Chapter-II

REVIEW OF LITERATURE
EFFECT OF CONCENTRATION OF NAPHTHALENE ACETIC ACID (NAA)

Auxin synthesis occurs in shoot tip region (particularly young expanding leaves of the apical bud), developing embryos, developing fruit etc. The auxin synthesis occurs rapidly in green leaves in the presence of light than in dark. The velocity of auxin transport (1 to 1.5 cm/n) in stems and coleoptiles is about ten times faster than diffusions. Auxin promotes growth of shoots at a relatively higher concentration and that of root at a very low concentration (Pandey and Sinha 1995).

VEGETATIVE GROWTH AND FLOWERING

Saito (1975) observed that the treatment of eggplant seedlings with NAA at 10 ppm, 6 times at 4 days intervals retarded growth, number of leaves, flower bud differentiation and decreased the number of flower clusters. Mote et al. (1975) stated that when Planofix (NAA) was sprayed at 10, 20 and 50 ppm on chilli plants, the flower drop was reduced considerably. They also noted that as the concentration of Planofix was increased the flower drop decreased proportionately. Chandra et al. (1976) reported that in 2 year trials, capsicum were sprayed with Planofix (NAA) at 5, 10 or 15 ppm at flower initiation and 15 days later (peak flowering). The percentage of flower drop was reduced and the best results were obtained with 10 ppm concentration.
Sharma et al. (1977) studied the relative effect of 10, 20, 30 or 40 ppm NAA on chillies cv. NP-46-A and reported an increase in plant size due to the application of 10 ppm planofix (NAA). Satyanarayan Rao et al. (1977) conducted experiments with Pusa early dwarf variety of tomato during 1974-75 to study the effect of two starters both in solution and dry form, then NAA at two concentration (0.1 & 0.2 ppm). The number of flower clusters and fruit per plant were increased. Warde and Singh (1977) stated that planofix (H-5% NAA) at 100, 200 & 300 ppm was applied as a seed treatment and as a foliar spray at 4-6 leaf stage at the first bud stage and at flowering. Planofix treatment resulted in earlier flowering. Planofix at 200 ppm applied at flowering gave the highest flowering (70.5%) over control. Kamruddin et al. (1978) stated that the application of 10 ppm planofix (NAA) on tomato increased significantly the plant height.

Patil and Ballal (1980) reported that in trials with the capsicum cvs. NP-46A the seeds were soaked in GA or NAA solution, each at 20-30 ppm & the plants were later sprayed with NAA at 50 ppm at the beginning of flowering and 20 days later. The flower drop was reduced significantly and gave highest percentage of fruit-set. Onofeghara (1981) stated that when tomato seedlings were sprayed with NAA at 25 & 50 ppm flowering was promoted and number of flower primodia increased from 10 in water controls upto 40 per plant.
Barholla et al. (1982) stated the application of planofix at 20 ppm concentration significantly increased the plant height and fruit set in chillies.

Yamgar and Desai (1987) reported that when NAA was sprayed 3 times with 5 concentrations and a commercial NNA formulation (planofix) the percentage of short styled flowers (generally, the only type flowers to set fruit) was significantly influenced by type of chemical, concentration, time of spraying and interactions between these factors. In general, lower concentrations and earlier sprayings gave higher percentage of short styled flowers. The highest percentage (94.2%) was achieved with NAA at 120 ppm concentration applied on the 20th day after transplanting. Usha and Peter (1988) reported that NAA was applied at 15, 30 and 45 ppm concentration at 60 days after planting. The highest reductions in flower drop in the monsoon season was obtained with 15 ppm NAA in chillies.

Dodd et al. (1989) reported that when NAA was applied to capsicum cv. Pusa Jawala at 50 or 100 ppm concentration the plant height, number of branches, stem diameter, width of leaves and leaf area were increased significantly over control. Doddamani and Panchal (1989) stated that the application of NAA at 10 ppm concentration significantly increased the plant height (99.38 cm.) and fruit set in chillies.
Katewale and Saroj (1990) studied the relative effect of 0, 10, 20 and 40 ppm NAA applying as foliar sprays one month after transplanting and again after 20 days. The application of NAA at all levels produced significant increases in the plant height, girth and spread in chillies.

