EFFECT OF MOTHER PLANT NUTRITION AND CHEMICAL SPRAY ON SEED YIELD AND QUALITY IN TOMATO (*Lycopersicon esculentum* Mill.)

HITENDRA B. GOUDAPPALAVAR

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY
COLLEGE OF AGRICULTURE, DHARWAD
UNIVERSITY OF AGRICULTURAL SCIENCES,
DHARWAD-580 005

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HITENDRA B. GOUDAPPALAVAR

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY
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Certificate

This is to certify that the thesis entitled **EFFECT OF MOTHER PLANT NUTRITION AND CHEMICAL SPRAY ON SEED YIELD AND QUALITY IN TOMATO [*Lycopersicon esculentum* Mill.]** submitted by **HITENDRA B. GOUDAPPALAVAR** for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **SEED SCIENCE AND TECHNOLOGY** to the University of Agricultural Sciences, Dharwad is a record of research work done by him during the period of his study in this University under my guidance and supervision and the thesis has not previously formed the basis for the award of any other degree, diploma, associateship, fellowship or other similar titles.

Dharwad
November, 2000

(V. K. DESHPANDE)
Major Advisor

Approved by :
Chairman : (V. K. DESHPANDE)

Members : 1. (M. SHEKHARGOWDA)

2. (M. B. KURDIKERI)

3. (R. M. HOSAMANI)

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INTRODUCTION

I. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an important vegetable crop grown for its edible fruits, which can be consumed either fresh, cooked or in the form of various processed products like juice, ketchup, sauce and puree. In fact tomato tops the list of the processed vegetables and is a very good source of vitamin C and also contains vitamin A and B in moderate quantities.

Tomato is native to South America (Peru and Galapagos Islands), and it's cultivation has spread throughout the world occupying an area of 3.25 million hectare with the production of 90.4 million tonnes. In India it occupies about 0.35 million hectare with an estimated production of 5.3 million tonnes. (Anonymous, 1999) Karnataka accounts for an area of 0.42 lakh hectare with 10.48 lakh tonnes production (Anonymous, 1998).

Karnataka state has a very great potential for tomatoes production for export as it can be grown extensively all round the year due to favourable climatic conditions.

Under the normal agro-climatic conditions mother plant nutrition is the largest single factor influencing the yield and quality of vegetables and is particularly so in tomato. Recent findings in seed technology research have indicated that mother plant nutrition is one of most important factors in the production of higher quantity of good quality seeds in tomato.

In modern agriculture, fertilizer constitute the major portion of total cost of seed production. Hence to economise the cost of seed production there is a immediate need to standardize the optimum mother plant nutrition through judicious and balanced application of nutrients to obtain maximum quantity of high quality seeds.

Apart from fertilizer application, plant protection chemicals and weedicides application, efforts are also being made to maximize fruit yields and fruit quality through spraying of chemicals. However, the special attention is not given towards the use of chemicals for maximizing seed yield and quality.

Studies conducted elsewhere have indicated the beneficial effects of chemicals on fruit yield, seed yield and quality. Therefore, there is a need to generate precise information with regard to requirement of optimum fertilizer dose and appropriate stage of spray with suitable chemical so as to help seed grower to produce quality seeds in higher quantity.

In India Pusa Ruby, Sioux, Sanmarsano, Roma, Hybrid Karnatak, Delicious and Manipal are the popular varieties of tomato. The University of Agricultural Sciences, Dharwad released a variety Megha (L-15) which is high yielding, non stalking and bacterial wilt resistant. It bears small to medium size fruits and is now gaining more popularity.

Keeping all these points in view the present investigation entitled "Effect of mother plant nutrition and chemical spray on seed yield and quality in tomato", Cv. Megha (L-15) was undertaken with the following objectives.

1. To study the effect of levels of nitrogen on crop growth, seed yield and quality.
2. To study the effect of levels of phosphorus on crop growth, seed yield and quality.
3. To study the effect of chemicals and stages of sprays on crop growth, seed yield and quality.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

2.1 EXPERIMENT – I : Effect of mother plant nutrition on seed yield and quality in tomato

The available nutrients in the soil are inadequate to express full genetic potential for growth and yield. Therefore, it is essential to provide major nutrients viz., nitrogen, phosphorus and potassium through chemical fertilizers. Under the normal agro-climatic conditions, deficiencies of major nutrients are very common which cause serious set backs in commercial vegetable growing. Hence, there is a need to supply these major nutrients in balanced quantity so as to achieve higher seed yield combined with quality.

Though, tomato is one of the major fruit vegetable crop, little research work has been carried out with respect to mother plant nutrition on seed yield and quality. Therefore, research work on other vegetable crops have also been reviewed on the following aspects.

2.1.1 Role of Nitrogen and Phosphorous in growth and yield

Nitrogen is an important element required for the normal growth and development of the plant. it is the most mobile of all the mineral nutrients observed by the plants. it imparts healthy, dark green colour to leaves, stimulates a rapid early growth, contributes to the formation of a strong, well developed and active root system. Nitrogen is one of the main factors in the intensive production of carbohydrates (Starch and Sugars). It improves quality of leafy crops, causes a better seed growth and an abundance of healthy, well developed fruits, increases the protein content of food and field crops.

Phosphorus forms a source of power in the form of ATP and ADP. Phosphorus stimulates early root development and growth thereby helping to establish seedlings quickly. It gives rapid and vigorous start to plants, early maturity of crops. Phosphorus known to help in seed formation. Defeciency of phosphorus may adversly affect the plant in obtaining the full supply of nitrogen and potassium and excess of phosphorus may result in various nutritional problems.

2.1.2 Nutrient requirement and uptake

Being a higher yielder, tomato removes a considerable amount of nutrients from the soil. It is estimated that the crop yielding 50 tonnes of fruits removes about 88.88 kg of nitrogen, 35.55 kg of P_2O_5 and 177.76 kg of K_2O per hectare, besides other nutrients (Choudhari and De, 1969).

Various aspects of nutrient uptake by the tomato plant at different stages of its development engaged the attention of many workers. Mc.Ilrath (1956), observed two distinctive periods of accelerated absorbtion of ions which occurred during developmental cycle, one following the appearance of microscopic floral buds and the other at the time of anthesis and subsequent to anthesis. The greatest total quantity of ions was found to be absorbed during the fruitting stage. Calcium, nitrogen and potassium were taken up in the greatest amounts.

Koles and Vander (1953) after conducting long term green house experiments calculated the total nitrogen requirement to be 1 g per 400 g of fruit and showed that 1 : 1: 2 was the best ratio of N, P and K for tomato. Inadequate supply of nutrients had detrimental effect on growth, yield and quality of tomato and at very low supply of these nutrients it showed visual deficiency symptoms (Drobkov, 1964).

2.1.3 Effect of mother plant nutrition on plant height in tomato

Barooah and Ahmed (1964) while investigating the response of tomato to nitrogen, phosphorus and potassium noted increased plant height (110.2 cm) due to both nitrogen and phosphorus, (0-120 kg) but observed no response to potassium.

Drobkov (1964) studied the effect of four levels each of N, P and K in various combination on growth of tomato in sand culture experiment and observed retarded vegetative growth and under developed vegetative organs with the deficiency of these nutrients.

Moursi (1957) observed increasing levels of nitrogen (0, 60, 120 and 180 kg/ha) showed increase in the plant height of tomato (103.4 cm).

Murthy (1965) reported that the height and weight of the transplants varied directly with the amounts of applied phosphorus. Similar positive influence of P on the growth of tomato plants was also reported by Koles and Vander (1953).

The plant height and root growth as well as yields of tomato reduced with the decline in the quantity of phosphorus supply (Saito and Kano, 1970).

Kirthi singh and Sandhu (1970) observed that the increasing levels of nitrogen up to 100 kg per hectare increased the plant height (60.25 cm) in brinjal.

The nitrogen application increased the plant height, while the final height of the shoot was similar with different levels of phosphorus (Sharma and Mann, 1972).

Shivaprakasam and Rajagopalan (1974) observed an increase in vegetative growth (85.8 cm) with increase in nitrogen levels up to 200 kg per hectare in brinjal.

Dharmatti (1986) reported that the plant height of Bell pepper was significantly highest (39.9 cm) by application of 250 : 150 : 100 kg NPK per ha.

The plant height of brinjal was significantly increased (109 cm) with increase in levels of NPK fertilizers (Parashetti, 1991). Similar results have also been reported by Ramakrishna praseeda (1976) in tomato.

Baruah *et al.* (1993) observed significant difference in plant height due to application of nitrogen. They reported that with increase in nitrogen level there was increase in plant height and maximum plant height (69.1 cm) recorded at 150 kg N per hectare in tomato.

Revanappa *et al.* (1997) reported in chilli that plant height was increased (47.55 to 57.07 cm) with increased application of N (150 to 250 kg/ha, respectively) with basal dose of 75 kg each of P and K per hectare.

Biradar (2000) reported that application of 150 : 75 : 75 kg NPK per ha recorded significantly highest plant height (101.3 cm) in Byadgi kaddi variety of chilli.

2.1.4 Effect of mother plant nutrition on number of branches in tomato

Thorne and Watson (1955) speculated increase in the number of branches to higher nitrogen content in tissue, which helps in the assimilation of protoplasm resulting in greater cell formation, tissue and vigour of the plants.

Tiessen (1957) noticed that with increase in the levels of phosphate there were more number of branches in tomato.

Barooah and Ahmed (1964) working on the effect of nitrogen and phosphorus on tomato observed that the number of branches (24.6) increased with the increase in levels of both nitrogen and phosphorus from 0 to 120 kg per hectare. Similar results have been also reported by Patnaik and Farooqui (1964) in brinjal.

A profound effect was noticed on branching (21) in brinjal by applying 100 kg nitrogen per hectare (Kirthi singh and Sandhu, 1970).

Sharma and Mann (1972) found that increasing levels of both nitrogen and phosphorus increased the number of branches per plant. Further they also noted that the nitrogen-phosphorus interaction significantly influenced the production of number of branches in *summer* season tomato crop. Similar results have also been reported by Sube singh *et al.* (1988).

