The literature on the effects of water tables, salt concentrations and nutrients on the growth of citrus is briefly reviewed below under three heads:

A. Effect of Water Table

Reitz and Long (1955) found that the depth of rooting in citrus was proportional to water table, although the yield did not appear to be affected if the water table was 2.5 feet below the surface. In Southern China, where water table is high and floods occur frequently, citrus trees are reported to be grown on embankments or mounds (Chen and Dragacev, 1958). Similarly, Ford and Prevatt (1957-58), from their studies in greenhouse, reported that sweet orange seedlings could live in a flooded soil and sour orange seedlings could survive in water without aeration for at least one month. Prevatt (1958-59) observed no visible injury on various species of citrus growing on sandy soil when the flooding was done in January; but floods in April or during June to August caused leaf injury, depending of course, on the depth of the root-system, and the species.

A rise of water table during the growing season as a result of rain may cause considerable damage to the root system. Bloeman (1961) and Zuccardi (1961) observed harmful effects of rising water table on citrus trees.

In case of horticultural crops, the water table depth for maximum yield had to be 75 to 90 cm. (Roe, 1956). Mac Daniels and Heinicke (1939) reported from New York State that a high water
Batchelor (1948) concluded that a fluctuating water table is very serious because when it rises up, the deep roots rot and when it recedes, the shallow root system fails to draw its supplies from areas down below.

According to Pearson and Goss (1955), water table up to a depth of 2 feet caused distinct mottling and a high concentration of salts caused bronzing and burning of leaves, defoliation and twig dieback. Pearson et al. (1957) related tree growth to electrical conductivity of the saturation extract. They found this relationship in case of grapefruit. The saline factor, according to the authors, was responsible for about 96 per cent of the variance in growth while water table contributed only 4 per cent. The leaf concentration of calcium, magnesium and potassium appeared to be adequate in all treatments. Saline irrigation water resulted in accumulation of sodium and chloride in toxic amounts which were related to the growth response obtained.

B. Effect of Salts

(i) Concentration and nature of salts:— According to Cooper and Shull (1955) excess salts caused pronounced yellowing of leaf margins and burning of tips. In grapefruits, it was usually followed by heavy shedding of leaves in the later part of winter. Excessive concentration of salts especially chlorides led to complete defoliation. The trees were rendered susceptible to injury from adverse climatic conditions, and the quality and quantity of fruits were reduced. Thomas and Kelley (1920) reported that under alkaline conditions, the roots of citrus trees
did not penetrate deeply into the soil - 95 per cent of them remained within two feet of the surface.

Eaton (1955) argued that the injury due to salinity caused by irrigation water, usually lacked distinct symptoms. Cooper et al. (1958) and Cooper (1962) observed no symptoms of sodium sulphate injury in grape-fruits despite the abnormal accumulation in the tissues. Le Roux and Basson (1961) related the defoliation and fruit drop of citrus, following parathion spray, to soil salinity. They reported that the growth of plants may be substantially reduced due to salinity without developing apparent symptoms.

Haas (1950) expressed the opinion, that leaf tip burn in citrus which was previously supposed to be due to excessive content of chloride in leaves, might often be caused by excessive sulphate accompanied by low nitrogen or boron. He further suggested that the upward movement of excess or unused element kept the area about the midrib relatively free of the increasing accumulation and that the tip burn then extended more along leaf margins than downrib. His finding that the effect of salts was similar to water stress rather than to chemical ionic imbalance was in conformity with the observations of Richards (1954). Contrarily, Eaton (1959), after a number of experiments, found that the salt concentrations did not affect water uptake.

