

RELATIONSHIP BETWEEN NITRIFICATION INHIBITORS AND MANY OF ACETYLENIC COMPOUNDS IN SOILS

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ABSTRACT

Recent work has shown that acetylene is a potent inhibitor of nitrification in soil. To discover the substituted acetylenes which inhibit nitrification in soil, determination of the effects of seventeen acetylenes monosubstituted ($\text{HC} \equiv \text{CR}$) such as (propyne, 1-butyne, 2-ethynyl - pyridine, phenylacetylene, 3-butyne-2-one, 1-phenyl-2-propyn -1- ol, 1-pentyne, 4-phenyl -1- butyne, 5-phenyl -1- pentyne, 1-ethynylcyclohexamine, 2-propyn-1-ol, 2-propyn -1- amine, 1-hexyne, 3-butyne -1- ol, 1-heptyne, 1-octyne, acetylene monocarboxylic acid) and seven disubstituted ($\text{RC} \equiv \text{CR}$) acetylene (2-butyne, 3-phenyl-2-propyn -1-ol, diphenylacetylene, 2-butyne -1- ol, 2-butyne -1, 4-diol, acetylene dicarboxylic acid, 2-butyneic acid) on production of $(\text{NO}_3^- + \text{NO}_2^-)\text{-N}$ in soils treated with $(\text{NH}_4)_2 \text{SO}_4$. The obtained data showed that most of the tested acetylenes substitutes inhibited nitrification process in soil and that some of them were potent inhibitors of nitrification. The results with the four tested gaseous compounds showed that acetylene, propyne, and 1-butyne inhibited nitrification in soils at partial pressures is low (0.1 or 1.0 Pa) whereas 2-butyne had little or no effect on nitrification at partial pressures as high as 10 Pa. Also the obtained data with the 21 nongaseous compounds showed that 2-ethynylpyridine, phenylacetylene, and 3-butyne-2-one had the greatest inhibitory effect on nitrification and that acetylene monocarboxylic acid, acetylene dicarboxylic acid, and 2-butyneic acid had the least effect. Studies on the measuring of C_2H_2 production in soils treated with the nongaseous compounds showed that the inhibition of nitrification was not due to C_2H_2 formed by decomposition of these compounds in the soil. Experiments indicate that 2-ethynylpyridine and phenylacetylene can be compared favorably with nitrapyrin (N-Serve) and etridiazole (Dwell) as soil nitrification inhibitors and have potential practical value for retarding nitrification of N- fertilizers in soil.

Keywords: Etridiazole, nitrapyrine, phenylacetylene, 2-ethynylpyridine, substituted acetylene, soil nitrification inhibitors.

INTRODUCTION

Recent work has shown that acetylene (C_2H_2) is a potent inhibitor of nitrification of NH_4^+ in pure cultures of *Nitrosomonas europaea* as reported by (Hynes and Knowles, 1978, 1980&1981; El-Sayed and Abdel-Mawly, 1999 and El-Sayed, 2003) and in soils (Bremner and Blackmer, 1979; Walter *et al.*, 1979; Berg *et al.*, 1982 and Abdel-Mawly and El-Sayed, 1999). Studies using pure cultures of *N. europaea* and *Nitrobacter winogradskyi* have demonstrated that C_2H_2 is a specific and noncompetitive inhibitor of oxidation of NH_3 to hydroxylamine by *N. europaea* and does not affect oxidation of NO_2^- to NO_3^- by *N. winogradskyi* (Hynes and Knowles, 1981 and El-Sayed, 1995). Berg

et al. (1982) and El-Sayed *et al.* (2001) found that C_2H_2 retarded nitrification in soils when its partial pressure was as low as 0.1 Pa and that it completely inhibited nitrification at a partial pressure of 10 Pa, but several workers have demonstrated that the inhibitory effect of C_2H_2 on nitrification in soil disappears rapidly after removal of C_2H_2 from the soil atmosphere (Walter *et al.*, 1979; Hynes and Knowles, 1980; Berg *et al.*, 1982; El-Keiy and El-Sayed, 1991 and El-Sayed, 2002a,b & c). It is evident, therefore, that although C_2H_2 is an extremely potent inhibitor of nitrification in closed systems, it has little, if any, potential practical value as a soil nitrification inhibitor (El-Sayed, 1989, 2001 and El-Sayed and Abo-El-Wafa, 2001).