Parashetti (1991) found that the higher levels of nitrogen, phosphorus and potassium (187.5 : 150 : 75 kg/ha) had increased the number of branches per plant (31.1) in brinjal. Similar results have also been reported by Ramakrishna Praseeda (1976) in tomato, and Dharmatti (1986) in Bell pepper.

Baruah *et al.* (1993) reported that the increasing level of nitrogen resulted in increased number of secondary branches (10.8) in tomato Cv. Pusa ruby.

Revanappa (1993) observed, significantly higher number of primary (6.31), secondary (16.36) and tertiary (53.0) branches per plant with the application of 250 : 75 : 75 kg NPK per hectare. The increase in number of branches with enhancement of N was attributed to rapid meristemetic activity in plants.

Biradar (2000) reported that fertilizer level of 150 : 75 : 75 kg NPK per hectare recorded maximum number of primary, secondary and tertiary branches (7.45, 17.80 and 51.30, respectively) in Byadgi kaddi chilli.

2.1.5 Effect of mother plant nutrition on flowering and fruit set in tomato

Adequate supply of phosphorus tended to counteract the delay in maturity caused by an excessive supply of nitrogen in tomato (Jain, 1959)

Importance of N, P and K in influencing flower initiation and flowering in tomato, brinjal and pepper has been reported by Eguchi *et al.* (1958), who concluded that adequate amounts of N, P and K are very essential for early and proper flowering and good fruit set in tomato. Similarly, early differentiation and formation of flowers in tomato was also observed by Petrov and Andreev (1972) and Takahashi *et al.* (1973) with adequate fertilization.

Saito *et al.* (1963) found that increase in the soil fertility resulted in greater seedling vigour, early flower bud differentiation, a reduction in the number of leaves to the first inflorescence and production of more number of flowers.

Sharma and Mann (1972) noticed that higher levels of phosphate hastened earlyness and increase in nitrogen level (50, 100 and 150 kg N/ha) delayed the fruit maturity but did not influence the percentage of fruit set.

The days taken for 50 per cent flowering was significantly reduced by different levels of N, P and K and other interactions in hybrid tomato (Ramakrishna Praseeda, 1976).

Chandrasekharan and George (1973) observed significant increase in flower production with 125 kg per hectare nitrogen in brinjal.

Nagaraj Swamy (1982) noticed that fertilizer levels did not significantly influence the number of days taken to 50 per cent flowering in bell pepper. However, he observed a decreasing trend with increased levels of fertilizers.

Varis and George (1985) reported that the increase in N and P levels caused early flowering and ripening in tomato.

In brinjal the number of flowers increased and the days taken for flowering decreased with the increasing level of fertilizers (Parashetti, 1991).

Baruah *et al.* (1993) recorded maximum fruit set (92.8%) with the application of 150 kg N per ha in tomato.

Sharma (1995) noticed that application of increased levels of N (30 to 120 kg/ha) significantly increased the days to 50 per cent flowering (34.2 to 39.0 days) in tomato, with a basal dose of 30 and 60 kg P, K per hectare respectively.

Revanappa *et al.* (1998) observed that the number of days required for flowering were increased (28.00 to 30.56 days) with increase in N (150 to 250 kg/ha) and with basal dose of 75 kg per hectare each of P and K.

In chilli, the number of days taken for 50 per cent flowering increased (41.65 to 46.87) with increased levels of fertilizers (100 : 75 : 75 kg NPK/ha to 150 : 75 : 75 kg NPK/ha) Biradar (2000).

2.1.6 Effect of mother plant nutrition on fruit yield in tomato

Singh and Nettles (1962) observed an increased number of fruits in bell pepper by increasing the nitrogen level from 50 to 180 kg per hectare.

Cuocolo (1967) observed maximum number of bell pepper fruits in response to 120 : 120 : 100 kg NPK per hectare. In another study the maximum number of brinjal fruits were found when N, P and K were applied each at 250 kg per hectare (Gnana kumari and Satyanarayana, 1971).

Popova and Mihailov (1968) observed a positive co-relation between fruit size and number of seeds in tomato and capsicum.

Gill *et al.* (1974) reported that nitrogen dose alone increased the mean fruit number and yield. Interaction effect of nitrogen and phosphorus increased the fruit number considerably in the seed crop of sweet pepper.

Alekseev (1978) stated that plant height, plant spread and number of branches were significantly and positively co-related with total fruit yield in tomato. Similar results have also been reported by Nandpuri *et al.* (1976) in brinjal and Narasimharaju (1979) in bell pepper.

The number of fruits per plant, fruit weight and fruit yield per hectare increased with the increase in N and P levels. Application of N, P and K at 230, 208 and 60 kg per hectare respectively was found to be optimum for getting high yield of good quality fruits in hybrid tomato (Ramakrishna Praseeda, 1976).

Mahmoud and George (1984) reported that the fruit number and percentage of fruit setting were not influenced by application of N, however, fruit yield increased significantly with N application in tomato.

The fruit yield increased with increased level of N and P but the difference between the N levels had no effect on the fruit setting percentage or fruit number in tomato (Varis and George, 1985).

Chalakov (1987) observed an increase in yield and fruit size of tomato with higher levels of N. Similar observations were also made by Sube singh *et al.* (1988) in brinjal.

Thiagarajan (1990) recorded maximum fruit yield (5027 kg/ha) with the application of 140 : 35 : 0 kg NPK per hectare in chilli.

Baruah *et al.* (1993) reported that the fruit yield increased with the increase in N level and maximum fruit yield (180 q/ha) was obtained at 150 kg N per hectare in tomato. Similar results were also obtained by Gupta and Rao (1980) in brinjal.

Shrivastava (1996) noticed the highest chilli fruit yield per hectare with application of 250 : 200 : 200 kg NPK per hectare.

Singegol (1997) reported that the per hectare fruit yield was maximum (120.56 q/ha) with highest fertilizer levels (150 : 75 N, P kg/ha) and a basal dose of 50 kg K per hectare compared to control (49.92 q/ha) in chilli.

Patil (1998) noticed that the highest dose of fertilizer (200 : 100 : 100 NPK kg/ha) resulted in maximum fruit yield (19.12 q/ha) as compared to control (13.86 q/ha) in chilli.

Biradar (2000) obtained significantly highest fruit yield (13.13 q/ha) of chilli variety Byadgi kaddi with application of 150 : 75 : 75 kg NPK per hectare.

2.1.7 Effect of mother plant nutrition on seed yield of tomato

Silva (1971) recorded higher seed yield, seed weight per plant and per fruit, by application of NPK @ 60 : 50 : 50 kg per hectare in capsicum.

While working on the seed production of "Yolowonder" sweet pepper, Gill *et al.* (1974) recommended 250 kg per hectare each of nitrogen and phosphorus for maximizing the seed yield.

Godi (1982) recorded the maximum seed yield of 55.70 kg per hectare at higher levels of N and P in chilli.

Koonar and Randhava (1983) reported that increasing N levels from 50 to 200 kg per hectare increased the fruit (23 t/ha) and seed yields (170 kg/ha) in tomato.

The seed yield and quality increased with application of 100 : 100 : 100 kg NPK per hectare in tomato (Vadivelu, 1983).

Mahmoud and George (1984) reported that the seed yield and number of seeds per plant were both significantly increased by the N and P application in tomato.

Varis and George (1985) reported that with increase in fertilizer level there was increase in seed yield in tomato.

Seed yield of bell pepper was highest (84.9 kg/ha) at 200 : 112.5 : 75 kg NPK per hectare (Dharmatti, 1986).

Thiagarajan (1990) reported that the seed yield increased with increase in fertilizer level, the highest seed yield (1991 kg/ha) was recorded at 140 : 70 : 35 kg NPK per hectare in chilli.

The fertilizer level of 187.5 : 150 : 75 kg NPK per hectare recorded the highest seed yield (671.8 kg/ha) in brinjal. Parashetti (1991).

The higher level of nitrogen (210 kg/ha) significantly increased the seed yield per hectare in sweet pepper (209.3 kg) (Kalappa, 1992).

Dharmatti *et al.* (1992) reported that 120 : 100 : 60 kg NPK per ha was the best for getting higher seed yield in tomato Cv. L-15.

Gulshan lal (1992) observed that with increase in N level, there was increase in seed yield. The highest seed yield of (5.12 q/ha) was recorded at 100 kg N per hectare in chilli.

Seed yield increased with the increase in N level, the maximum seed yield (160.9 kg/ha) was recorded at 150 kg N per ha in tomato. (Buruah *et al.*, 1993).

Vijaykumar *et al.* (1995) concluded that the highest chilli seed yield was obtained by applying 200 : 100 : 60 kg NPK per hectare.

Biradar (2000) stated that application of 150 : 75 : 75 kg NPK per hectare in chilli variety Byadgi kaddi recorded highest seed yield (656 kg/ha).

2.1.8 Effect of mother plant nutrition on germination percentage in tomato

Lysenko (1980) observed 98 per cent seed germination in capsicum plants which receiving N, P and K at 360 : 360 : 180 kg per hectare as compared to plants with lower doses.

In tomato Cv. Manimaker, the combination of higher nitrogen and phosphorus increased the seed germination and seedling emergence rates of the progeny seeds. (George *et al.*, 1980).

Godi (1982) noticed an increased seed germination (83.59 %) with higher levels of N and P (200 : 100 kg/ha, respectively) in chilli.

Mohmoud and George (1984) observed that the germination percentage was significantly increased by N and reduced by K. The interactions NP and NPK also adversely affected the seed germination in tomato.

The percentage of germination was highest (69.11%) at 200 : 112.5 : 75 kg NPK per hectare in bell pepper (Dharmatti, 1986).

Vanangamudi *et al.* (1989) also reported increase in germination with increase in nitrogen (0 to 150 kg/ha) application in chilli.

Dharmatti *et al.* (1992) noticed the highest germination (98.8%) by application of 120 : 100 : 60 kg NPK per hectare in tomato.

The germination was maximum (82%) at 140 : 70 : 35 kg NPK per hectare in chilli, reported by Thiagarajan (1990).

