Fertilizer Sources for Cotton

fertilizer materials supplying nitrogen and phosphate tested for crop producing efficiency

D. S. Mikkelsen and E. G. Smith

Nitrogen is the most important single fertilizer element in the economic production of cotton in California.

Fertilizer sources which supply nitrate-nitrogen, ammoniacal nitrogen and nonproteid organic nitrogen are used most extensively.

Phosphate fertilizer is required in some areas, but is generally supplemented with nitrogen to obtain maximum fertilizer benefits. Concentrated superphosphate, ammonium phosphate and, more recently, aqua phosphoric acid have been used as phosphate sources.

In San Joaquin areas, different fertilizer materials supplying equivalent amounts of the fertilizer elements, nitrogen—N—and phosphate—expressed as P_2O_5—were compared to determine their relative crop producing efficiency. These tests, intended for evaluation of the fertilizer elements themselves in different chemical sources, have not been conducted long enough to determine the effect of other elements combined with the nitrogen or phosphate source or their residual effect of possibly altering the physical or chemical condition of the soil.

Fertilizer Sources

Fertilizer sources, both nitrogen and phosphate, differ in crop producing efficiency by way of their chemical nature, the method and time of application and such other factors as the crop being grown, the physical and chemical characteristics of the soil, soil moisture, cropping history, disease and climate.

Choice of nitrogen fertilizer source depends to an extent on the soil characteristics, particularly respecting texture. Cotton can use either nitrate or ammoniacal nitrogen with about equal facility. The main difference between these two forms is their movement in the soil. Nitrate-nitrogen is water soluble and subject to leaching in well drained or excessively drained soils. Ammoniacal nitrogen is completely available but temporarily resists leaching if some clay material is present to absorb it. A nonproteid organic form, such as urea, is converted to ammoniacal form which is completely available and likewise temporarily resists the leaching action of water. All nitrogen sources may ultimately appear as nitrate-nitrogen in normal agricultural soils.

Relative Efficiency of Nitrogen and Phosphate-Source Fertilizers on Cotton Production on Two California Soils

Fertilizer Source	Hesperia Sandy Loam* 1951 Seed Cotton Yield	Hesperia Sandy Loam* 1952 Pounds per acre	Panoche Loam† 1952
Aqua Ammonia	2705	3053	3999
Ammonium Sulfate	3051	2966	3938
Ammonium Nitrate	2727	2858	3798
Ammonia Gas	..	..	3767
Calcium Nitrate	2489	2620	3858
Urea	2748	2728	3752
Ammonium Phosphate Sulfate	3181	3074	3989
Treble Superphosphate	2271	1840	1881
Aqua Phosphoric Acid	2424	1645	1871
Check	2142	1537	2032
L.S.D. (.05)	366	279	353
Location	Shafter	Shafter	Five Points
County	Kern	Kern	Fresno

* 80 pounds actual N/acre; 100 pounds P_2O_5/acre.
† 100 pounds actual N/acre; 100 pounds P_2O_5/acre.

Phosphate materials in common use, such as concentrated superphosphate, ammonium phosphate and aqua phosphoric acid, have most of their phosphorus in a water soluble form. The amount of phosphorus which remains available is governed by the ability of the plant to utilize the supply and the nature of the physico-chemical processes operating in the soil.

Field Tests

These fertilizer source tests were established on soils used for continuous cotton production. Four and six row treatments were replicated five times in a randomized block arrangement. Panoche loam and Hesperia sandy loam soil were used in the tests because of their textural differences and known response to fertilization.

Liquid materials including aqua ammonia, and aqua phosphoric acid were applied by commercial applicator equipment which placed the material in two bands about 6″ each side and 3″–5″ below the seed. Ammonia gas was applied in the middle of each row to a depth of about 6″. The dry-form materials, ammonium sulfate, ammonium nitrate, calcium nitrate, ammonium phosphate-sulfate, treble superphosphate and urea were applied to the cotton in bands about 6″ each side and approximately 3″–5″ below the seed.

The Hesperia sandy loam was fertilized with dry form ammoniacal nitrogen sources and phosphate just prior to pre-irrigation while all aqueous sources and nitrate-nitrogen sources were applied in moist soil when the cotton was in the seed-leaf stage. In this test each nitrogen source supplied 80 pounds actual nitrogen and 100 pounds available phosphate an acre.

On the Panoche loam, all the fertilizer materials were applied—in the manner described above—when the cotton was in the seed-leaf stage. All nitrogen sources supplied 100 pounds actual nitrogen per acre and phosphate sources supplied 100 pounds available phosphate. Seed cotton yields were made in two pickings harvested by mechanical harvester.

Results

A summary of the average seed cotton yields obtained with each fertilizer source on two different cotton producing soils is shown in the table in column 2 of this page.

In the test conducted on Hesperia sandy loam in 1951, ammonium phosphate sulfate gave the best yield. There were small differences in average yield but no significant difference between the nitrogen sources of aqua ammonia, ammonium sulfate and ammonium nitrate. Nitrogen supplied as calcium nitrate was considerably poorer than the aqua ammonia and ammonium sulfate. Aqua phosphoric acid increased yields somewhat over the unfertilized treatment, but there were no real differences between the sources of phosphate applied in this test. Phosphate fertilization without adequate nitrogen had no beneficial effect while nitrogen and the nitrogen-phosphate combination increased yields as much as 48.5% over unfertilized plots.