The purpose of this study was to discover the monosubstituted ($HC \equiv CR$) and disubstituted ($RC \equiv CR$) acetylene for inhibiting the nitrification of NH_4^+ in soils and to assess the potential value of substituted acetylenes as soil nitrification inhibitors (El-Sayed, 1997a,b & c; 1998a & b and 1999).

MATERIALS AND METHODS

Surface soil samples (0-15 cm) differing in their texture were selected from different localities from Behera Governorate. The selected soils are extensively used for sorghum and pigeonpea production. The location names and routine analyses of the soil under investigation are listed in Table(1).

pH was determined with a glass electrode (soil/water ratio, 1:2.5), and total N was determined by a semimicro-kjeldahl procedure (Bremner, 1965). Organic C was determined according to the method described by Mebius (1960), and $CaCO_3$ equivalent was calculated from inorganic C determined as described by Bundy and Bremner (1972). Particle-size analysis was performed as described by Genrich and Bremner (1972).

Table (1):Some physical and chemical characteristics of the soil under investigation.

Soil location	Sand %	Silt %	Clay %	Soil texture	pH	Organic C mg kg ⁻¹	Total N mg kg ⁻¹	CEC* g kg ⁻¹
Abou El- Matameer	22. 26	39. 74	38. 00	Silty clay	8.0	43	4.3	41
Kafr El-Dawar	19. 31	56. 68	24. 01	Clay loam	7.6	34	3.5	4
Abou Hommos	64. 20	14. 90	20. 90	Sand clay loam	8.2	13	2.1	27

* $CaCO_3$ equivalent.

The names and formulas of the four gaseous and 21 nongaseous acetylenic compounds are reported in Table (2). The effects of these compounds on nitrification in soils were compared with two compounds patented as soil nitrification inhibitors namely nitrapyrin [2-chloro -6-(trichloromethyl) - pyridine; N-Serve] and etridiazole (5-ethoxy -3-trichloromethyl -1,2, 4-thiadiazole ; Dwell).

Table (2): Names of acetylenic compounds under investigation.

Name	Formula	State* (30°C)
Acetylene	$\text{HC} \equiv \text{CH}$	G
Propyne	$\text{HC} \equiv \text{CCH}_3$	G
1- Butyne	$\text{HC} \equiv \text{CCH}_2\text{CH}_3$	G
2- Butyne	$\text{H}_3\text{CC} \equiv \text{CCH}_3$	G
2- Ethynylpyridine	$(\text{C}_5\text{H}_4\text{N}) \text{C} \equiv \text{CH}$	L
Phenylacetylene	$\text{C}_6\text{H}_5\text{C} \equiv \text{CH}$	L
3- Butyn-2-one	$\text{HC} \equiv \text{CCOCH}_3$	L
1- Phenyl-2-propyn-1-ol	$\text{HC} \equiv \text{CCH}(\text{OH}) \text{C}_6\text{H}_5$	L
1- Pentyne	$\text{CH}_3\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
3- Phenyl-2-propyn-1-ol	$\text{C}_6\text{H}_5\text{C} \equiv \text{CCH}_2\text{OH}$	L
4- Phenyl-1-butyne	$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
Diphenylacetylene	$\text{H}_5\text{C}_6\text{C} \equiv \text{CC}_6\text{H}_5$	S
5- Phenyl-1-pentyne	$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
1- Ethynylcyclohexyl-amine	$\text{CH}_2(\text{CH}_2)_4\text{C}(\text{NH}_2)\text{C} \equiv \text{CH}$	L
2- Propyn-1-ol	$\text{HC} \equiv \text{CCH}_2\text{OH}$	L
2- propyn-1-amine	$\text{HC} \equiv \text{CCH}_2\text{NH}_2$	S
1-Hexyne	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
3- Butyn-1-ol	$\text{HC} \equiv \text{CCH}_2\text{CH}_2\text{OH}$	L
1- Heptyne	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
2- Butyn-1-ol	$\text{CH}_3\text{C} \equiv \text{CCH}_2\text{OH}$	L
1-Octyne	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$	L
2- Butyn-1, 4-diol Acetylene	$\text{HOCH}_2\text{C} \equiv \text{CCH}_2\text{OH}$	S
Monocarboxylic acid Acetylene	$\text{HC} \equiv \text{CCOOH}$	L
Dicarboxylic acid	$\text{HOOC} \equiv \text{CCOOH}$	S
2- Butynoic acid	$\text{CH}_3\text{C} \equiv \text{CCOOH}$	S