Gulshan Lal (1992) reported the highest seed germination percentage (91.41%) by application of 100 kg N per hectare in chilli Cv. Pant C-1.

Eryuce and Aydin (1993) reported that highest germination percentage (96%) was noticed with 180 : 120 : 60 kg NPK per hectare in tomato.

Gapsa *et al.* (1995) reported that at 300 : 150 : 200 kg NPK per hectare recorded the highest germination percentage in chilli.

Biradar (2000) reported that application of 150 : 75 : 75 NPK kg per hectare recorded significantly highest seed germination (62.83%) in chilli.

2.1.9 Effect of mother plant nutrition on 1000 seed weight in tomato

Godi (1982) noticed that 1000 seed weight was not significantly influenced by N and P levels, although there was linear increase in 1000 seed weight with graded doses of N and P levels in chilli. On the contrary reduction in thousand seed weight with increase in application of N, P and K was observed in tomato by Mohmoud and George (1984).

Varis and George (1985) reported that the 1000 seed weight (4.1 g) increased with increasing levels of N and P in tomato. Similar observations were also made by Seth and Choudhury (1970) in tomato.

Higher 1000 seed weight in bell pepper (4.22 g) was recorded at 200 : 112.5 : 75 NPK kg per hectare (Dharmatti, 1986).

Among different pickings the first and second pickings gave best seed quality with respect to 1000 seed weight and germination percentage in brinjal with higher fertilizer doses of 250 : 200 : 100 NPK kg per hectare compared to control (Parashetti, 1991).

Gapsa *et al.* (1995) reported that at 300 : 150 : 200 kg NPK per hectare, the 1000 seed weight was more with less EC of seed leachate in chilli. Biradar (2000) also found higher 1000 seed weight (4.39 g) with the application of 150 : 75 : 75 kg NPK per hectare in chilli.

2.1.10 Effect of mother plant nutrition on root and shoot length in tomato

Root length and shoot length did not differ significantly with N and P levels but an increasing trend was observed in shoot length with higher doses of N in chilli (Godi, 1982). Similar observations were also made by Dharmatti (1986) in bell pepper.

Vanangamudi *et al.* (1989) reported increased shoot length of chilli with increase in nitrogen application (0 to 150 kg/ha).

The highest seedling length was noticed with the application of fertilizer dose of 250 : 200 : 100 kg NPK per hectare in brinjal (Parashetti, 1991).

Biradar (2000) also noticed that, the seedling length was maximum (10.81 cm) with the application of 150 : 75 : 75 kg NPK per hectare in chilli Cv. Byadgi kaddi.

2.1.11 Effect of mother plant nutrition on seedling vigour index in tomato

Seedling vigour is too complex parameter. Most of the research work is concerned with the expression of vigour during seed germination and early seedling development. Abdul-Baki and Anderson (1973) reported that vigour index can be predicted by field emergence.

Nettles (1971) in sweet pepper and pet (1972) in tomato have reported a linear positive relationship between seed size and seedling vigour.

Tekrony and Egli (1977) suggested that the combination of germination and seedling emergence was good measure for evaluating the seed vigour.

The increased trend in vigour values with increased levels of N and P was observed by Godi (1982) in chilli.

According to Dharmatti (1986) vigour index was significantly influenced by increased fertilizer levels in bell pepper.

Parashetti (1991) reported that fertilizer dose of 250 : 200 : 100 kg NPK per hectare gave the best seedling vigour index in brinjal.

Biradar (2000) also recorded highest seedling vigour index (682) by application of 150 : 75 : 75 kg NPK per hectare in chilli.

2.1.12 Effect of mother plant nutrition on electrical conductivity of seed leachate in tomato

Higher the quantity of the seed material leached out of the seed, higher is the electrical conductivity of the seed leachate. This was used to predict the relative field emergence in pea seeds (Mackay, 1970).

Pollock and Roos (1972) formulated a method of evaluating relative vigour of seed leachate by measuring the amount of material leached out of seeds soaked in water, the lower the vigour the greater the amount of leachate.

Parashetti (1991) reported that EC was least in first two pickings when compared to third picking in brinjal.

Biradar (2000) recorded the least EC in second picking followed by first and third picking in chilli with application of fertilizer dose of 150 : 75 : 75 kg NPK per hectare.

EXPERIMENT – II : Effect of chemical spray on seed yield and quality in tomato

The literature pertaining to studies made on the effect of chemicals on crop growth, seed yield and quality of tomato is scanty. Hence, the reviews on these aspects on related crops have been included along with literature on tomato.

2.2.1 Role of growth regulators

Growth promoters (GA_3, IAA, NAA and 2,4-D) play an important role in changing both morphology and physiology of the plants. The effect of growth regulators varies with plant, species, variety, their concentration used, method of application, frequency of applications and various other factors which influence the absorbtion and translocation of the chemicals.

Growth retardants (Ethrel and TIBA) are the chemical substances that slow down the cell division and cell elongation in meristematic tissues of shoot and regulate plant height without formative effects and change the morphology and physiology of the plants.

2.2.2 Effect of chemical spray on plant height in tomato

GA_3 :

Rappapart (1960) observed more stem elongation when GA_3 was sprayed at the rate of 2.5 to 4 mg per plant in tomato.

Meharotra *et al.* (1970) found the significant increase in the plant height (95 cm) with 25 ppm GA_3 spray in tomato.

The maximum height of tomato plant was obtained with spray of GA_3 at 10 and 25 ppm after one month of transplanting. (Mehta and Mathai, 1975).

In chilli El – Asdoudi and Ouf (1993) visualized that the application of 50 ppm GA_3 at flowering and 15 days interval for two times, produced taller plants over other concentrations (10, 15, 25 and 100 ppm).

Gupta *et al.* (1997) observed an increase in the plant height (112 to 122 cm) of brinjal with increase in the GA_3 concentration from 100 to 300 ppm as compared to control (106 cm).

IAA :

According to Singh and Upadhyay (1967) foliar application of IAA (5, 10, 25 and 50 ppm) increased the plant height in tomato.

NAA :

Chhonkar and Singh (1959) observed that NAA treatments (0.05, 0.1, 0.2 and 0.4 ppm) at seedling stage increased the plant height of two tomato cultivars.

Spraying of 10 ppm NAA at flowering stage and three weeks later produced significantly more plant height (62.12 cm) over water spray (49.5 cm) in chilli (Pandita *et al.*, 1980).

In chilli Cv. Pusajwala, Dod *et al.* (1989) also recorded increased plant height by spraying 50 or 100 ppm NAA at full bloom stage (50 DAT) compared to control.

Pookan *et al* (1991) reported that NAA at 30 ppm recorded the maximum plant height in chilli.

Revanappa (1993) recorded marginal increase in plant height by spraying 20 ppm NAA at 40 and 60 DAT in chilli cultivars.

2,4-D :

Choudhary and Singh (1960) reported that the application of 2,4-D at lower concentrations of 1-2 ppm resulted in vigorous plant growth of tomato but high concentration retarded it.

Kumar (1979) noticed that application of 2,4-D at 5 and 10 ppm as whole plant spray resulted in decrease in plant height in tomato.

Foliar application of 1 ppm 2,4-D at 40 and 60 DAT recorded the highest plant height (51.6cm), whereas higher concentrations (5 to 20 ppm) reduced the plant height in chilli (Singh *et al.*, 1990).

Ethrel :

Ethephon (500-1500 ppm) suppressed growth of main stem and promoted development of lateral buds of sweet pepper plants (Rylski, 1972).

Nagdy *et al.* (1979) reported that ethrel application at 300, 400 or 500 ppm decreased the height of the chilli plants.

In tomato, Dimri *et al.* (1988) reported that the increase in concentrations of ethrel (500, 1000 and 1500 ppm) resulted in decrease in plant height.

2.2.3 Effect of chemical spray on number of branches in tomato

GA_3 :

In tomato, Meharotra *et al.* (1970) reported increased number of branches per plant (11.3) with 25 ppm GA_3 sprayed at 25 DAT and flowering against water spray (8.9).

Abdul *et al.* (1988) observed that number of branches per plant were significantly increased by increasing the concentration of GA_3 (50 to 100 ppm) in pepper.

Gupta *et al.* (1997) noticed that there was significant increase in mean number of branches per plant (14.9 to 21.1) by reducing the doses of GA_3 from 300 ppm to 200 ppm in brinjal Cv. Pusa purple long and Pusa kranti against water spray (12.9).

Increased number of primary, secondary and tertiary branches per plant were noticed with GA_3 50 and 100 ppm (Biradar, 2000) in chilli.

NAA :

Spraying NAA at 0.1 ppm at seedling stage increased the number of branches in two tomato cultivars (Chhonkar and Singh, 1959).

Meharotra *et al.* (1970) reported that there was a significant increase in mean number of branches per plant (10.2) in tomato by spraying 25 ppm NAA at 25 DAT and at flowering time as compared to water spray (8.9).

Pandita *et al.* (1980) observed that NAA (10 ppm) applied at flowering and again three weeks after resulted in maximum number of branches in chilli.

Singh *et al.* (1990) stated that the number of primary branches per plant were more (10) with 10 ppm NAA sprayed at 40 and 60 DAT against water spray (8.9) in chilli.

Revanappa (1993) with application of NAA (10 and 20 ppm) at 40 and 60 DAT recorded increased number of primary, secondary and tertiary branches per plant.

2, 4-D :

Adlekha and Verma (1964) reported that 2, 4-D (10 ppm) promoted branching in tomato cultivar "Devillian choice" while at higher concentration did not influence the branches. On the contrary Meharotra *et al.* (1970) found no marked effect of 2, 4-D (25 ppm) on vegetative growth of tomato.

According to Singh *et al.* (1990) there was significant increase in number of branches per plant by spraying 1 ppm 2, 4-D at 40 and 60 DAT. They further indicated that higher levels of 2, 4-D (10 and 20 ppm) showed deletarious effect on number of branches in chilli.

Ethrel :

Nagdy *et al.* (1979) noticed increased number of branches in chilli with ethrel at 300, 400 or 500 ppm.