Zeenat et al. (1990) An experiment was carried out on tomato cv. Pusa Ruby seedlings raised in nursery beds and transferred to pots after 4 weeks. The n2-fixing cyanobacterium, Aulosira fertilissima, the non N2-fixing cyanobacterium, Spirulina subsalsa, and the chemical fertilizer, diammonium phosphate (DAP) were applied in various combinations to the tomato seedlings 4 times at 7 day intervals. Highest plant FW (289.98) g., number of leaves/plant (126.6), number of flowers/plant (28.6), number of fruits/plant (36.6) and FW of fruits/plant (70.95) g. were obtained with the application of 2.25 g Aulosira + 2.25 g Spirulina + 0.5g DAP/Pot. This represents a 522% increase in number of fruits and 977% increase in yield over the control. Neither cyanobacteria nor DAP when applied alone produced significant increases in yield.

Jankiewicz et al. (1991) studied with the cultivars stano and ercka, some plants were grown in a greenhouse and some in a plastic clad tunnel. Several growth regulators were applied daily as droplets of solution to emasculated flowers on 5 consecutive days. Partheocarpy was stimulated best with GA3 at 100 mg/dcm³. Other
growth regulators, such as NAA, NOA, benzolinon or putrescine, added to GA3 did not markedly improve its effect on fruit set. Almost all flowers treated with BA alone at 30 mg/dcm³ dropped, and a high percentage of flower abscission also occurred after treatment with benzolinon at 50 mg/dcm³. The parthenocarpic seedless fruits obtained with GA3 treatment were almost always malformed and smaller than the seeded control fruits. Addition of NAA at 10-40 mg/dcm³ to GA3 increased fruit size compared with GA3 alone. The presence of developing seedless and seeded fruits inhibited the formation of new reproductive organs and led to their abscission.

Singh et al. (1994) reported that the best fruit setting during the summer was obtained by application of 20 ppm NAA. Revanappa et al. (1998) Conducted a field experiment at Dharwad on green chilli cultivars Pusa Jawala, plants were sprayed twice with 5 or 10 ppm cytokinin (unspecified), or 10 or 20 ppm NAA, twice, on the 35th and 45th days after transplanting. Significant cultivars differences were noticed regarding root parameters, flowering and yield. Highest yield (102.39q/ha in summer and 116.16 q/ha in Kharif) was seen in Nagavi, which had the highest root weight. Pusa Jwala had the longest roots. Nagavi was the last to complete 50% flowering. NAA treatments gave has highest yields with better root parameters.

Joshi and Singh (2001) An experiment conducted on chilli cv. Pant C-1 with NAA (20, 40 and 60 ppm Conc.). Data were recorded for
total leaf area per plant, shoot fresh weight, shoot dry weight, root fresh weight, root dry weight, pollen variability, number of seeds per fruit, weight of seeds fruit dry weight and fruit yield per plant. The highest total leaf area (297.90 cm$^2$) was recorded in NAA at 40 ppm. All the concentrations significantly increased fruit yield per plant over the control. The yield increases due to more number of fruits per plant, higher percentage of fruit set per plant and higher values for fruit length and thickness.

**YIELD AND FRUIT QUALITY**

*Pandita et al. (1976)* reported that the application of NAA at 50 ppm concentration significantly increased the vitamin C and fruit TSS. *Kaushik et al. (1977)* reported that the solutions of NAA at 10 or 100 mg/l were sprayed on tomato plants at the 2-leaf stage and the treatment continued weekly until the 5 leaf stage. The total yield was significantly increased with the highest NAA concentration.

*Pandita et al. (1980)* stated that in three years trials with the capsicum cvs. NP 46A and one years trials with the Cvs. Pusa Jwala, Planofix (NAA) at 5-20 ppm concentration was applied once at the beginning of flowering and twice by applying it again 3 weeks later. In both cvs. The highest yield (103-107 q/ha) was obtained from plants sprayed twice with 10 ppm planofix.