Cooper and Paynado (1955) found no apparent relationship between chlorosis of citrus and the total amount of soluble salts. Leaf analysis also showed no clear or consistent relationship between chlorosis and chlorine or calcium content. But Kanwar and Randhawa (1960) suggested that citrus chlorosis in Punjab was partially
due to salinity and high uptake of phosphorus and manganese which resulted in iron and zinc deficiency. Koverga (1957) attributed citrus chlorosis in Crimea to excess chlorine i.e. above 0.11 percent in the soil. Reed and Haas (1925) in their experiment to find out the nutritional causes underlying some physiological disorders found that continued absorption of sodium resulted in the tip-burn of citrus and sodium absorbed in turn is regulated largely by the amount of calcium present. The roots are not affected by the high sodium while the leaves may be badly burnt. Kelley and Cummins (1920) reported high sodium in the ash content of mature mottled leaves of citrus.

Plant species differ much in their salt tolerance. The same variety may also vary in salt tolerance depending upon the stock used. Cooper et al. (1951) experimented with grapefruit on 20 rootstocks and classified them into poor, medium and good tolerants of salinity. de La Rocha and Flores (1958) noted appreciable influence of rootstock on growth and toxicity to salts and boron. As observed by Cooper et al. (1951), trees on sour orange were less tolerant of salinity than those on Cleopatra mandarin. Cooper and Peyando (1959) reported that salt treatment decreased growth both in young and old lime trees, the decrease being of the same order in both and proportionate to the concentration of salts in irrigation water. Timkat and Sunki mandarin rootstocks excluded chlorides, but accumulated boron, the Citrange accepted both and C. macrophylla excluded sodium, but accumulated chloride. Embleton et al. (1962) observed that in case of Frost Nucellar Eureka lemon scions on several stocks, with high boron and $SO_4^{-2}$ content of
irrigation water, the Macrophylla rootstock resulted in a lower concentration of boron in leaf and lower incidence of boron toxicity. It also increased manganese and decreased magnesium content of leaves. Sodium content of leaves in Yugu rootstock was higher than in other rootstocks.

Peynado and Young (1962), while studying the performance of nucellar Red Blush grapefruit trees on thirteen kinds of rootstocks irrigated with saline and boron contaminated well water over a 5-year period, found that a good correlation existed between the uptake of Na and B as determined by foliar analysis, but not between Na and Cl. An increase in B and Na contents induced chlorosis. C. macrophylla rootstock reduced the uptake of boron, Rangpur lime, Cleopatra, Sunki and Timkat mandarin rootstocks reduced the uptake of Cl and sour orange rootstock lowered the Na content.

Cooper (1962) working on Ruby Red grapefruit reported, that Rangpur Lime, Cleopatra mandarin and Severina buxifolia were among the most tolerant to chloride and citranges and trifoliate orange were the least tolerant. The appearance of toxicity symptoms was closely related to chlorine content of leaves. Na content was affected by the variety of rootstocks and Na accumulation was higher in trees on mandarin than on trifoliate orange hybrid rootstock. After irrigation with salt water contaminated with B, trees on certain stocks accumulated chlorine but not boron. Severina buxifolia accumulated neither.

The salinity may affect the citrus plants indirectly by encouraging their parasites. Machmer (1958), for example, noted that excess of salts could be tolerated by citrus nematodes etc., thus causing damage to the plants. Van Gundy and Martin (1961)
reported that greatest reduction in growth of citrus seedlings from the presence of a certain micro-organism in soil was maintained at such levels of CaCO$_3$, Na and K that were border lines or unfavourable for growth of uninfected plants. The sodium content of leaves was higher in the case of plants infested with nematodes than the uninfected ones, grown in soil high in Na.

(ii) pH:- It appears that early workers were more interested in pH which could be tolerated by plants rather than the actual salt tolerance. Haas (1958) found that rough lemon seedlings grew best at pH 8.0 and that pH changes due to different cations influenced the plants differently. However, in his opinion, due to great buffer action of the soil, much importance should not be attached to pH. But Oberholzer (1944) pointed out that acid soils were deficient in exchangeable bases, besides being poor in buffer action.