* G = gas ; L = Liquid ; S = solid.

To study the effects of gaseous acetylenic compounds on nitrification in soils, 10 gs of soil samples in 250 ml narrow-mouth, screw-cap bottles were treated with 4 ml water containing 2 mg of N as $(\text{NH}_4)_2\text{SO}_4$, and the bottles were sealed with Mininert value caps supplied by Precision Sampling Crop (these caps are fitted with a small rubber septum that allows injection and removal of gas samples by gas syringes). The amounts of gaseous acetylenic compounds needed to establish 0, 0.1, 1.0, or 10.0 Pa partial pressures of these compounds were then injected into the bottles, and the bottles were placed in an incubator at 30°C. After 8 days, triplicate bottles were removed from the incubator, and their contents were analyzed for NH_4^+ -N, NO_2^- -N, and NO_3^- -N as described by Bremner and Keeney (1966) and Page *et al.* (1982).

Unless otherwise specified, the procedure used to study the effects of nongaseous compounds on nitrification in soils was as follows: Ten gram soil samples were placed in 250 ml screw-cap bottles and treated with 4 ml water containing 2 mg of N as $(\text{NH}_4)_2\text{SO}_4$ and different amounts of the test compound. The bottles were then sealed with Mininert value caps and placed

in an incubator at 30°C. After 8, 11, or 15 days, triplicate bottles were removed from the incubator, and their contents were analyzed for NH_4^+ -N, NO_2^- -N, and NO_3^- -N as described by Bremner and Keeney (1966) and Page *et al.* (1982).

Aqueous solutions of the nongaseous test compounds were prepared immediately before use. Test compounds with low water solubility were emulsified into water using a high speed mixer.

To compare the effects of 2-ethynylpyridine, phenylacetylene, nitrpyrin, and etridiazole on nitrification in soils incubated in an open system, 50gs of soil samples were placed in test tubes and treated with 20 ml water containing 10 mg of N as $(\text{NH}_4)_2\text{SO}_4$ and 0 or 250 μg of the test compound. The test tubes were then placed unsealed in an incubator at 25°C. The amount of water lost from soil samples during incubation was measured gravimetrically at 6 days intervals and was replaced if it was > 1 ml. After 11, 21, and 31 days, triplicate test tubes were removed from the incubator, and their contents analyzed for NH_4^+ -N, NO_2^- -N, and NO_3^- -N as described by Bremner and Keeney (1966) and Page *et al.* (1982).

The amount of $(\text{NO}_3^- + \text{NO}_2^-)$ -N produced during incubation was calculated from the analysis results of $(\text{NO}_3^- + \text{NO}_2^-)$ -N before and after incubation, and the inhibition percentage of nitrification due to the presence of test compound was calculated from the equation $(C - T) / C \times 100$, where T = amount of $(\text{NO}_3^- + \text{NO}_2^-)$ -N produced in the soil sample treated with the test compound and C = amount of $(\text{NO}_3^- + \text{NO}_2^-)$ -N produced in the control (no test compound added). None of the incubated soil samples contained > 1 mg NO_2^- -N kg^{-1} of soil and no NH_4^+ -N could be detected after incubation for 15 days in the $(\text{NH}_4)_2\text{SO}_4$ amended soil samples that have not been treated with a test compound.

