 ABC | 19.37 B |
| 10-AS 180 | 190.0 D | 212.5 B | 19.50 ABC | 19.87AB |

**Means within each column followed by the same letter are not statistically different at 0.05 level (Duncan's range test).**

## B- Yield and yield components

### 5-Number of tubers / plant

Table 4 show the average number of tubers / plant of potato plants Cv. Sanuora as affected by the studied treatments in the winter seasons of 2008/ 2009 and 2009/2010. Data indicated significant differences among the tested treatments for this trait. The application of ammonia gas at the rate of 180 kg / fed. gave the highest values in both seasons followed by treatments (AN 90 + AG 90, AS 90 + AG 90 , AN 180 and AS 180) while not reach to levels significant differences among them, in both seasons. The lowest values were recorded from using ammonia gas at the rate of 90 kg / fed. in both seasons,. El-Banna and Tolba (2000) and El- Banna *et al.* (2001) reported significant increases in number of tubers/plant when potato plants received 180kg/fed.

### 6-Total yield of tubers (ton / fed.).

Data concerning the effect of the tested treatments on total yield (ton/fed.) in potato plants Cv. Sanuora growing in the winter seasons of 2008/2009 and 2009/2010 are shown in Table 4. Data varied significantly with respect to total yield (ton/fed.), in both seasons. The highest values were recorded from the application of ammonia gas at the rate of 180 kg / fed. followed by treatments (AN 90 + AG 90 or AS 90 + AG 90) with insignificant differences among their mean values , in both seasons.. The lowest values were recorded from treatment using the ammonia gas injection at 90 kg / fed. in both seasons,. The effect of nitrogen in increasing total yield (ton/fed.) could be results from its effects on increasing growth characters. The important role of N in cell division process and the biosynthesis of protein could explain the beneficial effect of the proper rate of N on all mineral and organic nutrients movement to meet the superior increase in growth and development of tuber. These results are in line with those observed in sweet potato total yield (ton /fed.) as reported by Marti and Mills (2002) and Belanger *et al.* (2002).

**Table 4: Number of tubers/plant and total yield of tubers (t/fed) of as affected by application ofdifferent nitrogen sources in the two winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N/ fed kg.) | Number of tubers / plant | | Total yield of tubers(ton / fed) | |
|---|---|---|---|---|
| | First Season | Second season | First Season | Second Season |
| 1-AG 90 | 3.27 E | 3.75 B | 8.62D | 7.30D |
| 2-AG 180 | 6.15 A | 6.40 A | 12.55A | 12.82A |
| 3-AN 30 + AG 90 | 4.00 DE | 4.05 B | 11.02C | 11.35C |
| 4-AN 60 + AG 90 | 422 CDE | 4.55B | 11.12BC | 11.50C |
| 5-AN 90 + AG 90 | 5.12BC | 6.22A | 11.60ABC | 11.67BC |
| 6-AS 30 + AG 90 | 4.10CDE | 4.22B | 11.77C | 11.40C |
| 7-AS 60 + AG 90 | 4.42 CD | 4.67B | 11.17BC | 11.00C |
| 8-AS 90 + AG 90 | 5.50 AB | 6.45A | 12.25BC | 12.52AB |
| 9-AN 180 | 4.62BCD | 6.05A | 10.77BC | 10.97BC |
| 10-AS 180 | 5.00BCD | 6.32A | 10.87C | 10.95C |

**Means within each column followed by the same letter are not statistically different at 0.05 level (Duncan's range test).**

**7- Weight of marketable tuber for grate A (ton/fed.):**

Data in Table 5 show the effect of different N sources and rates on potato weight of marketable tuber > 85 (g) grade A in 2009 / and 2010 growing seasons. The highest weight of marketable tuber was produced from plants treated with ammonia gas at the rate of 180 kg / fed. and the differences were significant in both seasons. This treatment one followed by treatments (AN 90 + AG 90 or AS 90 + AG 90) with insignificant differences between their mean values, in both seasons. The lowest weight of marketable tuber (ton/fed.) > 85 (g) was produced with application ammonia gas at the rate of ( 90 kg / fed.) These are in harmony with those obtained by Mohammad (1999) in potato and Belanger *et al.* (2002) and Afaf *et al.* (2005) on sweet potato.

**8- Weight of marketable tuber grade B.**

Means of weight of marketable tuber grade B as affected by different N sources and rates are presented in Table 5. The differences due to the tested treatments were significant in both seasons. The highest weight of this grade was produced at using ammonia gas at rate of (90 kg / fed.) and the differences were significant in both seasons, followed by treatments (AN 30 + AG 90or AS 30 + AG 90) with insignificant differences between their mean values, in both seasons. The lowest weight of marketable tuber "grade B" was produced from application ammonia gas at the rate of (90 kg / fed.). Application of N fertilizer might be ascribed to its important role in increasing organic compounds (protein, enzymes, chlorophylls, vitamins, hormones and mucleic acids). These compounds divert to the tuber which in turn increased yield (Bourke, 1985). These results are in line with those obtained by Mohammad *et al.* (1993) and Sarkar *et al.* (1998) on potato and Afaf *et al.* ( 2005) on sweet potato.