The tests conducted on Hesperia sandy loam in 1952 were at the same location as the previous test. During this season combination nitrogen-phosphate treatments increased seed cotton yields by 100% over unfertilized plots. Small but not significant differences in yield were obtained where ammonium sulfate, aqua ammonia, and ammonium nitrate materials were

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Migrating Aphids on Walnuts

reinfestation of aphid-free orchards a constant threat from infested orchards on windward side

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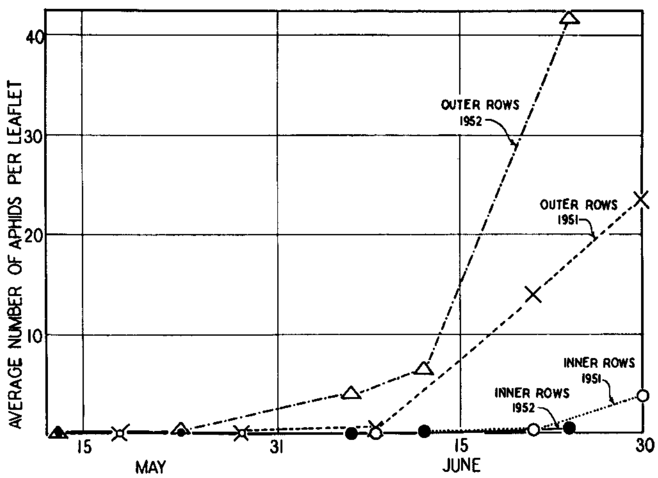
A single treatment—with one of the several available insecticides—could control aphids on walnuts for an entire season if migrating aphids could be kept from the orchard.

When a walnut grove without efficient aphid control is on the windward side of an aphid-free orchard, it furnishes a constant supply of winged aphids which migrate to and reinfest the clean orchard.

The reinfestation of an experimental orchard in 1951 and 1952 was studied carefully. The outer five to 10 rows in both years became heavily infested in from four to five weeks after treatment, while the trees deeper in the orchard remained almost free of aphids. The increase of aphids toward the center of the orchard was much delayed but there is little question that the rise in population was a result of migratory aphids.

The problem of reinfestation by migrating aphids could be minimized if the growers in a given area would apply effective treatments in a well coordinated program.



Influence of migrating aphids on the pattern of reinfestation in the experimental orchard at Linden.

Treatments for aphid control must be applied correctly because the newer aphicides adversely affect the natural enemies of the aphid. Investigations have shown that when their natural enemies are killed the aphid population is likely to reach a more destructive level than had no artificial control been applied. The aphid population will double about every three days which means that if it is reduced by treatment to an average of one aphid per leaflet, the population will increase—in the absence of natural enemies—to 32 aphids in 15 days and to 64 aphids in 18 days.

In 1952, experiments were conducted with a systemic insecticide—O,O-diethyl-S-(beta-mercaptoethyl) ethyl phosphate—which proved to be very effective against migrating aphids. The treatments were applied on May 10th and it was not until several months later that aphids were able to establish colonies on the old foliage. A single experimental treatment remained effective for the entire season, but this systemic insecticide has not yet been released for general use on walnuts. However, extensive studies during the coming year may result in sufficient information to permit the release of this new insecticide for commercial use in walnut orchards during the year 1954.

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used. Nitrogen supplied as urea and calcium nitrate were poorer than the nitrogen-phosphate combination and the best nitrogen source. Treble superphosphate was somewhat better than the unfertilized but was considerably poorer than some nitrogen or nitrogen-phosphate sources. There were no real differences in the phosphate materials tested.

Nitrogen sources compared on Panoche loam which supplied 100 pounds actual nitrogen per acre increased seed cotton yields as much as 96.8%. No real differences were found to exist between the nitrogen or nitrogen-phosphate sources compared on this loam soil. Phosphate materials applied at 100 pounds an acre, a rate higher than economically recommended, uniformly reduced seed cotton yields about 8% but did not differ in themselves.

Under conditions of these tests, where fertilizer sources supply equal amounts of the fertilizer elements, only small differences exist in cotton producing efficiency. Nitrate and ammoniacal-nitrogen are used equally effectively by cotton plants.

On light textured or sandy soils some nitrate-nitrogen may be lost through leaching action. In these circumstances ammoniacal-nitrogen sources tend to perform better than nitrate sources and the nonproteid source such as urea.

Phosphates

Phosphate sources which were supplied at the rate of 100 pounds available phosphate an acre did not materially differ in crop producing efficiency. Phosphate materials used without adequate nitrogen may not benefit cotton yields and may in some cases reduce yields.

Nitrogen fertilization has an important effect in economic production of continuous cotton in California. In some areas, phosphorus may increase yields, but must be supplemented with nitrogen for maximum effect.

Small yield differences exist between nitrogen sources on soils which do not rapidly lose nitrate-nitrogen through leaching action. Ammoniacal nitrogen tends to perform better on light textured soils. In areas where the efficiency of fertilizer sources are equal, the grower should select the material with the lowest unit cost of plant food.

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