recommended rate for young trees, until the groves
begin to bear fruit. As the trees approach maturity,
P applications can be limited to once every few years.
Diagnostic information from leaf and soil testing can
help determine whether P fertilization is necessary.
Citrus yields have not been correlated with the results
of soil tests measuring P levels in calcareous soils;
however, soil testing with Mehlich 3, sodium
bicarbonate, or another suitable extractant still can be
useful in estimating the magnitude of accumulated P.
An increased level of P measured by soil tests
following periodic fertilization would indicate an
increase in available P above the native soil level.

Leaf tissue testing can be used to determine
whether soil P is available to citrus trees. For best
results, the leaf P concentration of 4- to 6-month-old
spring flush leaves from mature trees should be
evaluated. The optimum range for leaf P in mature
citrus leaves is from 0.12% to 0.16% on a dry weight
basis. A decline in leaf P concentration from
 optimum to low over several years indicates declining
soil P availability and justifies a P fertilizer application.

Potassium. For citrus on noncalcareous soils,
nitrogen and potassium fertilizer applications with a
1:1 ratio of N to K₂O are recommended. If leaf
testing on calcareous soils reveals that high levels of
soil Ca may be limiting K uptake, the K₂O rate should
be increased by about 25%. This approach may not
work in all situations, however. Another way to
increase leaf K concentration is through foliar
application of KNO₃. A solution of 20 lbs KNO₃ per
100 gallons of water, sprayed to the point of foliar
runoff, has been shown to raise leaf K, especially if
applied several times during the year. Concentrations
greater than 20 lbs KNO₃ per 100 gallons of water
should be avoided, since high salt levels promote leaf
burn. The availability of N applied through foliar
spray equals that of N applied in regular ground
fertilizer programs. Therefore, the amount of N
applied as KNO₃ should be considered when
determining annual N fertilization plans for citrus
groves.

Zinc and manganese. The most common
inorganic Zn and Mn fertilizers are the sulfates
(ZnSO₄, MnSO₄) and the oxides (ZnO, MnO).
Broadcast application of these compounds to correct
Zn or Mn deficiencies in calcareous soils is not
recommended, since the alkaline pH renders the Zn
and Mn unavailable almost immediately. Zinc is also
available in chelated forms, including Zn-EDTA and
Zn-HEDTA. A chelate is a large organic molecule
that "wraps around" a micronutrient ion such as
Zn²⁺, sequestering it from soil reactions that make it
unavailable. Chelated Zn is sometimes, but not
always, superior to inorganic Zn sources. Soil
applications of chelated Zn are rarely economical,
however. Manganese chelates have limited
effectiveness in calcareous soils and are not normally
used.

The least expensive way to apply Zn and Mn to
citrus is through foliar sprays. In addition to the
forms listed above, a number of other Zn and Mn
formulations are available for foliar spraying,
including nitrates and organically chelated forms using
lignin sulfonate, glucoheptonate, or alpha-keto acids.
Preliminary research data indicate little difference in
magnitude of foliar uptake, regardless of the form of
carrier or chelate applied. Similarly, foliar
applications of low rates of Mn or Zn (e.g., 0.5 to 1.0
lb elemental per acre) are not adequate to correct
moderate to severe deficiencies often found in soils
with high pH values.

Iron. It is not easy to remedy iron chlorosis of
citrus trees on susceptible rootstocks planted on
calcareous soils. Iron fertilizer formulations are
available that can correct chlorosis; however, the
required application rate and frequency make the
treatment expensive. Inorganic sources of Fe such as
ferrous sulfate (FeSO₄) or ferric sulfate [Fe₂(SO₄)₃]
are not effective unless applied at extremely high
rates; these sources should not be used on calcareous
soils. Iron chlorosis should be addressed through soil
application of Fe chelates. Chelates are superior
sources of Fe for plants because they supply sufficient
Fe at lower rates than are required with inorganic Fe
sources. The most popular synthetic organically
chelated forms of Fe include Fe-EDTA, Fe-HEDTA,
Fe-DTPA, and Fe-EDDHA. The effectiveness of
these fertilizers varies greatly, depending on soil pH
(see Table 3). Fe-DTPA may be used on mildly
alkaline soils (with pH values of 7.5 or less),
whereas Fe-EDDHA is the chelate of choice for use
on highly calcareous soils (with a pH value greater
than 7.5).

Natural, organically complexed Fe exists in
organic waste products such as sewage sludge, but at
lower concentrations than in chelated Fe fertilizers.
On calcareous soils in the western United States,
sludge applied at 15 tons per treated acre was an
effective Fe source for field crops severely deficient in
Fe. The efficacy of sludge as an Fe fertilizer for