**Table 5: Weight of Marketable tuber and weight of marketable tuber as affected by application of different nitrogen sources in the two successive winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N/ fed kg.) | Weight of Marketable tuber (ton/fed) for > 85 (g) | | Weight of Marketable tuber (ton/fed) for < 85 (g) | |
|---|---|---|---|---|
| | First Season | Second Season | First Season | Second Season |
| 1-AG 90 | 3.87 G | 2.40F | 2.05AB | 2.17A |
| 2-AG 180 | 9.47A | 9.62A | 1.32C | 1.37A |
| 3 AN 30 + AG 90 | 6.67F | 7.07E | 2.00AB | 2.10A |
| 4-AN 60 + AG 90 | 6.90EF | 8.12CD | 1.80ABC | 1.90A |
| 5-AN 90 + AG 90 | 8.62BC | 8.72BC | 1.47C | 1.50A |
| 6-AS 30 + AG 90 | 7.07EF | 6.97E | 2.15A | 2.12A |
| 7-AS 60 + AG 90 | 7.40DEF | 7.52DE | 1.80ABC | 1.92A |
| 8-AS 90 + AG 90 | 9.10AB | 9.22AB | 1.40C | 1.52A |
| 9-AN 180 | 7.55DE | 7.70DE | 1.70ABC | 1.77A |
| 10-AS 180 | 8.17CD | 8.27CD | 1.60BC | 1.60A |

**Means within each column followed by the same letter are not statistically different at 0.05 level (Duncan's range test).**

**9- Weight unmarketable tuber (ton /fed.)**

Data regarding the effect of treatments with different N sources and rates on weight of unmarketable tuber trait in potato plants cv. sanuora in both winter seasons of 2008/2009 and 2009/2010 are shown in Table 6. The differences in weight of this character due to the application of various treatments were significant in both seasons. The highest value of was produced from fertilizing potato plants by ammonia gas at the rate of 90 kg / fed. followed by treatments (5,6,7or 8) with insignificant differences between their mean values, in both seasons. The lowest weight of unmarketable tuber (t /fed.) was produced from plants treated with ammonia gas at the rate of 180 kg / fed in both seasons.

**10- Tuber dry weight percentage**

Effete of various N source and rates on tuber dry weight percentage of potato plants cv. "Sanuora" in winter seasons 2008/2009 and 2009/2010 are illustrated in Table 6. Data obtained varied significantly from treatments to other with respect this character, in both seasons. The highest values were recorded from using ammonia gas at the rate of 180 kg / fed. followed by treatments (AN 90 + AG 90, AS 90 + AG 90 , AN 180 and AS 180). On the other hand, the lowest values were recorded from application ammonia gas at the rate of (90 kg / fed.) in both seasons. These results are in line with those observed in potato tuber dry weight percentage as reported by Singh and Singh (1994) who found that effect of fertilizing plants potato cv. "Kufri Badshah" with 60, 120, 180 and 240 N/ ha. dry weight was increased with the application of 180 kg N / ha.

**Table 6:Weight unmarketable tuber (t/fed) and tuber dry matter percentage as affected by application of different nitrogen sources in the two winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N/ fed kg.) | Weight unmarketable tuber (t/fed) | | Tuber dry matter percentage | |
|---|---|---|---|---|
| | First season | Second Season | First Season | Second Season |
| AG 90 | 2.70 A | 2.72A | 28.62F | 28.27DE |
| AG 180 | 1.75C | 1.82CDE | 43..25 A | 37.35A |
| AN 30 + AG 90 | 2.35AB | 2.40AB | 27.25 F | 27.50E |
| AN 60 + AG 90 | 2.42AB | 2.52AB | 30.00 EF | 31.65CD |
| AN 90 + AG 90 | 1.47C | 1.45EF | 37.00BC | 35.92AB |
| AS 30 + AG 90 | 2.55A | 2.30ABC | 33.25CDE | 32.75BC |
| AS 60 + AG 90 | 1.97BC | 2.10BCD | 31.75DEF | 32.87BC |
| AS 90 + AG 90 | 1.75C | 1.77DE | 39.50AB | 36.22AB |
| AN 180 | 1.52CD | 1.50EF | 34.37CDE | 35.70AB |
| AS 180 | 1.10D | 1.07F | 35.75BCD | 36.00AB |

**Means within each column followed by the same letter are not statistically different at 0.05 levels (Duncan's range test).**

**11- Percentage of marketable yield grate "A".**

Table 7 shows the data of this character for potato cv. " sanuora" as affected by N sources and rates in winter seasons 2008/2009 and 2009/2010. There are significant differences among the studied fertilizer treatments. The weighest values were obtained from those received ammonium gas at the rate of 180 kg / fed. treatment (AG 180 , AN 90 + AG 90, AS 90 + AG 90 , AN 180 and AS 180) in both seasons. On the other hand the lowest values were obtained from plants received ammonium gas at the rate of 90 kg / fed. in both seasons.

