

and ^{60}Co also expected to be produced in meteoritic iron and nickel were not observed, the signal from the small fragment presumably being below our detection limit.

The meteorite has fallen at the time of solar minimum when the cosmic ray flux in the interplanetary space is high. The high activity of ^{54}Mn and ^{57}Co is consistent with the levels expected during solar minimum. The activity can be compared with the production profiles in meteoroids of different sizes^{1,2}, according to which maximum activity is produced at the centre of an iron meteorite of ~20 cm radius. The level of ^{54}Mn present indicates that the ablation of the meteorite during its atmospheric transit has been small (<20 cm) and the size of the meteoroid in space was between 30 and 50 cm.

This is the seventh observed fall in the past 15 years in Rajasthan and the only iron meteorite, the other six stony meteorites being Didwana (H5, 12 August 1991), Lohawat (how, 30 October 1994), Devri Khera (L5/6, 30 October 1994), Piplia Kalan

(euc, 20 June 1996), Itawa Bhopji (L3/5, 30th May 2000) and Bhawad (LL 6, 6 June 2002). All these meteorites belong to different classes and have different exposure ages (ranging between 8 and 110 Ma). Since only about 126 falls have been observed all over India in the past two centuries, this frequency of fall (one every two years) in a small area of Rajasthan is anomalously high, as we have noted earlier³. In comparison, only eight falls have been reported from the rest of India during the past 15 years. The question whether this is a regional or temporal statistical fluctuation or the Earth is going through an unusually dense swarm of interplanetary bodies, is strengthened due to this additional fall. Better awareness regarding meteorites may have also contributed to its efficient recovery in this desert area of India.

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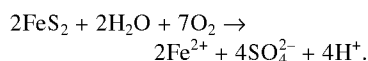
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Iron pyrites for reducing ammonia volatilization losses from fertilizer urea applied to a sandy clay loam soil

Ammonia volatilization (AV) is an important mechanism for the loss of nitrogen applied to farm fields and may range from 0 to 50% of applied N^{1,2}. Sudhakara and Prasad³ reported a loss of 8.37% of surface applied urea-N due to AV from a rice field, while Sarkar *et al.*⁴ reported a loss of 15–20% of applied urea-N due to AV from a wheat field. After application to a moist soil, urea hydrolyses to ammonium carbonate, which increases soil pH (8.5 or more). Ammonium carbonate then breaks down to CO₂, NH₃ and water⁵ and part of the NH₃ formed is volatilized. AV losses can be reduced by the addition of acids⁶.

Large amounts of iron pyrites (about 350 million tonnes) containing 22% S found at Amjhore, Rohtas district, Bihar⁷, are being currently recommended for the reclamation of alkaline (sodic) soils⁸ and for meeting S deficiency in soil, which is widespread in the country^{9,10}. Once applied to soil, iron pyrites are oxidized by the bacteria *Thiobacillus ferrooxidans* according to the reaction given below¹¹:



The acidity so produced may help in reducing AV losses. The present laboratory study was therefore conducted to find out if addition of pyrites to urea could help in reducing AV losses.

The laboratory incubation study was conducted on a sandy clay loam soil collected from the surface 0–20 cm layer of an experimental field under the rice–wheat cropping system for the last 15 years at the Indian Agricultural Research Institute, New Delhi. The soil had a pH of 7.9 (1 : 2.5 soil : water) and contained 5.4 g organic C and 0.5 g kjeldahl's N kg⁻¹ soil.

The soil was air-dried and ground to pass through a 2 mm sieve. One hundred grams soil was taken in each of the desired number of 250 ml beakers and was brought to field capacity (–10 kPa) moisture by adding the required quantity of distilled water; this moisture content was maintained by adding drops of water through the side of the beaker

as and when required during the entire period of study. Urea @ 56.6 mg N 100 g⁻¹ soil without or mixed with pyrite in 1 : 1, 1 : 2 and 1 : 4 urea : pyrite ratios (w/w), was surface-applied. A 20 ml beaker containing 10 ml boric acid mixed with methyl red indicator, was kept on the surface of the soil and the 250 ml beaker was made airtight by covering with an aluminium foil. Each day, the 10-ml boric acid beaker was replaced by a new one of similar type. Ammonia evolved and trapped in boric acid was titrated with 0.05 N H₂SO₄ and the amount of ammonia evolved was estimated. During incubation, the maximum and minimum laboratory temperatures were 35 ± 2°C and 25 ± 2°C respectively.