(iii) Sodium:- Harding et al. (1958) reported that grapefruit, tangerine, valencia and Navel orange trees wetted by sprinkler water were able to absorb sufficient Na and Cl during an irrigation season to cause leaf burn and defoliation. Where foliar absorption of Na and Cl has been found to occur, the amount of Na in irrigation waters ranged from 69 to 190 ppm and of Cl from 56 to 151 ppm, with total dissolved salts ranging from 500 to 900 ppm. Huberty and Pearson (1949) recorded adverse effects of Na on the yield and quality of citrus fruit. Reed and Haas (1923) pointed out that Na was more injurious in the absence of Ca. Zusman (1956) in Israel found, that sweet lime seedlings in soil containing 1.1 m.e./100 g. of Na developed Na toxicity. Peynado and Young (1962) reported that a good correlation existed between the uptake of Na and
B as determined by foliar analysis of the Red Blush grapefruit, but not between that of Na and Cl.

(iv) Chlorine:— Haas (1945) found that chlorine ion effects on the plant growth depended upon factors such as kind of plant, growth media and climate. Buchner (1951) reported that excess of chlorine intensified K deficiency in plants. The unfavourable K : Cl ratio of less than 1 resulted in an injury. Cooper and Gorton (1952) observed that though the chlorine accumulation varied much with the rootstock used, the element was not consistently related to that of any other ion. In pot experiments with lemon, Koverga (1957) observed that 0.05 per cent Cl in the soil caused leaf drop and withering of citrus shoots.

More recently Brusca and Haas (1958) found that at low concentrations, rootlets of orange contained comparatively more chlorine than the leaves, but at high concentrations (i.e. at 560 ppm) the percentage in leaves was more than in roots. Orange blossom also showed a sudden increase in chlorine content above 500 ppm. The accumulation of Cl ion gave highly distinguishable symptoms. Many plant species were found to be more sensitive to Cl than to isosmotic concentrations of sulphate. Reed and Haas (1924) described burning of citrus leaves due to excessive chloride ions.

Breazeale and McGeorge (1952) observed decreased availability of P and N associated with excessive chlorine in substrate.

(v) Bicarbonate:— According to Iljin (1951, 1952) and McGeorge (1949), in lime induced chlorosis, the chlorotic symptoms and associated divergence in metabolism involving content of active ion, organic acid fractions and essential cations were very similar
to typical case of bicarbonate induced chlorosis.

(vi) Sulphate: Zusman (1956) observed that toxicity symptoms of $\text{SO}_4^{2-}$ ions in sweet lime and sour orange seedlings became apparent at concentrations above 1000 ppm. The calcium absorption was reduced with increasing sulphate concentrations in the soil.

(vii) Boron: Haas (1929) in solution culture studies reported lemon seedlings to be more sensitive than orange seedlings to the effect of Boron. At concentration 1 ppm of Boron, there was slight injury to the lemon leaves. At 2 ppm all the lemon leaves showed injury but orange leaves remained unaffected. The injury became noticeable on orange leaves only when there was 3 ppm boron in nutrient solution. Eaton (1935) concluded that the ill effects of concentrations of boron or other salts were in a measure inter-related and additive. Eaton (1941) found a considerable overlapping beneficial and injurious effects of boron in as many as 50 species. Climate, light and temperature were found to be other agents affecting the dose which injures the crop. Fennman (1949) found that characteristic symptoms were caused in citrus by boron poisoning, if its content in the dry matter exceeded 500 ppm. Irregular yellowish areas developed between veins. Heavy leaf fall occurred during early spring. Cooper et al. (1958) found no evidence of boron toxicity as a primary factor in the decline of Webb Red Blush grapefruit on sour orange rootstock. Oertli (1960) found that in rough lemon the injurious concentrations of boron moved mainly into marginal and interveinal areas near the leaf tip, where concentrations could be 100 times as much as in petioles.

C. Effect of nutrients

(1) Nitrogen: In carefully controlled experiments with citrus plants, Chapman and Liebig (1940) found a close relationship between the degree of nitrogen starvation and greenness of leaves.
The results were further supported by Batchelor (1948) in citrus. Leonard et al. (1958-1959) reported from their studies with citrus that yellow veining (sometimes called winter chlorosis) was caused by nitrogen deficiency. This conclusion is supported by Leonard and Stewart (1961) who found lower nitrogen content in yellow veined than normal green leaves. By the application of nitrogen the Ca content increased but the reverse did not happen.