Dimri *et al.* (1988) reported increase in number of branches with increase in concentration of ethrel (500, 1000 and 1500 ppm) in tomato.

2.2.4 Effect of chemical spray on flowering and fruit set

GA_3 :

Flowering was hastened by 4 to 5 days when GA_3 25-100 mg was sprayed in both determinate and indeterminate varieties of tomato (Rappapart, 1960).

Satti and Oebker (1986) reported increased fruit set in tomato due to application of 25 ppm GA_3 at various stages of inflorescence development.

In capsicum Cv. California wonder plants were sprayed at flowering stage with GA_3 (0, 5, 15 or 30 ppm). The fruit set per cent was highest at 15 ppm GA_3 spray (63.3%) compared to other levels of GA_3 (El-Asdoudi and Ouf, 1993).

NAA :

Acceleration in flowering and increased number of flowers have been reported with various concentration of NAA (5, 10, 15 ppm) in tomato (Chhonkar and Singh, 1959).

Balyan (1988) reported that NAA at 0.25 ppm recorded reduced number of days taken for flowering and highest per cent fruit set in tomato cultivar Pusa ruby.

Doddamani and Panchal (1989) recorded increased fruit set (29.8%) of chilli with 10 ppm NAA sprayed at pre-bloom stage, while water spray recorded less fruit set (13.17%).

Lata and Singh (1993) sprayed NAA (20, 40 and 60 ppm) at 30 and 60 DAT and observed that the fruit set was highest with 40 ppm NAA and beyond that concentration the fruit set percentage reduced greatly in chilli.

Revanappa (1993) stated that spraying of 20 ppm NAA at 40 and 60 DAT increased the fruit set per cent by 31.5 and 28.8, respectively compared to water spray (19.7 and 18.8%, respectively).

The per cent fruit set was maximum (31.8%) with 20 ppm NAA in chilli (Biradar, 2000).

2, 4-D :

Muthukrishnan and Srinivasan (1963) noticed marked improvement in fruit set in six cultivars of egg plant with spray of 2, 4-D at 2 ppm.

Alimova (1976) reported that spraying 2, 4-D (10 ppm) on inflorescence of tomatoes reduced flower drop and improved the fruit set.

Rajmani *et al.* (1990) sprayed 2, 4-D (2 and 5 ppm) at 20, 40, 60 and 80 DAT. Among these the per cent fruit set was highest with 2 ppm 2, 4-D over untreated plants in chilli.

2.2.5 Effect of chemical spray on fruit yield in tomato

GA3 :

Nair *et al.* (1974) noticed increased fruit yield in five tomato cultivars when treated with GA_3 at 10 ppm.

Mourya and Lal (1987) sprayed GA_3 (50 to 150 ppm) at flowering and three sprays at 15 days interval and reported that the highest fruit yield (281 q/ha) was obtained with 50 ppm over water spray (199.2 q/ha) in chilli.

El-Asdoudi and Ouf (1993) recorded the highest fruit yield per plant (182-195 g) by spraying 5 ppm GA_3 at flowering stage as against other levels of GA_3 (0.15 and 30 ppm) in bell pepper.

IAA :

Commerate (1973) reported that increase in total yield of tomato when inflorescence were treated at flowering with IAA 50 ppm.

NAA :

Working with chilli and tomato, Chhonkar and Singh (1959) reported that NAA (0.1 ppm) can be effectively used for seedling treatment to get early and higher yields of quality fruits.

Pandita *et al.* (1980) reported that NAA at 10 ppm sprayed at flower initiation recorded significantly higher fruit yield followed by 2, 4-D at 5 ppm and IAA at 50 ppm in tomato.

Spraying 20 ppm NAA at flower opening stage followed by two sprays at an interval of 30 days was most effective in increasing yields of four chilli cultivars (Patil *et al.*, 1985).

Singh and Lal (1995) concluded that the highest fruit yield (89.6 q/ha) could be obtained by spraying 40 ppm NAA against water spray (62.2 q/ha) in chilli.

Gollagi (1999) sprayed 100 ppm NAA at 45 and 65 DAT and recorded maximum fruit yield of 11.75 q per hectare compared to untreated plants (9.33 q/ha).

Biradar (2000) recorded the highest fruit yield per hectare (1379 kg) by spraying 20 ppm NAA at 35 and 50 DAT in chilli.

2, 4-D :

The yields of tomato were maximum in response to 2, 4-D at 5 ppm followed by NAA at 0.2 ppm (Mehta and Mathai, 1975).

Application of 2, 4-D at 5 ppm as foliar spray recorded maximum fruit yield in tomato (Mehta *et al.*, 1989).

Among various concentrations of 2, 4-D (1 to 20 ppm) sprayed at 40 and 60 DAT, concentration of 5 ppm recorded the highest fruit yield over water spray in chilli (Singh *et al.*, 1990). Similar increase in fruit yield by spraying 1 ppm 2, 4-D at 30 and 60 DAT was observed in chilli (Lata and Singh, 1993 and Singh and Gulshan lal, 1994).

Ethrel :

Dimri *et al.* (1988) observed maximum fruit yield through application of ethrel 1500 ppm as foliar spray twice at 15 and 45 DAT in tomato.

TIBA :

Meharotra *et al.* (1970) observed higher number of fruits and fruit yield per plant when sprayed with TIBA at 25 ppm in tomato.

2.2.6 Effect of chemical spray on seed yield and quality

Very less number of research reports are available on influence of foliar spray of GA_3, IAA, NAA, 2, 4-D, Ethrel, TIBA and DAP on seed yield and seed quality parameters in tomato and hence the literatures pertaining to other related crops are also reviewed and presented here under.

Seed yield

GA_3 :

Application of GA_3 50 ppm at bolting stage increased the seed yield in onion (Fakhri Naamni *et al.*, 1980).

Singh (1995) reported that foliar application of GA_3 at 50-100 ppm at 50 per cent flowering increased the fruit set and seed yield in tomato.

IAA :

The combined application of IAA and NAA at 10 ppm concentration recorded maximum seed yield in pea, this was followed by IAA alone at 10 ppm (Padmaja Rao, 1975).

NAA :

Yadava *et al.* (1980) obtained maximum seed yield (6.28 q/ha) in vegetable cowpea by applying planofix (NAA) at 10 ppm.

Singh *et al.* (1990) stated that more seed yield per fruit (324 mg) was obtained by spraying 40 ppm NAA at 40 and 60 DAT over water spray (270 mg) in chilli.

Significantly higher seed yield per plant (42.1 g) by application of 40 ppm NAA against untreated plants (34.40 g) in chilli (Singh and Lal, 1995).

Biradar (2000) stated that higher seed yield per ha (684 kg) was obtained by spraying NAA (20 ppm) at 35 and 50 DAT in chilli.

2, 4-D :

In tomato Cv. Pusa ruby, Mehta *et al.* (1989) reported that plants sprayed with NAA (1 to 5 ppm) at 30, 45 and 60 DAT recorded maximum seed yield per kilogram of fruit with 2, 4-D (1 ppm) and beyond this concentration adverse effect on seed yield was noticed.

Singh *et al.* (1990) recorded higher seed yield (305 mg) per fruit with 1 ppm 2,4-D foliar spray over water spray (270 mg) in chilli.

Singh and Singh (1996) sprayed 5 ppm 2, 4-D at 20, 30 and 40 DAT and recorded lower seed yield (287 kg/ha) than water spray (396 kg/ha) in chilli. They further concluded that higher doses of 2, 4-D had adverse effect on seed yield due to poor pollen grain germination and parthenocarpic fruit set.

Ethrel :

Sitaram *et al.* (1989) observed that application of ethrel at 200 ppm as foliar spray recorded significantly higher seed yield (13.76 g/plant) in cucumber.

TIBA :

Hipp and Cowley (1969) obtained highest yields in Southern peas with TIBA application (5 g). A non-significant decline in yield was observed with higher concentration of the chemical.

Seed quality

GA_3 :

Application of GA_3 (50 ppm) at bolting stage recorded the highest germination per cent in onion (Fakhri Naamni *et al.*, 1980).

Balakumar and Balasubramanian (1988) recorded significantly higher seed germination, shoot length and vigour index by application of 25 ppm GA_3 as foliar spray in tomato over water spray.

Singh (1995) reported that foliar application of GA_3 at 50-100 ppm at 50 per cent flowering stage recorded significantly higher seed germination in tomato.

NAA :

Yadava *et al.* (1980) obtained maximum 1000 seed weight in vegetable cowpea by the application of NAA at 10 ppm.

Singh and Lal (1995) sprayed NAA (10 to 180 ppm) at 40 and 60 DAT and reported that the highest seed germination (66.1%) was recorded with 20 ppm NAA compared to water spray (56.1%) in chilli.

Biradar (2000) reported that NAA at 20 ppm was recorded the highest 1000 seed weight (4.43 g), seed germination (64.14%), seedling length (10.89 cm) and seedling vigour index (692) with decreased EC (1.76 dSm^{-1}).

2, 4-D :

Carlucci and Castro (1985) stated that tomato seeds obtained from plants sprayed with 2, 4-D (10 or 20 ml/l) during anthesis period had reduced germination percentage.

In tomato Cv. Pusa ruby, Mehta *et al.* (1989) sprayed 2, 4-D (1 to 5 ppm) at 30 DAT and two sprays at 15 days interval and reported that seed germination was significantly higher (92%) with 1ppm 2, 4-D compared to untreated plants (85%). Similar increase in per cent germination (63.6%) by spraying 1 ppm 2, 4-D at 30 and 60 DAT in chilli was observed by Singh and Lal (1995).

Ethrel :

Sitaram *et al.* (1989) observed that application of ethrel at 200 ppm as foliar spray recorded significantly higher 1000 seed weight and per cent seed germination in cucumber.

MATERIAL AND METHODS

III. MATERIAL AND METHODS

Two field experiments were carried out to study the effect of mother plant nutrition and chemicals spray on seed yield and quality of tomato Cv. Megha (L-15). during *kharif* season, 1999 at the Main Research Station, University of Agricultural Sciences, Dharwad. Further, the seed quality parameters were determined in the Department of Seed Science and Technology, Uiniversity of Agricultural Sciences, Dharwad. The details of the experiment and techniques adopted during the course of investigation are presented below.