*Barholla et al. (1982)* reported that NAA at 20 ppm concentration increased the yield significantly in chillies.
Patil et al. (1985) observed that in cultivars of chilli spraying with NAA at 20 ppm concentration at first flowers opening following by two sprays at an interval of 30 days was most effective in increasing the yield, ascorbic acid content, carbohydrate, protein and fat of chilli fruits.

Sumiati (1987) reported that the tomato cultivars Gondol, money marker, Intan and Ratna were sprayed with 1000 ppm chlorfurenol, 100 ppm IAA, 50 ppm NAA or 10 ppm GA3 or left untreated. The per plant and total fruit weight/ha were significantly increased in cv. Money maker treated with 50 ppm NAA or 100 IAA, but not in the other cultivars. Dod et al. (1989) found that NAA at 50 or 100 ppm concentrations increased the total yield in capsicum cultivar Pusa Jawala. The best results were obtained with the 100 ppm NAA. Doddamani and Panchal (1989) reported that NAA (10 ppm) was applied as foliar spray before flowering. The fruit yield (13.93q/ha) fruit length (12.01cm and fruit thickness 13.00 mm) was significantly increased with the NAA treatment in chillies.

Katewal and Saroj (1990) stated that the seedlings of capsicum annuum were treated with NAA at 0, 10, 20 and 40 ppm concentrations as foliar sprays one month after transplanting and there after at 20 day intervals. Application of NAA at all levels produced significant increases in all characters. The highest yield
(268.25 q/ha) was obtained with 40 ppm NAA and lowest yield (34-80 q/ha) was noted under control.

Phookan et al. (1991) reported that the four different concentrations of CCC (500, 1000, 1200 or 1500 ppm) and NAA (10, 20, 30 or 40 ppm) were applied to the tomato variety Pusa early dwarf at flowering stage. The highest yield was obtained with 10 and 20 ppm NAA (779.52 and 651.34 q/ha) respectively. Lata and Singh (1993) reported that yield of chilli variety Pant C-1 was increased with spray of NAA (40 ppm). The fruit length, fruit diameter, number of fruit per plant and fresh weight of fruit per plant were also increased with spray of 40 ppm NAA. Singh et al. (1994) reported that significantly increased yield of chilli during the summer was obtained by the application of 20 ppm NAA.

Belakbir et al. (1998) studied the effectiveness of different bio-regulators for enhancing capsicum yield and fruit quality in green house in spain. The commercial bio-regulators CCC (chloromequat chloride), NAA GA₃ and Biozyme R (GA₃ + IAA + Zeatin + Micro nutrients) were sprayed on to plants at flower initiation, followed by 2 additional applications at 30 day intervals. Biozyme increased yields, but 40% of the fruits were not marketable. Any treatments did not affect fruit firmness compared with the control. NAA produced the highest yield of marketable fruits. The treatments could not affect the fruit Ca or pH.
Revanappa and Nalawadi (1998) reported that 5 week old seedlings of 3 new chilli (Capsicum) cultivars (Pusa Jwala, Nagavi and Kadrolli) were treated with cytokinin (5 or 10 ppm), NAA (10 or 20 ppm), or water (control). Nagavi developed the most primary, secondary and tertiary branches and had the highest yields in the summer and kharif seasons. NAA at 20 ppm produced the largest number of branches in both seasons with the consequent response of increased fresh weight and yield. There were no significant interactions between genotype, season and treatment except for secondary branching in the kharif season.

Joshi et al (1999) an experiment was conducted during 1997 in Pant Nagar, Uttar Pradesh, India, to determine the suitable and optimum concentration of plant bio-regulators for chilli cv. Pant C-1. The plant bio-regulators, i.e. NAA at 20, 40 and 60 ppm; GA3 at 10, 20 and 30 ppm; ethephon at 50, 100 and 150 ppm; 2,4-D at 2,4 and 6 ppm; and paclobutrazol at 100, 200 and 300 ppm concentrations along with a control (Water spray) were used as foliar spray at flower bud initiation and 20 days later. Results revealed that paclobutrazol at 300 ppm, 2,4-D at 2 ppm and NAA at 40 ppm were the most suitable for summer season crop chilli. NAA at 60 ppm, 2,4-D at 4 and 6 ppm had an adverse effect on yield as well as growth characters.