Iwasaki and Owada (1960) observed that nitrogen application in autumn minimised the alternate bearing habit in Satsuma orange and lemon, depending upon the nutritional status of the plant. Addition of phosphorus and potassium besides nitrogen had no effect.

Chapman (1951) reported that though citrus crops removed only 40 to 60 lbs of nitrogen per acre, the application of 200 to 400 lbs of nitrogen per acre was necessary. Smith et al. (1953) while experimenting on young Valencia orange in sand culture, found that nitrogen affected the growth and fruiting far more than potassium and magnesium. They further reported in 1954, that numerous interactions existed between nitrogen and potassium or magnesium, depending upon the concentration of various elements in both roots and leaves.

Haas (1937) observed that retarded top growth and injury to roots and leaves of Valencia cuttings resulted when nitrate exceeding 5 ppm was added to complete nutrient solutions. Lynch and Goldwebber (1957, 1958) found in Persian limes that interval of nitrogen application might affect yield, but did not affect the trunk increase.

According to Reuther and Smith (1950) zinc deficiency might be accentuated by high doses of nitrogen and potassium in oranges. Labanauskas et al. (1959) observed an increase in
manganese content of Valencia leaves when nitrogen was applied as ammonium sulphate instead as calcium nitrate. Nitrogen in all cases reduced the boron content of leaves.

Ford (1954) and Kuraoka et al. (1959) reported fewer number of feeder roots in citrus plants when the amount of nitrogen applied was high.

(ii) Phosphorus:— Citrus plants suffering from phosphorus deficiency have unthrifty foliage with irregularly shaped burnt spots and decreased fruit yields, while applications of phosphorus improved the colour and growth of foliage and also increased the fruit set [Haas (1936), Chapman and Brown (1941), Winisk (1950), Haas (1951), Aldrich and Cooney (1952), Embleton et al. (1952), Bingham and Martin (1955) and Domato and Ratkovic (1960)].

Chapman (1934) found that under certain conditions citrus plants may accumulate very high amount of inorganic phosphate within both the woody and the leaf tissues, without any influence upon the growth. But Chapman et al. (1937) showed that mottle leaf of citrus due to Zn deficiency could be aggravated by increasing the P supply in the nutrient medium; and that Fe deficiency symptoms could also be produced likewise. Haas (1936) secured better growth of citrus in solution cultures with an intermittent rather than a continuous supply of P.

Haas (1951) noted that the application of P to lemon gave response to both low and high range of its supply, while orange responded appreciably to low range supply and at the high range level of P, N deficiency symptoms developed. Haas and Brusca (1954) reported that P₂O₅ in the acid form improved root growth of Lisbon
lemon on sour orange stock when aluminium citrate was applied to the soils, but at higher levels small fruit formation was resulted. Valencia orange on rough lemon rootstock gave a maximum response to phosphate at 77.5 ppm. Their all these conclusions were based on studies on soil and sand cultures. Spencer (1958-59) found that Ruby Red grapefruits receiving P were smaller than trees receiving lime only on sandy soils with pH 4.5. Application of phosphate markedly reduced the concentration of feeder roots in the upper root zone. Similar depressing effects on root growth have been reported by Kuraoka et al. (1959) and Spencer (1958-59).

Rasmussen and Smith (1959-60) reported that orange seedlings might die within six days of planting, when the soil contained 2500 ppm of P derived from superphosphate or triple superphosphate. The death occurred owing to the deleterious effect of free acid in superphosphate; while rock phosphate had no effect at that concentration. Reuther et al. (1949) reported that heavy applications of phosphate were associated with increased accumulation of P, increased Ca content and decreased Mg content in the foliage of orange. Aldrich and Haas (1949) asserted that the K deficiency symptoms could also be caused by low P in lemon plants. The rootstock influenced P and K content of leaves. Labanauskas et al. (1959) associated the heavy applications of P to oranges with reduced leaf concentration of Cu and increased Mn and Fe contents. According to Spencer (1960), P, Ca and Mn content of leaves registered an increase by the application of superphosphate to grapefruit while, K, Mg, Fe, Cu, B and Al content decreased.

