EFFECT OF NITROGEN SOURCES AND RATES ON GROWTH AND YIELD OF POTATO CROP. Hemada, A. A. and H. A. Awadall Vagatable Res Dept Hort Res Inst. Agric Res Center Giza Equat

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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.

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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
CaCo₃	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

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

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 m². 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 °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.)

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- 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 ^oC up to constant weight to determine.
- H- Average weight unmarketable tuber (ton/fed.).
- 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).

Treatments	Plant	height	Number	of main I plant
(N kg / fed.)	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	51.82 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

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.

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).

Treatments	Average shoot (g/pla	fresh weight ant)	Shoot dry mat	tter percentage
(N/ fed kg.)	First	Second	First	Second
	Season	Season	Season	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

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.

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).

Treatmente	Number of tu	ubers / plant	Total yield of tub	pers(ton / fed)	
(N) fod kg)	First	Second	First	Second	
(IN IEU KG.)	Season	season	Season	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	

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

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.

Treatments	Weight of Marketa for > 8	ble tuber (ton/fed) 35 (g)	Weight of Mark (ton/fed) for	etable tuber r < 85 (g)
(N/ lea kg.)	First Second Season 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

Table 5: Weight of Marketable tuber and weight of marketable tuber asaffected by application of different nitrogen sources in the twosuccessive winter seasons of 2008/2009 and 2009/ 2010.

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
	perce	ntage as affect	ted by	applicat	ion of	f differ	ent ni	itrogen
	sourc	es in the two v	vinter s	easons	of 2	008/200)9 and	d 2009/
	2010.							

	Weight unmark	marketable tuber (t/fed) Tuber dry m		er percentage
Treatments (N/ fed kg.)	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	4325 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

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 900r 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.

Treatments (N/ fed kg.)	Percentage ma 85	rketable yield >	Percentage Unmarketabl 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

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

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.

REFERENCES

- Abram, A. and D.L. Forster(2005). A primer an ammoning nitrogen fertilizers, and natural gas markets. Ohio State University, USA, AEDE- RP-0053-05: 1-48.
- Afaf A. Salem; A.A. El-Morsy and M.N. Gohar (2005). Effect of nitrogen form and rate of application on growth and productivity of some sweet potato cultivars. Minufiya J. Agric. Res. Vol.(30) No. 2: 635:651.
- Barakat, M. A. S.;S. M. Al-Araby and F.I. El- Adghan(1994). Varietal response of potato to graded dose of nitrogen and potassium. Alex. J. Agri. Res., 39(2): 399:414.
- Belanger, G.; J. R. Walsh; J.E. Richards; P. H. Miburn and N. Ziadi (2000). Yield response of two potato cultivars to supplemental irrigation and N fertilization in new burn swich. Amer. Potato Res., 77 :11-21.
- Belanger, G.; J. R. Walsh; J.E. Richards; P. H. Miburn and N. Ziadi (2002). Nitrogen fertilization and irrigation affected tubers cultivars. Amer. J. Potato Res. 79: No. 4 269 – 279.
- Bourke, R. M. (1985). Influence of nitrogen and potassium fertilizers on growth of sweet potato (Ipomoea batatas L.). Field Crop Res. Vol. 12(4): 363:375.
- Das, S. K. and N.C. Haneche(1994). Effect of potato based crop sequences with different manurial on the growth and tuber yield of potato. Indian Agriculturist, Vol. 38(1): 27-34.