Pundir and Yadav (2001) stated that the NAA application increased the total soluble solid percentage significantly in tomato crop.
Balraj et al. (2002) reported that NAA at 20 ppm was the best for improving yield. The yield was highest when NAA at 20 ppm was applied at 35 and 50 DAT. Sridhar and Koti (2003) made a comparative study of 15 treatments comprising NAA and mepigquat chloride at different concentrations and applied at different stages of growth of bell pepper. It was concluded from the experiment that NAA at all concentrations and at all the stages affected the growth characteristics like leaf area, leaf area index and plant height and yield characteristics positively.

**EFFECT OF CONCENTRATION OF GIBBERELLIC ACID**

It was first known by a Japanese farmer Konishi (1898) but kurosava working in farmosa discovered GA in 1926. It was first extract from the asamycetons fungus gibberella fujikuroi the causal organism of foolish seedling of rice. Gibberellin moves readily in all directions and in all tissues including phloem and xylem. These are synthesized by young leaves (major site) roots and immature seeds (embryo). GA moves in the same pattern as the carbohydrates translocation system and with a similar velocity (5 cm/h).

Gibberellic acid stimulates conversion of storage polymers (Polysaccharides, Proteins and fats) into sucrose or mobile amino acid or amides to facilitate their translocation via phloem in to through out the young root and shoots.
VEGETATIVE GROWTH AND FLOWERING

Aung and Byrne (1976) found that apical application of varying concentrations of gibberellin A4/7 promoted hypocotyl and cotyledonary growth in tomato seedlings. GA 4/7 significantly increased both the length and width of cortical cells.

Pandey et al. (1980) The most important effect of GA is the stem elongation. i.e. GA reduces internodal elongation or sub-apical elongation. It has been confirmed on several plants such as tomato, pepper etc. In these plants a significant elongation of internodes is reported. A rosette habit showing in cabbage grows 2 m tall and produce. Flowers after treated with GA.

Patil and Ballal (1980) reported that soaking of chilli seeds in 20 or 40 ppm GA increased the germination. Maurya et al. (1985) worked at the BHU Varanasi in summer season of 1983 to study the use of gibberellic acid on okra. The height of plant increased with foliar spray of 50 ppm gibberellic acid but declined with the increase in treatments.

Mohan and Sinha (1988) Noted significant effect of GA on flowering and fruiting of tomato increase in GA up to 20 ppm caused an increase in height of the plants, length of the internodes and girth of stem. Flowering in tomato plants took place at about 15 days earlier at 5 and 20 ppm GA and about 8 days earlier at 80 ppm GA level in comparison to that in control and other level of GA.
Sharma et al. (1992) reported that the plants of brinjal (Solanum melongena L.) cv. pusa purple long were treated with GA3. The plants sprayed with 300 GA3 flowered earliest. El-Abd-SO et al. (1995) studied that all concentrations of IAA, GA3, ACC and ABA induced early fruit set compared with controls sprayed with distilled water. For the first of the 2 crops, the highest BA concentration (10.5 M) accelerated fruit set, but the other two conc. delayed it for the second crop, however, all BA treatments accelerated fruit set. BA applications also retarded bed fruit colour formation, more 50 at increasing concentrations. GA3 led to the formation of leafy clusters, with the number of leaves formed increasing with GA3 concentration.

Ahmed and Tahir (1996) reported that the plant of okra cv. "Pusa Kranti" grown in pots sprayed with 100 ppm GA3 twice (3 and 4 weeks after planting). They observed significantly increased number of leaves and shoot growth.