(iii) Potassium: Chapman et al. (1945) found that orange trees could apparently secure ample potassium from a low supply of 2 to 5 ppm, while with high supply of 350 to 400 ppm of K the trees
showed injury and at 117 ppm of K they showed no ill effect. Haas (1948) found that when the K content of citrus leaves was 0.2% it represented deficiency, whereas 1.0 per cent represented ample amount. He further observed that maintenance of an ample supply of K might be a possible means of delaying the effects of salinity in the leaves.

Aldrich and Coony (1952) found, in lemon trees showing leaf spot symptoms and unthrifty foliage with tip or marginal burn and some defoliations, the application of K did not affect the appearance of trees, but produced small consistent increases in yield. The application of P markedly improved the condition of leaves.

Martin et al. (1959) noted, in increasing concentrations of Na and K decreased growth of trifoliate orange seedlings, the effect being much more in clay loam soil. The effects of Na and K on growth were additive. Increasing Na in the soil decreased Ca and increased K percentage in the leaves.

Reed and Haas (1923) found, that various parts of K deficient orange trees showed subnormal amounts of K and greatly increased Ca content. Harding (1958) stated, that high K in the top 30 cm. of soil gave rise to Mg deficiency. According to Labanauskas et al. (1959) in the absence of P, the application of K reduced Mn & Zn and increased B content of Valencia leaves, though this effect was produced at high concentrations only. In Valencia orange, application of 20 lbs of K$_2$SO$_4$ per tree increased B and reduced Mn, but had no effect on the Zn, Cu or Fe contents. Reitz and Koo (1960) observed, that both N and K fertilization
caused Mg deficiency in Valencia orange leaves. Smith and Rasmussen (1961) observed the appearance of chlorosis with K deficiency in grapefruits.

According to Gallo et al. (1960) the scion leaves in citrus differed mainly in their K content. Leaf composition also varied with rootstocks. The K, Ca and Mg contents were significantly different with the scion on Pera and Cleopatra rootstocks.

(iv) Calcium: According to the findings of Batchelor (1948), Floyd (1917) and Reed and Haas (1923, 1925), lack of Ca caused a chlorosis, characterised by yellowing of veins, defoliation and dieback in citrus. Brusca and Haas (1956) stated that on both, sour orange and trifoliate orange rootstocks, the most marked effect when no Ca was added, was reduction in leaf size. By increasing the Ca level the Mg content of leaves was reduced.

Bain and Chapman (1940) reported vein chlorosis in leaves due to root decay caused by many factors including Ca deficiency.

In Ca starved citrus trees, Reed and Haas (1923) found a high K and low Ca content, however, in the woody tissues the Ca content was not much affected. Haas and Brusca (1954) stated that increase in Ca content decreased K content of the leaves of grapefruit on various stocks and of lemon on grapefruit.

Wallace (1955) indicated a relationship between Ca and Mg in the foliage and seeds of citrus plants. Similar relationship was observed by Jacoby (1961) who concluded that in C. aurantifolia, the impaired Mg uptake at low Mg : Ca ratio, leading to visual
symptoms of Mg deficiency, was due to excess of Ca rather than to deficiency of Mg.

(v) Magnesium: Haas (1948) observed, that healthy mature leaves of citrus in California orchards usually contained more than 0.5 per cent Mg on dry weight basis. The deficiency symptoms appeared at 0.2 per cent concentration of Mg. Bingham et al. (1956) have associated the deficiency symptoms of Mg with the Mg level below 0.2 per cent. It was primarily due to the translocation of Mg from the older leaves to the developing fruit and also to young leaves. Injury in the form of yellowing of leaves has also been described by Camp (1945).

Heymann (1961) reported, that chlorosis on Shamauti orange associated with Mg deficiency was alleviated by spraying with 2 to 4 per cent MgSO₄ supplemented by the addition of minor elements like Fe, Zn and Mn. But these micronutrients when applied alone did not improve the leaf colour.