EXPERIMENT – I : Effect of mother plant nutrition on seed yield and quality in tomato.

3.1 Experimental site

The experiment was conducted on black clay loam soil of the Main Research Station, University of Agricultural Sciences, Dharwad, plot No.108 situated at 15° 12′ N, latitude of 75° 07′ E longitude and at an altitude of 774m above the mean sea level.

3.2 Climate

The meteriological data as recorded at Meteriological Observatory, Agricultural College, Dharwad, for the year 1999–2000 and mean data of past 50 years (1950–1999) are presented in Appendix I.

The average annual rainfall of 50 years (1950–1999) was 796.68mm, which was fairly distributed from April to

37.11°C (April) and 27.11°C (August) where as, the mean minimum temperature ranged between 21.45°C (May) and 13.42°C (December). The mean relative humidity was high during the month of July (88.32%) and was low during the month of February (51.44%).

The total rainfall during the year 1999–2000 was 422.8mm, which was well distributed over a period of seven months (April to October). The mean maximum temperature varied from 27.1°C to 36.6°C and the mean minimum temperature varied from 15.1°C to 20.8°C. The relative humidity was maximum during the month of July (89.0%), and minimum during the month of December (51.0%).

3.3 Previous crop on the experimental site

In the experimental plot previously potato was grown during *rabi* 1999.

3.4 Experimental details

3.4.1 Treatment details

The experiment consisted of 12 treatment combinations comprising of four levels of nitrogen and three levels of phosphorus with uniform level of potassium.

3.4.2 Treatment combinations

T_1	60 : 60 : 80	NPK kg per hectare
T_2	60 : 120 : 80	NPK kg per hectare
T_3	60 : 180 : 80	NPK kg per hectare
T_4	120 : 60 : 80	NPK kg per hectare
T_5	120 : 120 : 80	NPK kg per hectare
T_6	120 : 180 : 80	NPK kg per hectare

T_7	180 : 60 : 80	NPK kg per hectare
T_8	180 : 120 : 80	NPK kg per hectare
T_9	180 : 180 : 80	NPK kg per hectare
T_{10}	240 : 60 : 80	NPK kg per hectare
T_{11}	240 : 120 : 80	NPK kg per hectare
T_{12}	240 : 180 : 80	NPK kg per hectare

3.4.3Replications:

The treatmentswere replicated three times.

3.4.4 Design and Layout

The experiment was laid out in randomised block design in three replications and plan of layout is depicted in figure 1.

3.4.5 Plot size

Gross plot size : 4.5 x 3.6 m

Net plot size : 3.0 x 2.4 m

3.5 Seed source

The seeds of variety megha (L-15) were obtained from the division of Horticulture, University of Agricultural Sciences, Dharwad.

3.6 Description of the variety

Megha (L-15) is a high yielding, non stalking and bacterial wilt resistant variety. It bears small to medium size fruits.

3.7 Cultural practices

3.7.1 Nursery operations

One raised bed of 10 m length, 1.2 m width and 10 cm height with fine tilth was prepared and incorporated 4-5

LEGEND

TREATMENTS

($N : P_2O_5 : K_2O$)

T_1 (60 : 60 : 80 kg/ha)

T_2 (60 : 120 : 80 kg/ha)

T_3 (60 : 180 : 80 kg/ha)

T_4 (120 : 60 : 80 kg/ha)

T_5 (120 : 120 : 80 kg/ha)

T_6 (120 : 180 : 80 kg/ha)

T_7 (180 : 60 : 80 kg/ha)

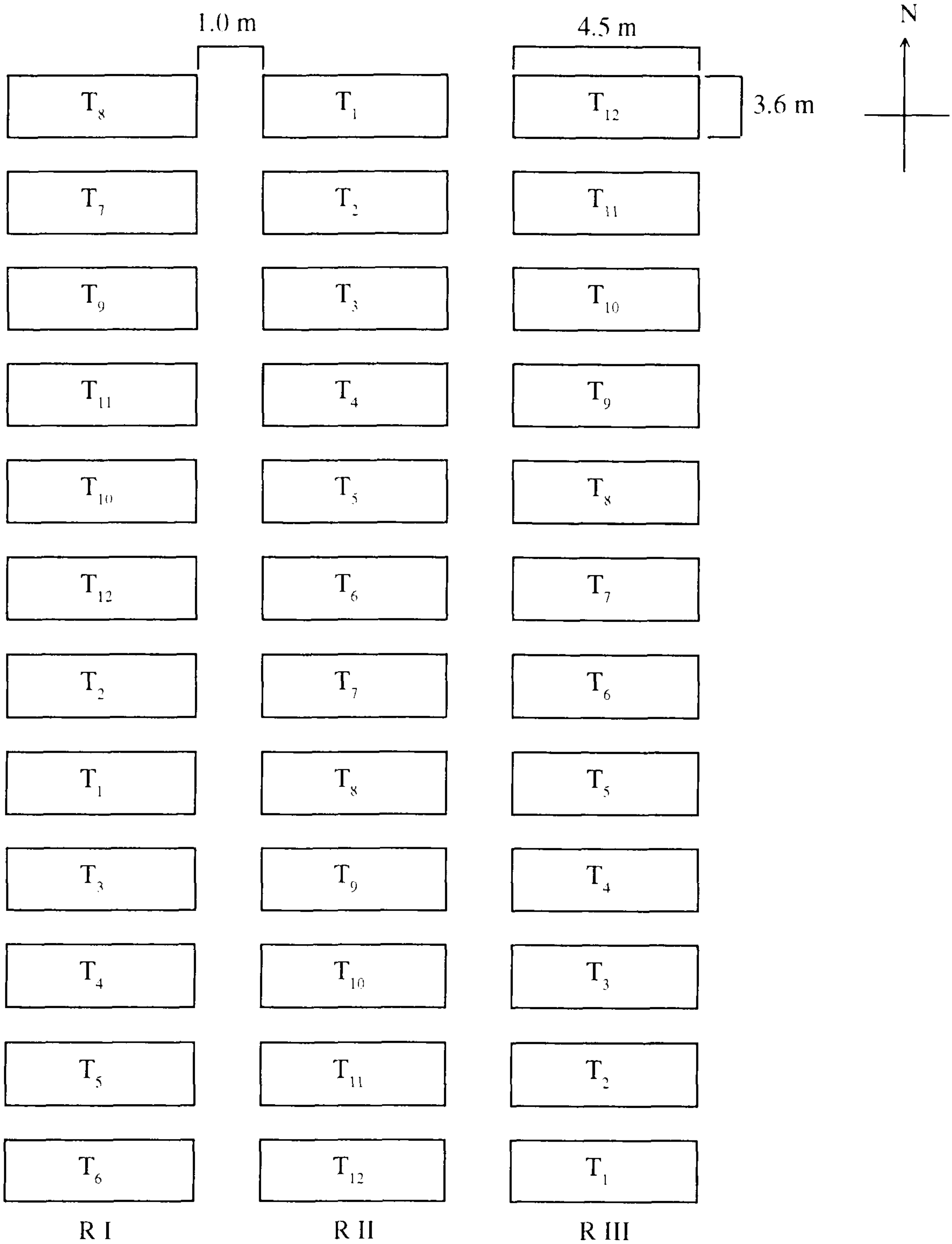
T_8 (180 : 120: 80 kg/ha)

T_9 (180 : 180 : 80 kg/ha)

T_{10} (240 : 60 : 80 kg/ha)

T_{11} (240 : 120 : 80 kg/ha)

T_{12} (240 : 180 : 80 kg/ha)



Figuare 1. LAYOUT OF THE EXPERIMENT
Effect of mother plant nutrition on seed yield and quality in tomato

One raised bed of 10 m length, 1.2 m width and 10 cm height with fine tilth was prepared and incorporated 4-5 baskets of well decomposed farmyard manure and Five hundred grams of 15 : 15 : 15 complex fertilizer thoroughly with soil. Previous day of sowing, the bed was drenched with captan @ 3g per litre of water. Furrows were made at a distance of 10 cm across the length of the bed and the seeds of variety Megha (L-15) were sown. The nursery bed was watered and plant protection measures were taken as and when required.

3.7.2 Preparation of experimental plot

The land was prepared by ploughing and harrowing to break the clods and soil was brought under good tilth. Then FYM was applied at the rate of 25 tonnes per hectare and mixed well with soil. The land was levelled with plank to bring the soil to fine tilth. Then layout was made as per the plan given in figure 1. All the cultural operations were followed as per the package of practices.

3.7.3 Transplanting

Healthy and uniform sized seedlings of four weeks old were transplanted during mid June at the rate of one seedling per hill with a spacing of 75x60 cm.

3.7.4 Application of fertilizer

The furrows were opened manually with a row spacing of 75 cm using a marker. In these furrows fertilizers were placed as per the treatments and were thoroughly mixed with the soil. The fertilizers were applied in the form of urea, DAP and full dose of phosphorus and potassium fertilizers were applied at the time of transplanting and other half of nitrogen was applied 30 days after transplanting.

3.7.5 Gap filling

Seven days after transplanting, the gap filling was made with fresh seedling, in order to maintain cent per cent population in all the treatments.

3.7.6 After care

The experimental plot was kept free of weeds by regular hand weeding. Earthing up was done after top dressing. To control the pest and diseases, necessary plant protection measures were taken as and when required.

3.8 Biometric observations

Five plants from each plot were selected at random and tagged for recording observations on the following growth and yield parameters.

3.8.1 Growth parameters

3.8.1.1 Plant height at harvest

On the earlier five randomly selected and tagged plants, the plant height was measured from the base of plant to the terminal growing point of the main stem at harvest. The average plant height was expressed in centimeters.

3.8.1.2 Number of branches per plant

The tagged plats were used for counting the number of primary, secondary and tertiary branches per plant at harvest.

3.8.1.3 Days to 50 per cent flowering

The number of days taken from the date of transplanting to flowering of 50 per cent of plants in each treatment was recorded and expressed as days to fifty per cent flowering.