Shittu and Adeleke (1999) found that foliar application of gibberellic acid (GA3; 0, 10, 25 or 50 ppm) on growth and development of tomatoes sowing in pots were investigated plant height and number of leaves, buds and flowers were significantly enhanced my GA3 treatment. Plants treated with GA3 at 25 ppm were the tallest with the highest number of leaves. Plants treated with GA3 at 10 ppm had the most buds and flowers. GA3 promoted fruit set and plants treated with GA3 at 50 ppm had the highest number of fruits 12 weeks after.
Balraj et al. (2002) the plant growth regulators were sprayed at 35 and 50 days after transplanting (DAT) and at both 35 and 50 DAT. GA at 20 ppm was best treatment for improving plant height and number of branches, while application of plant growth regulators at both 35 and 50 and DAT was the most efficient for improving the growth and yield of the plants.

YIELD AND FRUIT QUALITY

Patil and Ballal (1980) conducted traits with the capsicum cv. NP-46- A in which the seeds were soaked in GA solutions at 20-40 ppm and the plants were later sprayed at the beginning of flowering and again 20 days later. Good reduction in flower drop and highest yield (58.5% over the control) were obtained from plants whose seeds were treated with GA at 40 ppm with 2 subsequent foliar applications of NAA. Pandey et al. (1980) conducted experiment to evaluate various growth regulators on frost affected plants of tomato varieties HS-101, HS-102, Pusa Ruby and 5-12 during 1977-78 at the experimental farm of the deptt. of vegetable crops HAU Hisar in order to get in early crop. GA at 25 ppm concentration produced maximum fruit yield.

Maurya et al. (1985) worked at the BHU Varanasi in summer season to study the effect of GA on okra. The number of fruits per plant and yield were increased (22.42 q/ha) with foliar spray of 50 ppm GA but declined with the increase in treatments.
Patil et al. (1985) reported that the yield attributes, yield and quality of fruits of capsicum were improved by foliar spray of 10 ppm GA. Mohan and Singh (1988) Fruit size of tomato was increased with increase up to 20 ppm in GA spray level. Dry matter yield of tomato plant tops at 100 days and of fruits were increased with the increase in GA up to 5 ppm level. Over all the ascorbic acid content of tomato fruits was found to be maximum at 20 ppm GA level at all the stages of growth. Kumar et al. (1988) reported that fruit quality of tomato cv. HS 10-1 remained unaffected by the treatments with different concentrations of GA. Shanmugavelu (1989) reported that gibberellic acid was found to produce the largest number of fruits of Brinjal (17.75) at 50 ppm followed by control (3.00) these sprays of GA significantly improved the quality of tomato fruits.

Ramanandam et al. (1991) reported that the application of GA3 at 100 ppm concentration significantly increased in percentage of fruit set and fruit yield of brinjal plants. El-Asdoudi and Ouf (1993) Concluded that tomato cv. carmelle seeds were sown on 15 Nov. in plastic green houses at Mariut near Alexandria in Egypt and planted out when 16 cm high on 21 Dec. 1, 2 or 3 whole plant sprays of GA3 (10, 15, 25, 50 or 100 ppm) were given at 15 day intervals, between 7.00 and 8.00 h when RH was high. Three sprays of 100 ppm. GA3 gave the highest early yield and one spray of 15 ppm gave the highest total yield. Three sprays of 50 ppm produced the tallest plants. In general, the sprays decreased fruit volume and number of seeds/fruit
(3 sprays of 50 ppm resulted in seedless fruits). The treatments produced no consistent trend in number of fruits /plant or citric acid content. Kar et al. (1993) Stated that GA₃ (50, 75 or 100 ppm) was applied to tomato cv. pusa early dwarf by presoaking seeds with or without a foliar spray at 30 DAT. Overall, the application as a seed pre-soaking + spray save the best fruit retention and yield.

Ahmed and Tahir (1996) reported that the plant of okra cv. Pusa Kranti grown in pots were sprayed with 100 ppm GA₃ twice (3 and 4 weeks after planting). The number of fruits and weight of fruit were increased significantly. Gulshanlal and Lal (1998) reported that the treated plants of okra with 150 ppm GA₃ gave the highest seed yield (20.4 and 19.4 q/ha, respectively), which were 7.9 and 6.9 q/ha higher than the control. Barai and Sarkar (1999) studied that GA₃ (10, 25, 50 or ppm) were applied to transplanted seedlings of chilli (Capsicum annum) cultivars var.- 13, var.- 29 and var.- 4 in an attempt to control premature flower and fruit drop. GA₃ treatments showed encouraging effect on the retention of flowers, fruit setting and increase of fruit weight.