Jacoby (1961) in a comprehensive experiment observed that dry matter in sweet lime seedlings did not vary by a change in Mg : Ca ratio. The sweet lime seedlings were less sensitive than sour orange seedlings to the low Mg : Ca ratio. Smith et al. (1955) also observed that on young Valencia orange, low Mg supply had no effect on total dry weight of the trees despite the deficiency symptoms on the foliage.

Jacoby (1961) observed a positive correlation between Mg & Ca in the growing medium. He is of the opinion that in Israel high values of exchangeable Ca/Mg in the soils impaired Mg uptake in orange more than slight differences in pH and CaCO₃.
Mc Colloch et al. (1957) established a high negative correlation between the exchangeable K : Mg in the soil and the percentage of Mg in the leaves.

(vi) Copper: - Woglum (1945) and Koltz and Middleton (1945) referred to severe injury caused by the use of Cu sprays in the form of leaf pittings especially on the under side, fruit pittings and twig dieback. Lemon, oranges and grapefruit all showed susceptibility.

Reitz and Shimp (1953) reported that at high Cu levels, the toxic effects of sulphate and oxide forms were equal and Cleopatra accumulated less Cu in the leaves than sour orange and rough lemon. Smith and Specht (1953) stated that out of Cu, Zn and Mn, the first was the most toxic element and toxicity occurred in the lowest concentration in the plants.

According to Reuther and Smith (1955), Cu appeared to be 50 times more toxic than Mn and 12 to 25 times more toxic than Zn in citrus.

Dikshit (1958), Singh and Singh (1953) and Dutt (1962) have reported beneficial effects of Cu sprays in curing citrus chlorosis.

Rodriguez and Gallo (1960) reported that critical level for copper deficiency in leaves of Pera orange was between 2.8 and 6.7 ppm. They further emphasised the influence of rootstock on the Cu content of leaves. Majorna (1960) reported that foliar content of sweet orange and Mandarin was 5.5 ppm in leaves showing deficiency and 7.5 ppm in those without showing visible symptoms and 10.6 ppm in healthy trees. Brayon (1958) reported that Cu requirements for citrus were less than 1 ppm of available Cu in normal soils and
3 to 5 ppm in soils with high P.

Reuther et al. (1949) associated the decrease in Cu accumulation in leaves with heavy applications of P. Similar results were obtained by Bingham and Martin (1955).

According to Smith and Rasmussen (1959) Cu tended to repress the uptake of Zn or Mn, while Mn did not show similar effect. Reuther and Smith (1952) reported that Cu was more potent than either Zn or Mn in producing Fe chlorosis in citrus, and abnormal root development, especially at low pH.

Reuther et al. (1955) reported that in sandy soils much lower levels of Cu proved toxic to citrus seedlings than in heavy soils. Heavy liming greatly reduced the toxicity of Cu.

(vii) Zinc:—Deficiency of Zinc in citrus orchards occurs almost in every citrus growing area of the world. The zinc deficiency symptoms consisting of yellowing of interveinal areas and twig dieback etc. have been described in detail by Batchelor (1948), Parker (1957), Parker (1954), Chowdhry (1954), Russo and Raciti (1955), Scaramuzzi (1956), and Dikshit (1958).

Brusca and Haas (1959) in soil and sand culture experiments with minor elements, reported that Zn at 0.2 ppm prevented the occurrence of mottle leaf and stimulated the growth of young lemon plant. The growth of lemon did not appear to be retarded by Zn concentration up to 15 ppm. Chapman (1952) stated that excessive Zn added to solution and sand culture produced Fe deficiency symptoms in the leaves of lemon and orange plants. Similar results were reported by Smith and Specht (1953).

In Foggia province, on the Cargano coast, three
different types of leaf abnormalities were observed on orange and lemons. The most important one was due to Zn deficiency accompanied apparently by deficiencies of both Mg and Mn as reported by Scaramuzi (1956).

