Nitrification of Fertilizers

mean winter temperature of 45°F prevalent in state's farm areas not sufficiently low to prevent substantial oxidation

K. B. Tyler, F. E. Broadbent, and G. N. Hill

The validity of the assumption—that nitrogen losses, by leaching, are small when ammonium fertilizers are applied in the fall—was tested in a series of incubation experiments.

Interest in fall application of ammonium fertilizers to supply nitrogen for spring season crops has increased in recent years.

Fall fertilizing is one means the farmer has to better distribute his time, labor, and equipment use throughout the year. Also, storing nitrogen in the soil during the winter season would eliminate—for both the farmer and the fertilizer industry—the necessity of expensive facilities for bulk storage. Often fertilizer costs to the farmer can be reduced by late fall delivery. However, the application of nitrogen several months before it is needed by the spring crop raises the question of losses, principally those resulting from the leaching of nitrate. Ammonium nitrogen, because it is adsorbed to the soil colloids upon contact with the soil, leaches hardly at all. Nitrate nitrogen, on the other hand, moves very readily with the soil water and is easily displaced from the zone where plants are able to utilize it.

To investigate the inhibiting effect of winter temperatures on the oxidation of ammonia to nitrate in California soils, incubation experiments were conducted with soil temperatures at 75°F and at 45°F. Limited tests were made also at 37°F.

Nitrogen sources included ammonium sulfate and aqua ammonia applied broadcast at rates of 0, 100, 200, 400, 800, and 1,600 pounds of nitrogen per acre. The various levels of fertilizer were used to simulate a cross-section of the fertilizer band in the various soils with the lowest concentration at the fringe and the highest concentration approaching the center of the band.

Samplings at two-week intervals up to eight weeks were made to determine the extent of nitrification at the different temperatures as measured by the increase of nitrate nitrogen and decrease of ammonium nitrogen.

Three of the four soils receiving 200 pounds of nitrogen per acre were incubated at 37°F.

Nitrification of ammonium nitrogen at 75°F was rapid at all concentrations, nearing completion within 2–4 weeks. Decreasing the temperature to 45°F slowed the nitrification process considerably, but did not stop it entirely except at the highest ammonium concentration in two of the four soils.

At the 200-pound level of ammonium nitrogen application the amount of nitrate produced in six weeks at 45°F was roughly equivalent to the quantity produced in two weeks at 75°F. Even as low as 37°F, nitrate was being produced, although at a very reduced rate as compared with the rates at the two higher temperatures.

At the 37°F and 45°F temperatures, accumulations of nitrite nitrogen were found in the two alkaline soils—Yolo loam and Salinas clay—where the nitrogen application exceeded 100 pounds per acre. At the higher levels of application there were temporary nitrite accumulations at 75°F. The finding that low temperature in combination with alkaline soil reaction appears to favor nitrite accumulation, even at low levels of ammonium nitrogen application, suggests that the second step of nitrification carried out by the Nitrobacter group—bacteria that oxidize nitrites to nitrates—is more sensitive to low temperatures than the first step, for which the Nitrosomonas group—bacteria that oxidize ammonia to nitrites—is responsible.

The interaction between temperature

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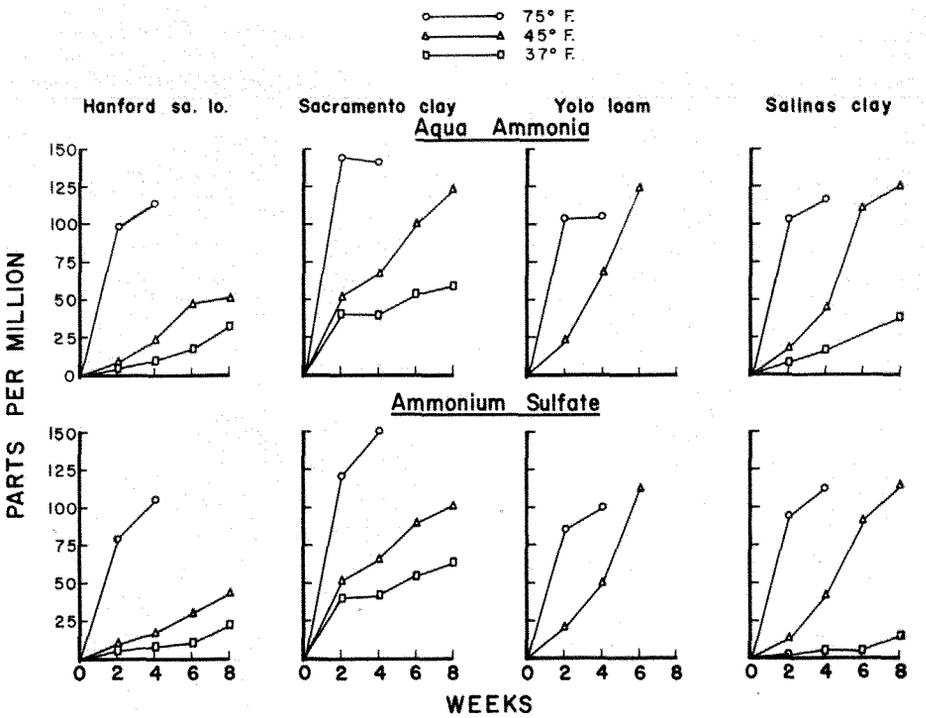
Comparison of Maximum Nitrification Rates of Aqua Ammonia at 45°F. and 75°F.