Arora et al. (2000) conducted a laboratory study to evaluate the effect of GA₃ treatment on the shelf life of chilli cv. Pusa Jwala. Chilli fruits were treated with 0, 50, 100 and 200 ppm GA₃ for 10 minutes and air dried before packing data on physiological loss in weight (PLW), fruit decay loss, total chlorophyll and vitamin - C
content were recorded at 5 day intervals until day 25. PLW increased with increasing period of storage in all treatments with GA3 at 200 ppm exhibiting the lowest PLW (20.8 % on the 25th day storage, compared with 33.4 % in the control). Decay loss increased with increasing period of storage, in all treatments. No decay loss was observed on the 5th day of storage, but the highest decay loss on the 25th day of storage, was observed in the control (12.7%) compared with GA3 treated fruits. Total chlorophyll content decreased during storage in all treatments the highest chlorophyll content on the 25th day of storage (1.6mg /100g) was recorded with GA3 at 200 ppm. Ascorbic acid content increased with increasing period of storage the highest (165 mg/100g) being observed with GA3 at 100 and 200 ppm on the 25th day of storage.

**Pundir and Yadav (2001)** reported that GA3 at 25 ppm significantly increased the yield and yield components and also improved the quality of tomato var. Punjab Chhuhara.

**Sorte et al. (2001)** reported that the effect of plant growth regulators on growth, yield and quality of aubergine cultivars Aruna, Manjri Gota, Pusa Purple Round and Vaishali was investigated in a field experiment conducted in Nagpur, Maharashtra, India, during 1999-2000. Sowing was done on 31 July 1999 and uniform and healthy 43 days old seedlings were transplanted in the field at 0.75x0.60 m spacing. The Plants were sprayed at 4th and 8th weeks
after transplanting with 2 growth regulators. Gibberellic acid (GA) and IAA, each at 100 and 200 ppm concentrations along with water spray (control). Pusa Purple Round sprayed with 200 ppm GA showed the greatest growth in terms of height, branches, spread, weight, number and size (length and diameter) of fruits per plant resulting in the highest yield of 257.55 fruits/ha.

Pelt- RS-Van et al. (2002) determine the efficiency of plant growth regulator (PGR) and plant growth enhancer (PGE) application on the production of paprika cayenne pepper (C. annuum) cultivars. The peppers used for the 1997 study were paprika cultivar B-18 and Sonara, and the Cayenne cv. Durkee. All trials in 1998 were conducted on paprika cv. B-18. The PGRs investigated during 1997 were PGR-IV (at 0.14 litre/ha), an IBA and gibberellic acid (GA) combination product and cytoplex (at 0.28 litre/ha), an IBA/ GAA/ cytokinin combination product. The PGRs investigated during 1998 were PGV-IV and early Harvest (at 0.22 litre/ha) an IBA/ GAA/ cytokinin product. The PGE investigated in both years was crop + 2 (at 2.34 litre/ha) in combination with cytofred (at 2.34 litre/ha), which are both mixes of fermentation products with Macro and micro nutrients. The results indicate that application of PGRs or the PGEs tested can improve yields of paprika or cayenne peppers under production conditions. Even though mean yield differences were some times not significant. They were sufficient to more than pay for the material and application costs and provide the producer with increases in profit.
The consistent increase in yield occurring without reduction in quality. Warrant their use in production of paprika and cayenne.

**EFFECT OF DI-AMMONIUM PHOSPHATE**

**GROWTH AND FLOWERING**

Leboudi *et al.* (1976) found that the foliar application of urea (1.71%) and single super phosphate (1.9%) on the plant of tomato resulted in higher plant dry matter content in treated plant. Split application of nitrogen coinciding with growth stages according to the needs of foliar application of nitrogen have been found encouraging in improving the efficiency of applied nitrogen in chilli (*Dod et al.* 1983).