Kanwar and Randhawa (1968) while comparing healthy and chlorotic citrus leaves and soils having normal and chlorotic citrus plants, reported that besides salinity, higher uptake of P and Mn, resulting in deficiency of Zn and probably of Fe is responsible for this malady. Dhingra and Kanwar (1965) have also reported that soils having chlorotic citrus plants are deficient in exchangeable Cu, Zn and Fe and high in K and Ca. Kanwar and Dhingra (1961, 1962), Healy (1952), Brusca and Haas (1959), Singh and Aggarwal (1961), and Dikshit (1955) have recommended spray of ZnSO₄ as a control measure against citrus chlorosis. Lewis (1946) pointed out injury to citrus, caused by Zn added to spray lime sulphur spray. Kanwar et al. (1963) in the Punjab concluded that if the concentration of Zn in one year old citrus leaves falls below 16.95 + 5.20 ppm, there is an evidence of Zn deficiency.

Reuther et al. (1949) found that heavy P application was associated with increased accumulation of Zn in orange leaves. Bingham and Martin (1955) on the other hand observed that Zn was reduced to deficiency level by excess P, but Bingham et al. (1956) reported that Zn uptake was reduced only when exceedingly large contents of P were added.

(viii) Iron: Occurrence of Fe deficiency in citrus plantations have been reported by Batchelor (1948), Chowdhry (1954), Bingham and Martin (1955) and Kanwar and Dhingra (1961). Yellowing of interveinal areas with a fine net work of green veins has been
described as a prominent symptom. The leaves become progressively smaller with continued deficiency of Fe and new growth eventually ceases. During the process of recovery by the application of Fe, small specks of green tissue appear in the leaves.

From the leaf analysis figures given by various workers it can be concluded that the Fe content is extremely variable. Kuykendall (1955) reported that trees grafted on rough lemon had higher Fe content of leaves than those on sour orange. Valencia had highest average Fe content and Pineapple and Temple Orange relatively low content. The mean Fe content in leaf was found to be 66.6 ppm. In Sicily, lime induced chlorotic leaves showed Fe content below 5.5 ppm, while healthy leaves contained more than 68 ppm (Raciti, 1956).

Reuther et al. (1949), Bingham and Martin (1955) and Bingham et al. (1958) reported that the application of excess P did not affect the uptake of Fe much. Reuther and Smith (1952) associated high concentrations of Cu, Mn and P in the top soil, with Fe chlorosis. Similarly, Smith and Specht (1954) reported that excessive quantities of Cu, Zn and Mn led to a reduced concentration of Fe in the top, but not in the roots of Valencia seedlings.

Ford (1954) concluded that chlorotic orange trees had a lesser number of feeder roots.

Cooper et al. (1954) stated that species of citrus differed in their susceptibility to chlorosis on calcareous as well as noncalcareous soils.
Manganese:— Occurrence of Mn deficiency has been reported by Chawdhry (1954), Mukherjee (1949), Govinda and Redy (1957) and Dikshit (1958). In Punjab, Kanwar and Randhawa (1960) have suggested that its excessive absorption resulted in deficiencies of Zn, Cu, and Fe. Haas (1952), Chapman et al. (1959) and Parker et al. (1946) have given for citrus plants the symptoms due to Mn deficiency as small light green spots on the leaves, resinous surface excrescence and injury to terminal growth.

According to Arnon (1938), Mn could apparently compensate to some degree, the lack of oxygen in nutrient medium.

Chapman et al. (1939) showed that citrus leaves affected with Mn deficiency contained much lower Mn than healthy green leaves.

Boron:— Haas (1946) reported that the effect of boron deficiency in citrus varied with the species.

Roy (1943) found that application of a large amount of soluble arsenic to boron sufficient grapefruit trees results in symptoms characteristic of B deficiency.

Wilson (1951) thought that visible symptoms were not reliable as a guide to B deficiency. In trials conducted by Smith (1954) on bearing citrus trees, the leaves did not show severe B deficiency symptoms, although leaf analysis revealed low B content.