3.9 Fruit yield and yield components

3.9.1 Number of fruits per plant

Number of fruits harvested at each picking from five tagged plants were recorded and later added to get total number of fruits per plant.

3.9.2 Fruit yield per plant

The fresh weight of fruits harvested at each picking from five tagged plants was recorded and later added to get total fruit yield per plant and expressed in kilograms per plant.

3.9.3 Fruit yield per plot

The total fruit weight for a net plot area was recorded from overall pickings and expressed in kilograms per plot.

3.9.4 Fruit yield per hectare

The fruit yield per hectare was worked out based on the fruit weight per net plot and expressed in tonnes per hectare.

3.10 Seed yield and yield components

3.10.1 Seed yield per plant

The seeds were extracted from the ripe fruits and dried under shade for 6-8 days till it reached constant moisture (8%).

The seeds obtained from each picking from the five tagged plants were weighed and later added to get total seed yield per plant and expressed in grams per plant.

3.10.2 Seed yield per plot

The total seed yield for a net plot area was recorded from overall pickings and expressed in grams per plot.

3.10.3 Seed yield per hectare

The seed yield per hectare was worked out based on seed yield per net plot and expressed in kilograms per hectare.

3.10.4 Seed recovery per cent

Seed recovery per cent was calculated by dividing the seed yield per plant with fruit yield per plant obtained from each pickings and multiplied by hundred

$$\text{Seed recovery per cent} = \frac{\text{Seed yield per plant (g)}}{\text{Fruit yield per plant (g)}} \times 100$$

3.10.5 Economics of seed production

The prices of the inputs that were prevailing at the time of their use were considered to work out the cost of cultivation, (Appendix-III). Gross returns was calculated by multiplying the price of the produce (seeds) with the total seed yield produced per hectare. Net returns (Rs./ha) was calculated by deducting cost of cultivation from the gross returns and cost benefit ratio was worked out by deducing the net returns by total cost of cultivation.

3.11 Seed quality attributes

3.11.1 1000 seed weight

The thousand seeds from all the treatments were counted separately in four replications and mean thousand seed weight was recorded and expressed in grams.

3.11.2 Germination (%)

Germination test was conducted in four replications of hundred seeds each by adopting "between paper method" as described by ISTA (Anonymous, 1993). The first and final germination counts were made on 5^{th} and 14^{th} day of germination test for normal seedlings and expressed in percentage.

3.11.3 Shoot length (cm)

During germination test, ten normal seedlings were selected randomly from each treatment from all the replications on 14^{th} day. The shoot length was measured from collar region to the base of the leaf and mean shoot length was expressed in centimeters.

3.11.4 Root length (cm)

Ten normal seedlings used for shoot length measurement were also used for the measurement of root length. The root length measured from tip of primary root to base of hypocotyl and mean root length was expressed in centimetres.

3.11.5 Seedling dry weight (mg)

The same ten seedlings selected for shoot and root length measurement were kept in an oven maintained at $85 \pm 1°$ C for 24 hours. After drying, the sedlings were kept in a desicator for cooling. The weight of dry seedling was recorded and mean weight was calculated per seedling and was expressed in miligrams (Anon., 1993).

3.11.6 Seedling vigour index

The vigour index of seedlings was calculated by adopting the method suggested by Abdul-Baki and Anderson (1973) and expressed in number by using the below formula.

Seedling vigour index = Germination (%) x (Shoot length + Root length in cm).

3.11.7 Electrical conductivity of seed leachate (dSm-1)

Five gram seeds from each treatment in four replications, were weighed and surface sterilized by using 0.1 per cent mercuric chloride solution and then rinsed with water for three times. These seeds were soaked in 25 cc distilled water in a beaker and kept in an incubator maintained at 25 ± 1°C temperature. After 24 hours of soaking, the solution was decanted and volume was made upto 25 ml by adding distilled water. The EC was recorded using the digital conductivity meter and expressed in disisimons per meter (dSm^{-1})

3.12 EXPERIMENT II : Effect of chemical spray on seed yield and quality in tomato.

3.12.1 Experimental site

The experiment was conducted on black sandy clay soil at Main Research Station, University of Agricultural Sciences, Dharwad, plot No.204 situated at a latitude of 15° 12′ N, longitude of 75° 07′ E and at an altitude of 774m above mean sea level.

3.12.2 Climate

The meteriological data presented in Appendix-I and explained under 3.2

3.12.3 Previous crop on the experimental site

The previous crop in the experimental plot was sorghum grown during *rabi* 1999.

3.12.4 Experimental details

3.12.4.1 Treatment details

The experiment consisted of 16 treatment combinations involving two stages of spray (main plots) and eight chemicals (sub plots) including control with three replications.

Main plots : Stages of spray (S)

S_1 = At 50 per cent flowering

S_2 = At fruit setting stage.

Sub plots : Chemical spray (C)

C_1 = GA_3 @ 100 ppm

C_2 = IAA @ 50 ppm

C_3 = NAA @ 50 ppm

C_4 = 2,4-D @ 1 ppm

C_5 = Ethrel @ 200 ppm

C_6 = TIBA @ 10 ppm

C_7 = DAP @ 2%

C_8 = Control (water spray)

3.12.4.2 Treatment combinations

S_1C_1	S_2C_1
S_1C_2	S_2C_2
S_1C_3	S_2C_3
S_1C_4	S_2C_4
S_1C_5	S_2C_5
S_1C_6	S_2C_6

S_1C_7	S_2C_7
S_1C_8	S_2C_8

ABBREVATIONS USED

S	-	Stage of spray
C	-	Chemical spray
GA_3	-	Gibberllic acid
IAA	-	Indole acetic acid
NAA	-	Napthaleian acetic acid
2,4-D	-	2, 4-Dichloro phenoxy acetic acid
Ethrel	-	2- Chloro ethyle phosphonic acid
TIBA	-	Tri-iodobenzoic acid
DAP	-	Diammonium phosphate

3.12.4.3 Replications

The treatments were replicated three times

3.12.4.4 Design and layout

The experiment was laid out in split plot design with three replications and plan of layout is given in figure 2.

3.12.4.5 Plot size

Gross plot size : 4.5 x 3.6 m

Net plot size : 3.0 x 2.4 m

3.12.5 Cultural practices

3.12.5.1 Nursery operations

The nursery operations were carried out as explained under 3.7.1

3.12.5.2 Preparation of experimental plot

The preparation of experimental plot was done by following the procedure as explained under 3.7.2 and the plan of layout was done as depicted in Figure 2.

LEGEND

CHEMICALS

C_1 GA_3 100 ppm

C_2 IAA 50 ppm

C_3 NAA 50 ppm

C_4 2, 4-D 1 ppm

C_5 Ethrel 200 ppm

C_6 TIBA 10 ppm

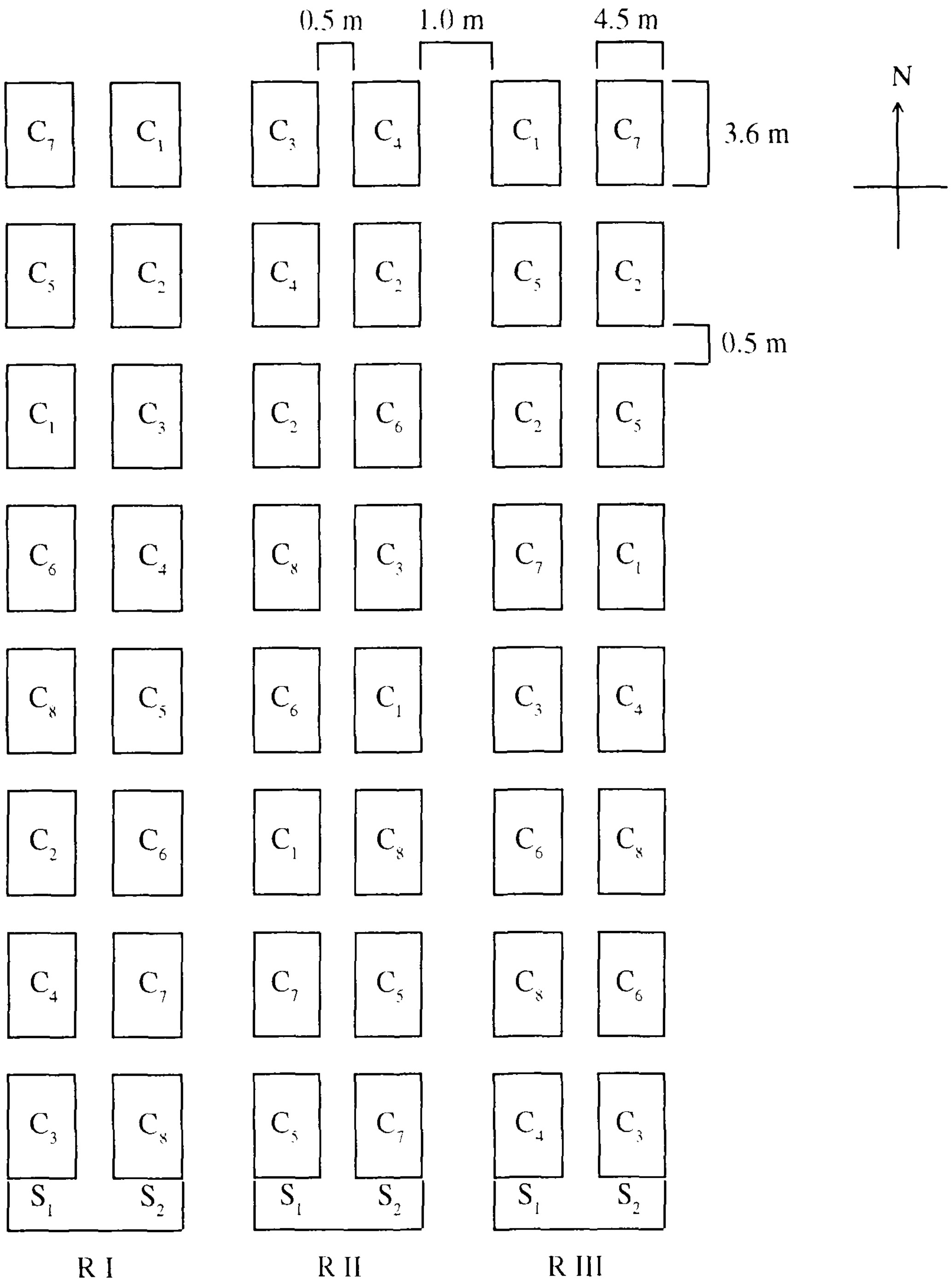
C_7 DAP 2%

C_8 Control

STAGES OF SPRAY

S_1 50% flowering stage

S_2 Fruit setting stage



Figuare 2. LAYOUT OF THE EXPERIMENT Effect of chemical sprays on seed yield and quality in tomato

3.12.5.3 Transplanting

Transplanting of tomato was done as explained in 3.7.3.