Pathak *et al.* (1985) conducted an experiment to compare soil and foliar application of DAP on chickpea, using 6 treatments of DAP (No, DAP, one, two and three sprays of 5% DAP, 100 kg DAP basal and 100 kg DAP (½ basal and ½ foliar). They found that DAP at 100 kg/ha (½ soil and ½ foliar) gave significantly more seed yield than other treatments. Maurya *et al.* (1985) found that the height of plant of okra increased with the foliar spray of 2.0% urea.

Tayo (1986) worked on cowpea (*vigna unguiculata*) and suggested that concentration of 25-30 mg/litre of urea applied as foliar spray during reproductive stage. It produced more seed yield and accumulated more dry matter in leaves, stem and root than application of 50-100 mg N/litre concentration.
Doddamani and Panchal (1989) reported that the 1% DAP was applied as foliar spray before flowering. Greatest plant height and highest percent fruit set were obtained with the DAP treatment.

Katewale and Saroj (1990) reported that the urea at 0.1 and 1.5% was applied as foliar sprays at one month after transplanting. Green chillies were harvested 110 days after transplanting and thereafter at 20 days intervals. Spray of urea at all levels increases plant height, girth and spread.

Davis and Linderman (1991) reported that the seedlings of *C. annum* cv. Early Bountful were grown in containers of river sand inoculated or without inoculation. Long Ashton Nutrient Solution (LANS) were modified to supply P at 11, 22 or 44 mg/ml after 42 days plants were evaluated for growth, development and leaf elemental contents. The short term effects occurred with P treatments. They found increasing P supply increased the leaf area and shoot of plant.

Sharma (1994) concluded that the maximum values with respect to plant height and number of branches per plant were obtained at 20kg N/ha as foliar spray on tomato.

Sharma *et al.* (1995) reported that the nitrogen (25 kg N foliage) was foliar spray. Spray of nitrogen produced increases in plant height, number of green leaves and fresh weight of plant chillies.
YIELD AND FRUIT QUALITY

Verlodt and Boesan (1977) stated that ammonium nitrate was sprayed at 2.5% concentration on tomato cvs. Venturea, campbell 1327, spenoma, V.F. 198 and Petmoech. The yield average 55 t/ha was significantly higher over control. Shinohara et al. (1980) reported that the urea (17.3ppm) was sprayed on tomato plant cv. Suiko. The average tomato fruit weight was greatest with the urea foliar treatment. Ascorbic acid was also remarkably high (40 mg in fresh weight).

Pathak et al. (1985) found that DAP at 100 kg/ha (½ soil and ½ foliar) gave significantly more seed yield than other treatments in chickpea. Das and Singh (1989) conducted experiment on tomato cv. LE-79. Thirty days old seedlings were transplanted in the 1st week of Nov., nitrogen was applied as a basal dressing (40 kg/ha), top-dressing (20 or 40 kg/ha) and foliar spray (10, 20 & 30 kg/ha) alone or in various combinations. Significant increase in the total number of fruits/plant and fruit yield were obtained with N applied with N foliar spray.

Doddamani and Panchal (1989) found that DAP (1%) was applied as foliar sprays before flowering in chilies. The fruit yield, number of fruits/plant, fruit length and fruit thickness were increased.
Zeenat-Rizvi et al. (1990) an experiment was carried out on tomato cv. Pusa Ruby seedlings raised in nursery beds and transplanted to pots after 4 weeks. The N₂ fixing Cyanobacterium aulosira fertilissima, the non N₂-fixing Cyanobacterium, spirulina subsalsa, and the chemical fertilizer, di-ammonium phosphate [DAP] were applied in various combination to the tomato seedlings 4 times at 7-day intervals. Highest plant Fw [289.98gm], number of leaves /plant [126.6] number of flower/plant [28.6], number of fruits/plant [36.6] and Fw of fruits/ plant [70.55g] were obtained with the application, of 2.25g Aulosira +2.25g spirulina +0.5 g DAP/pot. This represents 522% increase in number of fruits and a 977% increase in yield over the control. Neither Cyanobacterium nor DAP when applied alone produced significant increases in yield.