To determine the studied nongaseous acetylenic compounds that decomposed in soil with formation of acetylene, 10 gs of the three soils described in Table (1) were placed in 250 ml screw cap bottles and treated with 4 ml water and 0 or 10 μmol of the test compound. The bottles were then sealed with Mininert value caps and placed in an incubator at 30°C, and 1 ml samples of their atmospheres were removed for C_2H_2 analysis after 4, 8, and 15 days. Acetylene was determined by a gas chromatographic method involving use of a Tracor Model 550 G instrument fitted with a flame ionization detector and a 2 m by 2.1 mm (i.d.) stainless steel column packed with Porapak N. The column was maintained at 45°C, and N_2 was used as carrier gas (flow rate, 25 ml min^{-1}).

Statistical analysis :

All data were analyzed using analysis of variance (ANOVA) procedures appropriate for a completely randomized block design with

replicated three times (Steel and Torrie, 1982). Mean differences were evaluated by the least significant difference (LSD) method at $P \leq 0.05$ level of significance. All statistical analysis were performed using the Statistical Analysis System Software (SAS, 1990).

RESULTS AND DISCUSSION

Concerning the data of the four studied gaseous acetylenic compounds are listed in Table (3). It confirm a report obtained by Berg *et al.* (1982) and El-Sayed (2003) that C_2H_2 inhibits nitrification in soil when its partial pressure is low (0.1 Pa) and show that this gas caused almost complete inhibition of nitrification at a partial pressure of 10.0 Pa. The data in Table (3) also show that the two monosubstituted acetylene (propyne and 1-butyne) markedly inhibited nitrification in soil when their partial pressure was in the range of 1.0 to 10.0 Pa, whereas the disubstituted acetylene (2-butyne) had little or no effect on nitrification at these partial pressures (El-Sayed, 1995, 1997a,b&c; 2001).

Table (3): Effects of gaseous acetylenic compounds on nitrification in soil*.

Compound	Partial pressure (Pa)	% inhibition of nitrification in soil **		
		Abou El-Matameer	Kafr El-Dawar	Abou Hommos
Acetylene	0.1	33	66	77
	1.0	63	87	90
	10.0	96	98	99
Propyne	0.1	4	7	13
	1.0	41	82	87
	10.0	93	97	97
1- Butyne	0.1	0	4	7
	1.0	37	77	81
	10.0	91	96	97
2- Butyne	0.1	0	0	0
	1.0	0	0	2
	10.0	2	2	4

*10 gs of each soil samples were incubated (at 30°C; 4 ml water) for 8 days after treatment with

2 mg N as $(NH_4)_2SO_4$ and amount of compound required to establish partial pressure specified.

** LSD = 4.

The obtained data respective to 21 nongaseous acetylenic compounds are presented in Table (4). It is seem that most of these compounds caused substantial inhibition of nitrification of NH_4^+ in soils when applied at the rate of 0.5 or 1.0 m mol kg^{-1} soil and that 2-ethynylpyridine and phenylacetylene completely inhibited nitrification in the Kafr El-Dawar and

Abou Hommos soils when applied at these rates (El-Sayed, 1989 and El-Keiy and El-Sayed, 1991). The data in Table (4) also showed that the percentage inhibition of nitrification by the most of nongaseous acetylenic compounds increased with the increase of the amount of added compound , and decreased with increasing the incubation time .

In this concern ,Bundy and Bremner (1973) and El-Sayed (2002a,b &c) found that the effectiveness of nitrapyrin and other compounds proposed as inhibitors of nitrification in soil depended greatly upon the type of soil and these compounds were most effective with light textured soils. The data in Tables (3) and (4) showed that soil type had a similar influence on the effectiveness of acetylenic compounds as inhibitors of nitrification in soils (all tested compounds were more effective with the light textured soils . The effectiveness in case of Abou Hommos soil was higher than in case of either Abou E-Matameer or Kafr El-Dawar soil.

Table (4): Effects of nongaseous acetylenic compounds on nitrification in soil*.