3.12.5.4 Application of fertilizer

A common fertilizer dose of 120 : 100 : 60 kg $N:P_2O_5:K_2O$ per hectare was applied in the manually opened furrows at a spacing of 75 cm by using a marker. Fertilizers were applied in the form of urea, DAP and muriate of potash as a source of nitrogen, phosphorus and potassium respectively. The half of the dose of nitrogen and full dose of phosphorus and potash fertilizers were applied at the time of transplanting and other half of nitrogen was applied at 30 days after transplanting as top dress.

3.12.5.5 Spraying of chemicals

The required concentration of GA_3, IAA, NAA, 2,4-D, Ethrel, TIBA and DAP were prepared and sprayed on the plant as per the treatments. The first spray was given at 50 per cent flowering stage and second spray was given at fruit setting stage as per the plan. In the similar way water was also sprayed as control.

3.12.5.6 Gap filling

The gap filling was done by following the procedure as explained under 3.7.5

3.12.5.7 After care

The experimental plot was kept free of weeds by regular hand weeding. Earthing up was done after top dressing. Necessary plant protection measures were taken to control pest and diseases.

3.12.6 Biometric observations

Five plants from each plot were selected at random and tagged for recording observations on the following growth and yield parameters.

3.12.6.1 Growth parameters

3.12.6.1.1 Plant height at harvest

The plant height was recorded by following the procedure as explained under 3.8.1.1

3.12.6.1.2 Number of branches per plant

The number of branches per plant was recorded by following the procedure as explained under 3.8.1.2

3.12.7 Fruit yield and yield components

3.12.7.1 Number of fruits per plant

The number of fruits per plant were recorded by following the procedure as explained under 3.9.1.

3.12.7.2 Fruit yield per plant

The fruit yield per plant was recorded by following the procedure as explained under 3.9.2.

3.12.7.3 Fruit yield per plot

The fruit yield per plot was recorded by following the procedure as explained under 3.9.3.

3.12.7.4 Fruit yield per hectare

The fruit yield per hectare was worked out by following the procedure as explained under 3.9.4.

3.12.8 Seed yield and yield components

3.12.8.1 Seed yield per plant

The seeds yield per plant was recorded by following the procedure as explained under 3.10.1

3.12.8.2 Seed yield per plot

The seed yield per plot was recorded by following the procedure as explained under 3.10.2

3.12.8.3 Seed yield per hectare

The seed yield per hectare was worked out by following the procedure as explained under 3.10.3.

3.12.8.4 Seed recovery per cent

The seed recovery per cent was worked out by following the procedure as explained under 3.10.4.

3.12.8.5 Economics of seed production

The economics of seed production was worked out by following the procedure as explained under 3.10.5.

3.12.9 Seed quality attributes

3.12.9.1 1000 seed weight (g)

The 1000 seed weight was worked out by following the procedure as explained under 3.11.1

3.12.9.2 Germination (%)

Germination test was conducted by following the procedure as explained under 3.11.2

3.12.9.3 Shoot length (cm)

The shoot length was worked out by following the procedure as explained under 3.11.3

3.12.9.4 Root length (cm)

The root length was worked out by following the procedure as explained under 3.11.4

3.12.9.5 Seedling dry weight (mg)

The seedlings dry weight was worked out by following the procedure as explained under 3.11.5

3.12.9.6 Seedling vigour index

The seedling vigour index was calculated by following the method as explained under 3.11.6

3.12.9.7 Electrical conductivity of seed leachate (dSm-1)

The electrical conductivity of seed leachate was recorded by following the procedure as explained under 3.11.7

3.12.10 Statistical analysis

Statistical analysis of the data for both the experiments was done by following the Fisher's analysis of variance technique as given by Panse and Sukhatme (1967). The level of significance used in F-test was 0.05.

EXPERIMENTAL RESULTS

IV. EXPERIMENTAL RESULTS

EXPERIMENT – I : Effect of mother plant nutrition on seed yield and quality in tomato

4.1 Plant height

The data on plant height at harvest as influenced by mother plant nutrition are presented in Table 1.

Mother plant nutrition significantly influenced the plant height. Maximum plant height (114.8 cm) was observed in T_{12} which was on par with T_{11}, T_9, T_{10}, T_8, T_7, T_6 and differed significantly with rest of the treatments. The lowest plant height (72.8 cm) was recorded in T_1.

4.2 Number of branches per plant

The data on number of primary, secondary and tertiary branches per plant as influenced by varied levels of mother plant nutrition are presented in Table 1.

The number of branches per plant differed significantly among the treatments. Maximum number of primary branches per plant were recorded in T_{12} (2.4) which was on par with T_6, T_7, T_8, T_9, T_{10} and T_{11}. But differed significantly from rest of the treatments. The lowest and equal number of primary branches per plant recorded in T_1 and T_2 (1.2).

Similarly, the highest number of secondary branches per plant were recorded in T_{12} (9.5) which was significantly superior over other treatments except T_6, T_7, T_8, T_9, T_{10} and T_{11} which were on par with each other. The lowest secondary branches per plant were recorded in T_1 (4.2).

The maximum number of tertiary branches per plant were recorded on T_{12} (5.5) which was on par with T_9, T_{10} and T_{11}. But differed significantly from rest of the treatments. The lowest number of tertiary branches per plant were recorded in T_1 (2.6).

4.3 Days to 50 per cent flowering

The data pertaining to days taken for 50 per cent flowering as influenced by mother plant nutrition are presented in Table 1.

Significant differences were noticed for days taken for 50 per cent flowering due to different levels of N and P. With increase in the level of N and P, days to 50 per cent flowering showed increasing trend. The significantly more and equal number of days (34 days) for 50 per cent flowering were noticed in T_{10}, T_{11} and T_{12} and they were on par with T_4, T_5, T_6, T_7, T_8 and T_9 and significantly differed from rest of the treatments. Lower and equal number of days (28 days) were recorded with the application of higher doses of N and P (T_1 and T_2).

4.4 Number of fruits per plant

The data on total number of fruits per plant at different pickings as influenced by varied levels of mother plant nutrition are presented in Table 2.

Number of fruits per plant differed significantly among the treatments. Maximum total number of fruits per plant were recorded in the treatment T_{12} (41.5) which was on par with T_6, T_7, T_8, T_9, T_{10} and T_{11}. But significantly differed from

Table 1. Plant height (cm), number of primary, secondary and tertiary branches per plant and days to 50 per cent flowering as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	Plant height (cm) at harvest	Primary branches	Secondary branches	Tertiary branches	Days to 50% flowering
T_1 (60 : 60 : 80 kg/ha)	72.8	1.2	4.2	2.6	28.0
T_2 (60 : 120 : 80 kg/ha)	77.6	1.2	4.8	2.8	28.0
T_3 (60 : 180 : 80 kg/ha)	80.7	1.4	5.1	3.0	29.0
T_4 (120 : 60 : 80 kg/ha)	85.7	1.5	5.7	3.1	30.0
T_5 (120 : 120 : 80 kg/ha)	94.4	1.6	6.0	3.0	30.0
T_6 (120 : 180 : 80 kg/ha)	110.5	1.9	7.8	4.2	31.0
T_7 (180 : 60 : 80 kg/ha)	110.7	2.0	7.9	4.3	32.0
T_8 (180 : 120: 80 kg/ha)	110.9	2.0	8.3	4.7	32.0
T_9 (180 : 180 : 80 kg/ha)	111.9	2.1	8.6	4.9	33.0
T_{10} (240 : 60 : 80 kg/ha)	111.0	2.2	8.8	5.0	34.0
T_{11} (240 : 120 : 80 kg/ha)	112.0	2.3	8.8	5.3	34.0
T_{12} (240 : 180 : 80 kg/ha)	114.8	2.4	9.5	5.5	34.0
Mean	99.3	1.8	7.1	4.0	31.2
S.Em ±	4.3	0.2	0.6	0.2	1.2
CD at 5%	12.6	0.5	1.7	0.6	3.7

Table 2. Number of fruits per plant as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total No. of fruits
T_1 (60 : 60 : 80 kg/ha)	5.1	5.7	4.1	4.3	19.3
T_2 (60 : 120 : 80 kg/ha)	6.8	7.2	5.2	5.3	24.5
T_3 (60 : 180 : 80 kg/ha)	6.9	7.9	6.1	5.5	26.6
T_4 (120 : 60 : 80 kg/ha)	7.0	8.7	7.0	5.7	29.5
T_5 (120 : 120 : 80 kg/ha)	7.0	8.9	7.1	5.7	31.4
T_6 (120 : 180 : 80 kg/ha)	10.5	11.5	7.8	7.5	37.0
T_7 (180 : 60 : 80 kg/ha)	10.5	11.7	7.9	7.3	37.1
T_8 (180 : 120: 80 kg/ha)	10.9	11.7	8.2	7.9	38.3
T_9 (180 : 180 : 80 kg/ha)	10.5	12.1	8.6	8.1	38.3
T_{10} (240 : 60 : 80 kg/ha)	11.4	12.1	8.2	8.5	40.1
T_{11} (240 : 120 : 80 kg/ha)	11.5	12.1	8.6	8.7	40.9
T_{12} (240 : 180 : 80 kg/ha)	11.5	12.1	9.1	8.9	41.5
Mean	9.1	10.1	7.3	7.0	33.7
S.Em ±	1.1	0.9	0.8	0.6	1.6
CD at 5%	3.3	2.6	2.3	1.8	4.9

rest of the treatments. The lowest number of fruits per plant recorded in T_1 (19.3).