Avakyan et al. (1991) reported that the changes in the leaf and fruit composition of tomato receiving various fertilizers treatments (Variable N, constant P and K were studied by means) of correlation analysis. Decreasing protein content in leaves during growth was correlated with change in the carbohydrate, P and K concentrations. The favorable effect of increased rates of N fertilizer noted could be due to the development of a considerable assimilating surface during the first half of the growing period and a non limiting protein supply during the second half. Alan et al. (1994) found that the foliar application of 0.2% Nitrozyme on the plants of determinate tomato cv. Sakata F₁ 0524 resulted in higher fruit yield per plant (3946
gm/plant). It was calculated that maximum values with respect to number of fruit per plant, seed yield per plot and low seed weight were obtained at 20 kg N/ha as foliar spray.

**Basavaraja et al. (1998)** experiments were conducted during kharif at Hanumanamatti, Karnataka, India to assess the agronomic efficiency of nitrogen fertilizers and graded rates of potash on chilli (*capsicum annum*) crop yield. N was supplied as di-ammonium phosphate (DAP) + calcium ammonium nitrate (CAN) or urea. K was supplied at rates of 0, 25, 50, 75 and 100 kg/ha. Pooled data for 2 years (1995 and 1996) indicated that the highest dry chilli pod yield of 586 kg/ha was recorded with DAP + CAN compared with area alone (460 kg/ha). K application at 50, 75 or 100 kg/ha gave the highest pod yields compared with 0 or 25 kg/ha. DAP + CAN application increased fruit, ascorbic acid content but reduced percentage whitened fruits and percentage disease incidence anthraenase (*Fusotrichium sp.*) and powdery mildew (*Leveillula taurica*) compared with area application. Highest gross returns and B:C (benefit:cost) ratio were observed with DAP+CAN. K at 75kg/ha gave the highest gross returns and B:C ratio.

**Guertal (2000)** conducted a field trial on slow-release N materials used to reduce N leaching losses from sandy soils and extend N availability over a growing season. By this examine the effectiveness of pre plant sulfur-coated urea (scu) and polyolefin resin coated urea (pcu) N fertilizers compared split applications of soluble
fertilizer on green bell pepper (capsicum annuum) yield and quality. The 3-year experiment consisted of green bell peppers grown on 15 cm raised beds using plastic mulch and drip irrigation. Treatments were N source (pre plant scu, pcu and ammonium nitrate) and N rate (90, 135, 180 or 225 kg/ha). Ammonium nitrate was applied as a split application, which 20% pre plant and 80% applied every other week in five equal applications. Other N sources were applied 100% before planting. A zero N control was also included. Collected data included plant height, leaf N content, fruit yield & quality. In two of three years pepper yield was maximized at rate of 135 kg N/ha. Nitrogen source rarely affected the partitioning of harvested peppers into grade groups. Adding N from any N source decreased percent non-marketable yield (cull) and increased the percentage of marketable yield that was large (US grade 1) peppers. Three were few consistent differences in pepper yield or quality due to N source. Given cost considerations of drip application and N sources, slow release N materials may be a viable option for small scale growers not using drip application systems.

Papadopoulos et al. (2000) field studies, on pellic vertisol in cybrus, were designed to investigate the response of drip irrigated tomato to conventional soil P fertilizer application at Triple Super Phosphate (TSP) and fertigation when P is applied in the form of urea phosphate (up) Monoammonium P applied in soil were 300 and 94 kg/ha. An equivalent amount of P and an amount of 70 kg P / ha in a combination with 150, 300 and 450kg/ha were applied with irrigation
water at a total amount of 200 mm of water. The K applied was 450 kg/ha in all treatments. Irrigation was applied when the soil water potential was between 0.03 and 0.04 Mpa and at full growth of plants was equivalent to 0.8 of pan evaporation from screened USWA class A pan. Similar treatments were tested using aubergines. The results indicated that fertilizer, irrespective of the combination of fertilizers, was superior to soil application. N application was more efficient when applied with the irrigation water. UP as a source of P gave the highest yield in both tomato and aubergine results are discussed.