Soil	NH_4-N added ppm	Period of maximum nitrification rate, weeks		Maximum nitrification rate lbs/acre/day		45° F. rate as % of 75° F. rate
		45°F.	75°F.	45°F.	75°F.	
Sacramento clay	50	0–2	0–1	7	22	34
	100	0–2	0–1	8	22	34
	200	0–2	0–1	8	24	31
	400	0–2	0–1	7	29	25
	800	0–2	0–1	9	29	31
Yolo loam	50	2–4	0–1	4	18	21
	100	4–6	0–1	8	26	31
	200	4–6	0–1	13	34	38
	400	4–6	0–1	10	39	26
	800	6–8	2–3	15	41	36

Increase of nitrate nitrogen in four soils receiving an application of 200 pounds of nitrogen per acre.



Filbertworm Control

experimental insecticides show promise in tests on northern California walnuts

A. H. Retan, G. R. Post, and A. E. Michelbacher

In the second year of tests, Guthion and Sevin—not yet released for use on walnuts—again showed encouraging control of the filbertworm on Payne and Franquette walnuts.

Prior to 1957 lead arsenate was the only insecticide that had shown much effectiveness against the filbertworm and the control obtained was less than desired, amounting to around 50%.

Experiments with Guthion and Sevin were undertaken in 1957. When applied on August 20 to Payne and Franquette walnuts in an orchard near Gridley both insecticides showed promise in controlling filbertworm. Because of the results the insecticides were investigated further in 1958.

All treatments and untreated checks were run in duplicate. Guthion, 25% wettable powder, at 6.5 pounds per acre and Sevin, 50% wettable powder at 8.0 pounds per acre were applied in approximately 200 gallons of water by an air carrier sprayer. Applications of both insecticides were made on August 20 when the husks of sound Payne nuts were just beginning to show signs of cracking.

At harvest, 100 nuts were picked from 10 trees for each variety plot. After curing, a crack test was made to determine the degree of infestation. Most of the wormy nuts had been attacked by the filbertworm. In the check plot, 22% of the Payne nuts and 9.6% of the Franquettes were infested. In the Guthion plots, 7.6% of the Payne and 2.4% of Franquettes were infested. The infestations in the Sevin treated plots were 10.2% for the Payne and 4.5% for the Franquettes. It is possible that both insecticides might have produced better results had they been used at a higher concentration per acre.

The filbertworm attacks walnuts nearly everywhere the crop is produced in northern California. Fortunately, it has proved to be a serious pest only in certain localities. However, in years of localized outbreaks there is a general rise in the infestation throughout most walnut producing sections.

The 1958 season concluded the fifth year of trapping filbertworm moths in bait pans in an orchard near Gridley. There was a large flight in 1958 and a destructive infestation occurred in the walnuts at harvest. The seriousness of the attack approched or may have surpassed the outbreak in 1954.

The 1958 season was the fifth consecutive year that the filbertworm has been a moderate to a severe pest in the potential areas of heavy attack. Prior to 1954 investigations indicated that the pest population reached peaks of outbreak proportions and then, in subsequent years, declined to almost noneconomic levels. The recent behavior may be caused by a developing strain of the filbertworm that has a greater preference for walnuts. The possibility of the development of such a strain certainly warrants investigation.

The filbertworm is unable to penetrate the sound green husks of walnut and therefore it can not enter the nuts until the husks begin to crack as maturity is reached. An outbreak of the filbertworm may not be very troublesome in itself, but can be annoying when added to the infestation caused by the codling moth or the navel orangeworm. Treatments directed against the codling moth exert no control against the filbertworm.

Because the information on chemical control is so limited, growers must rely upon cultural measures to check damage by the pest. Every effort should be made to harvest the crop at the earliest possible date because the filbertworm can not enter sound nuts until the husks begin to crack. Further, because the filbertworm is unable to complete its development on dried walnut meats, the crop should be thoroughly dried as soon as harvested.

Although neither Guthion nor Sevin has been released for use on walnuts, it is anticipated that permission for use on walnuts will be granted by the proper authorities.

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NITRIFICATION

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and ammonium concentration becomes evident from a comparison of the maximum rates of nitrification at 45°F and at 75°F. The inhibiting effect of high ammonium concentration in the soil on nitrification rate was more pronounced at the lower temperature. In general, the time lag before the maximum rate of nitrification was attained, was longer at the lower temperature, and was extended with increasing concentration of ammonium nitrogen. Maximum rates of nitrification where aqua ammonia was applied varied from 4–41 pounds per acre per day depending on the temperature and concentration. Generally, the maximum rate at 45°F was between 20% and 40% of the rate at 75°F.

In California, the mean January temperature in the major agricultural areas does not go much below 45°F. Results of these experiments demonstrate that nitrification is still appreciable at temperatures below 45°F, which indicates that winter temperatures in California are not sufficiently low to prevent oxidation of substantial quantities of ammonium nitrogen to the nitrate form. The concentration effect of band applications of ammonium fertilizers—combined with low temperature—will play a role in retarding nitrification and thus preserve a greater proportion of the fall applied nitrogen for use by the following spring crop.

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tions. In refilling, provisions should be made to break the fall of the fruit from the carrying belt into the bottom of the box.

5. When possible, fruit from cold storage should be permitted to attain room temperature before sizing operations take place.

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