Compounds	Added amount M mol kg ⁻¹ soil	% inhibition of nitrification in soil**			
		Kafr El-Dawar		Abou Hommos	
		8 days	15 days	8 days	15 days
2-Ethynylpyridine	0.5	100	—	100	—
	1.0	100	100	100	100
Phenylacetylene	0.5	100	—	100	—
	1.0	100	100	100	100
3-Butyn -2-one	0.5	97	—	98	—
	1.0	99	96	99	98
1-Phenyl -2- propyn -1-ol	0.5	95	—	97	—
	1.0	97	95	98	96
1-Pentyne	0.5	84	—	97	—
	1.0	93	87	99	93
3- Phenyl -2- propyn -1-ol	0.5	88	—	92	—
	1.0	92	91	96	94
4-Phenyl -1- butyne	0.5	82	—	94	—
	1.0	92	52	97	96
Diphenylacetylene	0.5	78	—	96	—
	1.0	86	51	97	79
5-Phenyl -1- pentyne	0.5	74	—	92	—
	1.0	75	31	96	94
1-Ethynylcyclohexylamine	0.5	73	—	91	—
	1.0	74	40	92	88
2-Propyn -1-ol	0.5	75	—	79	—
	1.0	88	83	97	93
2-Propyn -1- amine	0.5	57	—	95	—
	1.0	82	46	96	94
1-Hexyne	0.5	51	—	84	—
	1.0	62	50	91	89
3-Butyn -1-ol	0.5	62	—	71	—
	1.0	93	73	96	95
1-Heptyne	0.5	49	—	81	—
	1.0	59	49	91	57
2-Butyn -1-ol	0.5	52	—	66	—
	1.0	70	43	89	87
1-Octyne	0.5	50	—	48	—
	1.0	59	6	78	70
2-Butyn- 1,4 - diol	0.5	17	—	27	—
	1.0	55	6	77	21
Acetylene monocarboxylic acid	0.5	14	—	28	—
	1.0	21	11	46	16
Acetylene dicarboxylic acid	0.5	0	—	13	—
	1.0	0	0	14	11
2-Butynoic acid	0.5	0	—	0	—
	1.0	0	0	0	0

* 10 gs of each soil samples were incubated (at 30°C ; 4 ml water) for 8 or 15 days after treatment with 2 mg N as (NH₄)₂SO₄ and 0, 5.0, or 10.0 µ mol of compound specified.

** LSD = 5

With regard to the measure of C_2H_2 production in soils treated with $1.0 \text{ m mol kg}^{-1}$ soil of the 21 nongaseous acetylenic compounds showed that three of these compounds (acetylene monocarboxylic acid, 2-propyn -1-ol, and 2-propyn -1-amine) produced trace amounts of C_2H_2 and the other 18 compounds did not produce detectable amounts of this gas (the gas chromatographic procedure used to determine C_2H_2 could detect as little as 0.1 ng of C_2H_2). It is evident, therefore, that the observed inhibitory effects of the nongaseous acetylenic compounds on nitrification were not due to C_2H_2 formed by decomposition of these compound in soil (El-Sayed *et al.*, 2001; El-Sayed, 1998a & b and El-Sayed, 1999).

The results of Table (5) also, indicated that the effects of nongaseous acetylenic compounds added to soil at rate of either 0.5 or $1.0 \text{ m mol kg}^{-1}$ soil were much smaller on nitrification in the Kafr El-Dawar soil. But the data showed that, the addition of 21 nongaseous acetylenic compounds tested, 2-ethynylpyridine and phenylacetylene had the greatest inhibitory effect on nitrification, and acetylene monocarboxylic acid, acetylene dicarboxylic acid, and 2-butyneic acid had the least effect (Abdel-Mawly and El-Sayed, 1999).

Table (5): Effects of different amounts of nongaseous acetylenic compounds on nitrification in Kafr El-Dawar soil*.