AV loss from urea without pyrite was slow after the first day of incubation (1.28 mg N), peaked at 7.75 mg N after 2 days of incubation and then tapered down to 1 mg N day⁻¹ after 5 days of incubation (Table 1). AV loss was lower when urea was mixed with pyrite and it decreased as the amount of pyrite in the mixture was

Table 1. Effect of mixing pyrite with urea on ammonia volatilization (AV) loss (mg N day⁻¹) (urea applied at 56.6 mg N 100 g⁻¹ soil)

Prilled urea : pyrite	Days after incubation												Total in 12 days	AV loss as percentage of total added N
	1	2	3	4	5	6	7	8	9	10	11	12		
Urea (no pyrite)	1.28	7.75	2.43	1.26	1.00	0.39	0.42	0.42	0.44	0.37	0.37	0.35	16.48	29.34
1 : 1	0.65	7.30	2.31	1.26	1.07	0.35	0.35	0.35	0.30	0.25	0.25	0.23	14.67	25.93
1 : 2	0.21	5.27	2.17	1.09	1.00	0.32	0.25	0.25	0.28	0.21	0.18	0.21	11.44	20.22
1 : 4	0.07	3.43	1.98	0.82	0.53	0.28	0.21	0.18	0.18	0.16	0.18	0.18	8.20	14.49
LSD (<i>P</i> = 0.05)	0.40	1.15	NS	0.19	0.32	NS	0.09	0.16	0.16	0.12	NS	0.12	3.46	–

increased and the differences between the successive levels of pyrites were significant after 1, 2, 4 and 5 days after incubation. From 7 days after incubation all the urea : pyrite ratios (1 : 1, 1 : 2 and 1 : 4) were at par and resulted in a significant reduction in AV loss compared to urea without pyrite. No differences among the treatments were noted after 3, 6 and 11 days of incubation, which is difficult to explain.

Total N loss through AV after 12 days of incubation was 16.48, 14.67, 11.44 and 8.2 mg N with urea (without pyrite) and 1 : 1, 1 : 2 and 1 : 4 urea : pyrite mixtures respectively. Reduction in AV loss due to 1 : 1 urea : pyrite mixture was not significant, but with urea : pyrite mixtures of 1 : 2 and 1 : 3, there was significant reduction in AV loss compared to urea without pyrite; the difference between 1 : 2 and 1 : 3 urea : pyrite mixtures was not significant. Expressed as percentage of total urea-N lost due to AV, it was 29.14 with urea without pyrite and the least (14.49) with 1 : 4 urea : pyrite mixture. Blaise and Prasad¹² also reported that AV with urea after 8 days of incubation was reduced from 27.5% with

urea to 8.9% when urea was mixed with pyrite in 1 : 2 ratio.

The results of the present study show that iron pyrites can be usefully employed for reducing AV losses from the fertilizer urea applied to farm fields. It will also be acceptable to the proponents of organic farming.

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Vertebrate circadian clock research: Do experiments on birds and lower vertebrates promise better insights?

Most biological processes exhibit daily rhythmic changes. In the absence of environmental cues (e.g. day–night cycle), many of these changes persist with periods (τ , τ) close to 24 h – hence referred to as ‘circadian’ (*circa* – about; *dies* – daily) – reflecting the presence of an endogenous clock mechanism. A major focus of the vertebrate circadian clock research field over three decades has been to identify specific structures that contain the ‘circadian clock’. This includes identification of the suprachiasmatic nucleus (SCN) in the mammalian

hypothalamus (for summary and review see Rusak and Zucker¹). Identification of additional clock structures included independent clocks in the eye and the pineal gland of fish, reptiles and birds, the eyes of marine molluscs (e.g. *Aplysia* and *Bulla*), and the lateral neurons of *Drosophila*. Thus, circadian clocks appeared to be highly localized cellular processes, and usually found in neural or neuronal structures.

In the conceptualized framework, a clock system is shown with the oscillator at the centre, with afferents receiving input from

the environment, and with efferents to several outputs (Figure 1 a), although we now know that multiple input and output pathways as well as feedback loops exist in this circadian clock circuitry². Relentless research efforts in the last 30 years on vertebrate clocks were directed to designate SCN as the central or ‘master’ clock. The ‘master’ SCN clock is supposed to set the ‘pace’ of several other clocks located elsewhere; this thinking gave rise to the ‘master–slave’ oscillatory concept of the circadian clock system. A refined version