**12-Percentage of unmarketable yield.**

Data of percentage of unmarketable yield of potato cv. Sanuora as affected by nitrogen sources and levels in the winter seasons of 2008/2009 and 2009/2010 are shown in Table 7. Concerning the effect of the studied fertilizer treatments on percentage unmarketable yield, there are significant differences among those treatments, in both seasons. Treatment with ammonia gas at the rate of 90 kg / fed. gave the highest values of percentage of unmarketable followed by treatment (AN 30 + AG 90or AS 30 + AG 90) but not insignificant differences between their mean values, in both seasons. Treatment (AG 180 , AN 90 + AG 90, AS 90 + AG 90 , AN 180 and AS 180 ) gave the lowest values with insignificant differences among their main values, in both seasons.

**Table 7: Percentage marketable yield and percentage unmarketable yield as affected by application ofdifferent nitrogen sources in the two winter seasons of 2008/2009 and 2009/ 2010.**

| Treatments (N/ fed kg.) | Percentage marketable yield > 85(g) | | Percentage Unmarketable yield | |
|---|---|---|---|---|
| | First Season | Second Season | First Season | Second Season |
| 1-AG 90 | 35.85E | 32.90E | 21.12 A | 27.32 A |
| 2-AG 180 | 72.50 A | 75.07A | 14.70CD | 14.17CD |
| 3- 30 + AG 90 | 64.65D | 60.40D | 18.72AB | 21.07B |
| 4-AN 60 + AG 90 | 66.37CD | 61.52CD | 18.02ABC | 21.95B |
| 5-AN 90 + AG 90 | 73.00AB | 74.75A | 13.50D | 12.42DE |
| 6-AS 30 + AG 90 | 64.65D | 60.50D | 19.15AB | 19.65 B |
| 7-AS 60 + AG 90 | 69.55BC | 65.17C | 17.00BC | 18.15 BC |
| 8-AS 90 + AG 90 | 73.42AB | 73.72AB | 13.00D | 14.20 CD |
| 9-AN 180 | 72.97AB | 70.05B | 12.10D | 13.75 CD |
| 10-AS 180 | 74.20A | 75.82A | 11.90D | 9.82E |

**Means within each column followed by the same letter are not statistically different at 0.05 level (Duncan's range test).**

## Conclusion

The results suggest that anhydrous ammonia might become an alternative in large potato producing areas in Egypt, where conventional nitrogen fertilizers limiting. This practice can improve the potato tuber yield and decrease the production cost. These recommendations will need to be modified and fine-tuned to fit each potato field to optimize yield, quality, and the environmental protection at each location.

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## تأثير مصادر ومعدلات النيتروجين على النمو والمحصول فى البطاطس

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أجريت تجربتان حقليتان خلال عامين متتاليين في الموسم الشتوى٢٠٠٨/٢٠٠٩و٢٠٠٩/٢٠١٠بمحطة بحوث البساتين بسدس-مركز البحوث الزراعية لدراسة مقارنة الحقن بالامونيا الغازية بمعدل ( ٩٠ و١٨٠ كجم / للفدان) بمصادر النتروجين المختلفة ( سلفات الامونيا ؛ نترات الامونيا) بمعدلات (٣٠ – ٦٠– ٩٠ و ١٨٠ كجم / نتروجين للفدان) على النمو الخضري والمحصول ومكوناته على محصول البطاطس .واظهرت النتائج المتحصل عليها أن الحقن بالامونيا الغازية بمعدل ١٨٠ كجم / للفدان حقق زيادة معنوية فى جميع الصفات المدروسة بينما الحقن بالامونيا الغازية بمعدل ٩٠ كجم / للفدان أعطى اقل القيم في جميع الصفات المدروسة. وأعطى استخدام الامونيا الغازية اقل تكلفة من استخدام المصادر الأخرى من النتروجين وتفوق على هده المصادر من حيث الإنتاجية فيوصى باستخدام الحقن بالامونيا بمعدل ١٨٠ كجم / للفدان تحت الظروف المماثلة للبحث.

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