Compound	added Amount (mg kg^{-1} soil)	% inhibition of nitrification in soil**		
		1.0	5.0	10.0
2-Ethynylpyridine	86		96	99
Phenylacetylene	79		93	97
3-Butyn -2- one	5		41	69
1-Phenyl -2- propyn -1-ol	6		33	41
1-Pentyne	4		11	31
3-Phenyl -2-propyn -1-ol	0		5	26
4-Phenyl -1- butyne	0		6	22
Diphenylacetylene	0		17	29
5-Phenyl -1- pentyne	2		4	19
1-Ethynylcyclohexylamine	0		3	16
2-Propyn -1-ol	0		2	12
2-Propyn -1- amine	0		2	7
1-Hexyne	0		5	9
3-Butyn -1-ol	0		3	11
1-Heptyne	0		4	14
2-Butyn -1-ol	0		3	6
1-Octyne	0		4	7
2-Butyn- 1,4 - diol	0		2	5
Acetylene monocarboxylic acid	0		0	0
Acetylene dicarboxylic acid	0		0	0
2-Butynoic acid	0		0	0

- 10 gs of each soil samples were incubated (at 30°C ; 4 ml water) for 11days after treatment with 2 mg N as $(\text{NH}_4)_2\text{SO}_4$ and 0, 10, 50, or 100 μg of compound specified.

** LSD = 3.

Table (6): Comparison of effects of 2-ethynylpyridine, phenylacetylene, nitrapyrin and etridiazole on nitrification in soil (closed system)*.

Compound	added Amount** m mol kg ⁻¹ soil	% inhibition of nitrification in soil***		
		Abo El-Matameer	Kafr El-Dawar	Abou Hommos
2-Ethynylpyridine	0.01 (1.0)	68	93	100
	0.05 (5.0)	95	98	100
Phenylacetylene	0.01 (1.0)	68	84	100
	0.05 (5.0)	96	98	100
Nitrapyrin	0.01 (2.2)	51	69	100
	0.05 (10.9)	80	92	100
Etridiazole	0.01 (2.5)	62	86	100
	0.05 (12.4)	89	96	100

* 10 gs of each soil samples were incubated (at 30°C; 4 ml water) for 8 days after treatment with 2 mg N as (NH₄)₂SO₄ and 0, 0.1, or 0.5 μ mol of compound specified.

**Values in parentheses indicate the amount of added compound added expressed as mg kg⁻¹ soil.

*** LSD = 3.

Data of table (6) show the comparison of effects of 2-ethynylpyridine, phenylacetylene, and two patented nitrification inhibitors (nitrapyrin and etridiazole) on nitrification in soils incubated in sealed bottles at 30°C for 8 days, and Table (7) shows the comparison of the effects of these compounds on nitrification in soils incubated in unsealed test tubes at 25°C for 11, 21, and 31 days (El-Sayed and Abdel-Mawly, 1999 and El-Sayed and Abo-El-Wafa, 2001).

Table (7): Comparison of effects of 2-ethynylpyridine, phenylacetylene, nitrapyrin and etridiazole on nitrification in soil (open system)*.

Soil Compound	% inhibition of nitrification in soil**					
	Abou El-Matameer			Kafr El-Dawar		
	11 days	21 days	31 days	11 days	21 days	31 days
2-Ethynylpyridine	93	86	84	96	85	81
Phenylacetylene	91	74	57	94	64	54
Nitrapyrin	61	59	47	76	66	57
Etridiazole	64	64	50	84	76	64

* 50 gs of each soil samples were incubated (at 25°C; 20 ml water) in unsealed 25 by 200 mm

test tubes for 11, 21, or 31 days after treatment with 10 mg N as (NH₄)₂SO₄ and 0 or 250 μg of compound specified.

** LSD = 3.

CONCLUSIONS

The obtained data indicated that when the incubation of soil was performed in sealed bottles at 30°C in the presence of 2-ethynylpyridine and phenylacetylene caused marked inhibition of nitrification when applied at the rate of 0.01 or 0.05 m mol kg⁻¹ soil. They can be favorably compared with nitrapyrin and etridiazole as soil nitrification inhibitors (Table 6). While the data obtained (Table 7) show that both 2-ethynylpyridine and phenylacetylene are compared with nitrapyrin and etridiazole as soil nitrification inhibitors when applied at the rate of 5 mg kg⁻¹ to soil samples incubated in unsealed test tubes at 25°C. This research therefore, indicates that 2-ethynylpyridine and phenylacetylene have potential practical value for retarding nitrification of fertilizer N in soil.