- El- Banna, E. N. and A. F. Tolba (2000). Effect of microbein (Biofetilizers) and different levels of nitrogen and phosphorus on growth and yield of potato plant (*Solanum tuerosum* L.) J.Agric Sci. Mans. Univ., vol. 25(8)5343-5352.
- El- Banna, E.N.; E.M. Awad; H.M. Ramadan and M.R. Mohamed (2001). Effect of Bio- Organic fertilization in different seasons on growth, yield and tubers quality of potato (*Solanum tuerosum* L.). J. Agric Sci. Mans. Univ., 26 (3): 1687:1696.
- Hartemink, A. E.; S. O. Poloma; J. N. Sullivan; R. M. Bourke; M.G. Allen and J. C. Salisburg (2001). Integrated nutrient management research on sweet potato at Hobu. Morobe providence. Food security for Papua new guinea proceedings of the Papua Hew Guined food and nutrition 2000. Conference, PNG University of Technology late, Papua New Guireean 26-30 June 2000, 2001: 698- 711.
- Hassan, K.M.F.(2002). Response of potato plants to some chemical and biofertilizer treatments. Ph. D. Thesis Fac. Agric El-Minia Univ. Egypt.
- Karadogan, T. (1995). Effect of manure and fertilizer application on yields, yield component and quality of potatoes. Turkish J.Agri. & Forestry, vol. 19 (5): 373 – 377.
- Kumar,M.E.and A.Omar (1987). Effect of nitrogen levels and spraying with aminal – forte (amino acids soluation) on yield of cucumber and potatoes J.Agri.Soc.Mans.Univ.,
- Kumar, P.; S. K. Pandy, B. P. Singh; S.V. Singh and D. Kumar (2007). Effect of nitrogen rate on growth yield economics and crisps quality of Indian potato processing cultivars. Potato Research 50 : 143- 155.
- Love,S.L.,J.C.Stark and T.Salaiz (2005). Response of four potato cultivars to rate and timing of nitrogen fertilizer Amer.Potato Res.,82 : 21-30.
- Marti, H. and H. A. Mills (2002). Nitrogen and potassium nutrition affect yield, dry weight partitioning and nutrient use efficiency of sweet potato. Communications in soil Science and Plant analysis. 33; 1-2 287 – 301.
- Meyer, R. D., and D.B. Marcum (1998). Potato yield, petiole nitrogen and soil nitrogen response to water and nitrogen. Agromany J.90 (3): 420-429.
- Miller, P. and Marshal (1986). Growth nitrogen uptake and partitioning within the potato (Solanum tuberosum.) crop, in relation to nitrogen application J. Agric. Sci. UK 107: 421 – 429.
- Miller, J.S. and C.J.Rosen (2005). Interactive effect of fungicide programs and nitrogen management on potato yield and quality Amer. Potato Res., 82 : 399- 409.
- Mohammad, N. S. Khan; M. Ibrahim and Khalil UR- Rehman (1993). Effect of nitrogen and spacing on growth and yield of potato. Sarhad J.Agri. 9 (4): 305 – 308.
- Mohammad, M.J; S. Zuraiiqi ; W. Quasmeh and I. Papadopoulos (1999). Yield response and nitrogen utilization efficiency by drip irrigation potato. Nutrient – Cycling – in- Agroecosystems, vol. 54 (3) : 243- 249.
- MSTAT-C (1985). A software program for the design, management, and analysis of agronomic research experiments (Version 4.0) Michigan State University.

- Najm, A. A.; M. R. Haj Sayed Hadi, M. Taghi Darzi and R. Shamorady (2010): Effect of utilization of organic and inorganic nitrogen source on the potato shoots dry matter, leaf area index and plant height, during middle stage of growth. Intrnational J. Agri. and Bio. Sci. 1:1 2010.
- Russell, E.W. (1950). Soil conditions and plant growth. Elenen Edition.
- Santosa, M.(1992). Growth of potatoes Cv. "Granala and Temate" in Jetis, Malang (at 500 m above sea level). Agrivita vol 15 (2) 27-30(C.F. Potato Abs. 1994, vol. 19 No 4).
- Sarkar, D.; P.S. Naik and Sarkar (1998). Effect of inorganic nitrogen nutrition on cytokinin – induced potato microtuber production in vitro. Potato Research. Vol. 41: 3, 21 – 217.
- Singh T. P. and R. P. Singh (1994). Effect of rates and methods of nitrogen application on biomass and tuber production of potato. Crop Research (Hisar) vol. (3): 637 639.
- Shutske J.M. (2005): Using anhydrous ammonia safely on the farm. University of Minnesota, USA,WW-02326f (c.f.www. Extension. Umn. Educ/ distribution/ cropsytems/ dc 2326. html).
- Vos,J.(1997). The nitrogen response of potato (Solanum tuberosum L.) in the field : nitrogen uptake and yield, harvest index and nitrogen concentration. Potato Res.,40:237-248.
- Wu, J. and V. Sardo (2010). Sustainable versus organic agriculture. In sociology, organic farming , climate change and soil science. Sustainable Agriculture Reviews 3, eds. E Lichtfouse, 41- 76.
- Zelalem, A., T.T. Ekalign and D. Nigussies (2009). Response of potato(Solanum tuberosum L.) to different rates of nitrogen and phosphorus fertilization on vertisols at Debre Berhan in central highlands of Ethiopia, African J. pl. Sci. 3 : 16 24.

تأثير مصادر ومعدلات النيتروجين على النمو والمحصول فى البطاطس احمد عبد المنعم حميدة وحامد على عوض الله. معهد بحوث البساتين – بحوث الخضر - مركز البحوث الزراعية

أجريت تجربتان حقليتان خلال عامين متتاليين فى الموسم الشتوى٢٠٠٩/٢٠٠٨ و٢٠٠٩/٢٠١٠ بمحطة 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 – ٢٠- ٩٠ و ١٨٠ كجم / نتروجين للفدان) على النمو الخضري والمحصول ومكوناته على محصول البطاطس وأظهرت النتائج المتحصل عليها أن الحقن بالامونيا الغازية بمعدل ١٨٠ كجم / للفدان حقق زيادة معنوية فى جميع الصفات المدروسة بينما الحقن بالامونيا الغازية بمعدل ٩٠ للفدان أعطى القار في جميع الصفات المدروسة بينما الحقن بالامونيا الغازية بمعدل ٩٠ كجم / 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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