Based on the above discussion it concluded that the nitrification process under Egyptian soil conditions must be encouraged. Where, that process was associated by the element of hydrogen ions which lead to decrease soil reaction in the soil, consequently the availability of essential nutrients to plant will be increased. Therefore, it evaluated many acetylenic compounds to know the effectiveness of nitrification inhibitors in Egyptian soils.

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العلاقة بين مثبطات النترنة وكثير من مركبات الأستيلين بالتربة

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نظرا لأهمية مركب الأستيلين كمثبط فعال لعملية النترنة بالتربة. أجريت هذه الدراسة لتقدير تأثير سبعة عشر مركبا كبدل وحيد للأستيلين لتثبيط عملية النترنة بالتربة وهذه المركبات هي:

(propyne, 1-butyne, 2-ethynyl - pyridine, phenylacetylene, 3-butyne-2-one, 1-phenyl -2-propyn-1-ol, 1-pentyne, 4-phenyl-1-butyne, 5-phenyl-1-pentyne, 1-ethynylcyclohexamine, 2-propyn-1-ol, 2-propyn-1-amine, 1-hexyne, 3-butyne-1-ol, 1-heptyne, 1-octyne, acetylene monocarboxylic acid).

كما تم دراسة أثر سبعة مركبات أخرى كبدل ثنائي للأستيلين وهي:

(2-butyne, 3-phenyl-2-propyn-1-ol, diphenylacetylene, 2-butyne-1-ol, 2-butyne-1, 4-diol, acetylene dicarboxylic acid, 2-butyneic acid).

على إنتاج $\text{N-NO}_2^- + \text{NO}_3^-$ بالتربة المعاملة بكبريتات الأمونيوم.

وقد أظهرت النتائج المتحصل عليها أن معظم مركبات الأستيلين البديلة المختبرة كمثبطات للنترنة بالتربة كانت فعالة وقوية في تثبيط عملية النترنة. كما أوضحت نتائج أربعة مركبات غازية مختبرة أن ثلاثة منها هي:-

((acetylene, propyne and 1-butyne)) تعمل كمثبطات للنترنة بالتربة عند ضغط جزيئي منخفض في مدي يتراوح من (Pa ٠,١), (Pa ١,٠) حيث أن مركب (٢-butyne) قليل أو عديم التأثير في عملية النترنة عند الضغط الجزيئي المرتفع (Pa ١٠).

كما أظهرت النتائج المتحصل عليها لإحدى وعشرون مركب غير غازي مختبرا أن مركبات:

(٢-ethynylpyridine, phenylacetylene, and 3-butyne-2-one) لها تأثيرا كبيرا في عملية تثبيط النترنة، وأن مركبات:

(acetylene monocarboxylic acid, acetylene dicarboxylic acid, and 2-butyneic acid)

لها تأثيرا قليلا. أوضحت الدراسات الناتجة من قياس H_2C في التربة المعاملة بمركبات غير غازية أن تثبيط النترنة كان واضحا مع هذه المركبات وذلك ليس لإنتاج H_2C ولكن لتحللها بالتربة.

كما تشير نتائج التجربة أن كلا من مركب :-

(٢-ethynylpyridine and phenylacetylene)

كان إيجابيا مقارنة مع Nitrapyrin (N-Serve)، و etridiazole (Dwell) كمثبط لعملية النترنة بالتربة، وله قيمة عملية قوية في إعاقة أو تأخير عملية النترنة للأسمدة النيتروجينية بالتربة.

أوضحت النتائج أنه يجب تشجيع عملية النترنة تحت ظروف الأراضي المصرية، وذلك لأن هذه العملية ترافق أيونات الأيدروجين التي تؤدي إلى تناقص التفاعل الأرضي بالتربة. وبناء على ذلك فإن تيسر المحاليل المغذية الأساسية للنبات سوف تزداد.

تم تقييم عديد من مركبات الاسيتيلين لمعرفة فعاليتها كمثبطات لعملية النترنة بالأراضي المصرية.