Similar trend was noticed in first, second and fourth pickings but in third picking treatment T_{12} recorded maximum number of fruits per plant (9.1), was on par with T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}. The average number of fruits per plant was maximum in second picking (10.1) followed by first, third and fourth picking (9.1, 7.3 and 7.0, respectively). The mean total number of fruits per plant was 33.7.

4.5 Fruit yield per plant

The data on fruit yield per plant based on four pickings as influenced by mother plant nutrition are presented in Table 3.

The fruit yield per plant was significantly influenced by increased level of N and P. With increase in level of N and P, there was a significant increase in fruit yield per plant. Highest total fruit yield per plant was recorded in the treatment T_{12} (2058.3 g) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but significantly differed from rest of the treatments. The lowest fruit yield (807.7 g) per plant was noticed in T_1.

Similar trend was noticed in all the four pickings. The average fruit yield per plant was maximum in second picking (493.0 g) which was followed by first and third picking (452.7 and 352.9 g, respectively). The fourth picking recorded the lowest fruit yield (333.0 g). The mean total fruit yield per plant was 1631.4 g.

Table 3. Fruit yield per plant (g) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total fruit yield
T_1 (60 : 60 : 80 kg/ha)	213.3	240.7	173.0	180.7	807.7
T_2 (60 : 120 : 80 kg/ha)	285.0	301.3	216.3	220.0	1022.7
T_3 (60 : 180 : 80 kg/ha)	306.7	348.7	267.0	242.7	1165.0
T_4 (120 : 60 : 80 kg/ha)	385.3	418.3	336.0	273.0	1412.7
T_5 (120 : 120 : 80 kg/ha)	409.3	448.0	340.3	301.3	1502.0
T_6 (120 : 180 : 80 kg/ha)	523.3	573.3	390.0	373.3	1860.0
T_7 (180 : 60 : 80 kg/ha)	525.7	586.7	395.7	354.0	1858.7
T_8 (180 : 120: 80 kg/ha)	543.3	583.3	410.0	376.7	1913.3
T_9 (180 : 180 : 80 kg/ha)	523.3	606.7	418.3	380.7	1929.0
T_{10} (240 : 60 : 80 kg/ha)	569.3	602.7	409.7	428.3	2005.0
T_{11} (240 : 120 : 80 kg/ha)	571.7	601.7	430.0	439.0	2042.3
T_{12} (240 : 180 : 80 kg/ha)	573.3	605.0	448.3	431.7	2058.3
Mean	452.7	493.0	352.9	333.0	1631.4
S.Em ±	55.8	41.6	37.0	30.5	75.7
CD at 5%	163.7	122.0	107.5	89.4	222.0

4.6 Fruit yield per plot (kg)

The data on fruit yield per plot at different pickings and total fruit yield per plot as influenced by varied levels of mother plant nutrition are presented in Table 4.

The fruit yield per plot was significantly influenced by increased levels of N and P. With increase in level of N and P, there was significant increase in fruit yield per plot. Maximum total fruit yield per plot was recorded in T_{12} (24.82 kg) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but significantly differed from rest of the treatments. The treatment T_1 recorded lowest fruit yield (10.5 kg). Similar trend was noticed in first, second and third picking. But in fourth picking, treatment T_6 recorded maximum fruit yield (4.7 kg) which was on par with T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12}. The average fruit yield per plot was maximum in second picking (5.7 kg) which was followed by first, third and fourth picking (5.4, 5.2 and 3.5 kg, respectively).

4.7 Fruit yield per hectare

The data on fruit yield per hectare at different pickings and total fruit yield per hectare as influenced by mother plant nutrition are presented in Table 5.

Fruit yield per hectare differed significantly among the treatments. Highest total fruit yield was recorded in treatment T_{12} (34.5 t) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6 but differed significantly from rest of the treatments. The lowest fruit yield (14.5 t) was recorded in T_1. Similar trend was observed in first, second and third

Table 4. Fruit yield per plot (kg) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total fruit yield
T_1 (60 : 60 : 80 kg/ha)	2.8	3.2	3.0	1.5	10.5
T_2 (60 : 120 : 80 kg/ha)	3.2	3.8	3.3	2.2	12.4
T_3 (60 : 180 : 80 kg/ha)	3.6	4.1	3.6	2.6	13.9
T_4 (120 : 60 : 80 kg/ha)	4.3	4.8	4.3	2.5	15.8
T_5 (120 : 120 : 80 kg/ha)	4.3	5.4	4.3	3.5	17.4
T_6 (120 : 180 : 80 kg/ha)	5.8	6.2	5.8	4.7	22.5
T_7 (180 : 60 : 80 kg/ha)	6.0	6.2	6.2	4.3	22.8
T_8 (180 : 120: 80 kg/ha)	7.6	6.7	6.3	4.2	23.4
T_9 (180 : 180 : 80 kg/ha)	6.4	6.8	6.3	4.5	23.9
T_{10} (240 : 60 : 80 kg/ha)	6.5	7.0	6.2	4.3	24.0
T_{11} (240 : 120 : 80 kg/ha)	6.9	7.0	6.5	4.2	24.6
T_{12} (240 : 180 : 80 kg/ha)	7.0	7.1	6.5	4.2	24.8
Mean	5.4	5.7	5.2	3.5	19.7
S.Em ±	0.5	0.3	0.3	0.3	1.1
CD at 5%	1.3	1.0	1.0	0.9	3.1

Table 5. Fruit yield per hectare (t) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total fruit yield
T_1 (60 : 60 : 80 kg/ha)	3.9	4.4	4.2	2.0	14.5
T_2 (60 : 120 : 80 kg/ha)	4.4	5.3	4.5	3.0	17.3
T_3 (60 : 180 : 80 kg/ha)	5.0	5.6	5.0	3.7	19.3
T_4 (120 : 60 : 80 kg/ha)	5.9	6.7	6.0	3.4	22.0
T_5 (120 : 120 : 80 kg/ha)	5.9	7.5	5.9	4.8	24.2
T_6 (120 : 180 : 80 kg/ha)	8.1	8.6	8.1	6.5	31.3
T_7 (180 : 60 : 80 kg/ha)	8.4	8.7	8.5	6.0	31.6
T_8 (180 : 120: 80 kg/ha)	8.6	9.2	8.7	5.8	32.5
T_9 (180 : 180 : 80 kg/ha)	8.8	9.4	8.8	6.2	33.2
T_{10} (240 : 60 : 80 kg/ha)	9.0	9.7	8.7	5.9	33.3
T_{11} (240 : 120 : 80 kg/ha)	9.6	9.7	9.1	5.8	34.2
T_{12} (240 : 180 : 80 kg/ha)	9.7	9.8	9.1	5.9	34.5
Mean	7.4	7.9	7.2	4.9	27.3
S.Em ±	0.6	0.5	0.5	0.4	1.5
CD at 5%	1.8	1.4	1.4	1.1	4.3

pickings but in fourth picking, maximum fruit yield was observed in T_6 (6.5 t) which was on par with T_7, T_8, T_9, T_{10}, T_{11} and T_{12}. The lowest fruit yield was noticed in T_1 (2.0 t). The average fruit yield per hectare was highest in second picking (7.9 t) followed by first, third and fourth picking (7.4, 7.2 and 4.9 t/ha, respectively). The mean total fruit yield per hectare was 27.3 t.

4.8 Seed yield per plant (g)

The data on seed yield per plant at different pickings and total seed yield per plant as influenced by varied levels of mother plant nutrition are presented in Table 6.

Significant difference was noticed for seed yield per plant due to different levels of N and P. The treatment T_{12} recorded significantly highest total seed yield (13.98 g) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but differed significantly with rest of the treatments. The lowest seed yield per plant was noticed in T_1 (4.52 g). Similar trend was observed in first, second, third and fourth pickings. The average seed yield per plant was maximum in second picking (3.21 g) which was followed by first, third and fourth picking (2.96, 2.29 and 2.16 g, respectively). The average total seed yield was 10.63 g per plant.

4.9 Seed yield per plot (g)

The data on seed yield per plot at different pickings and total seed yield per plot as influenced by varied levels of mother plant nutrition are presented in Table 7.

Table 6. Seed yield per plant (g) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total seed yield
T_1 (60 : 60 : 80 kg/ha)	1.21	1.27	1.00	1.05	4.52
T_2 (60 : 120 : 80 kg/ha)	1.65	1.72	1.22	1.26	5.86
T_3 (60 : 180 : 80 kg/ha)	1.84	2.08	1.54	1.42	6.88
T_4 (120 : 60 : 80 kg/ha)	2.30	2.49	2.06	1.68	8.53
T_5 (120 : 120 : 80 kg/ha)	2.48	2.57	2.12	1.87	9.20
T_6 (120 : 180 : 80 kg/ha)	3.56	3.83	2.65	2.29	12.33
T_7 (180 : 60 : 80 kg/ha)	3.57	3.94	2.68	2.40	12.59
T_8 (180 : 120: 80 kg/ha)	3.63	3.99	2.76	2.52	12.90
T_9 (180 : 180 : 80 kg/ha)	3.56	4.10	2.82	2.57	13.05
T_{10} (240 : 60 : 80 kg/ha)	3.86	4.15	2.78	2.83	13.62
T_{11} (240 : 120 : 80 kg/ha)	3.92	4.15	2.86	3.00	13.93
T_{12} (240 : 180 : 80 kg/ha)	3.96	4.18	3.00	3.00	13.98
Mean	2.96	3.21	2.29	2.16	10.63
S.Em ±	0.28	0.38	0.24	0.24	0.63
CD at 5%	0.81	1.11	0.71	0.70	1.86

Table 7. Seed yield per plot (g) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total seed yield
T_1 (60 : 60 : 80 kg/ha)	16.24	18.89	17.40	8.41	60.60
T_2 (60 : 120 : 80 kg/ha)	18.56	22.00	18.90	12.58	72.04
T_3 (60 : 180 : 80 kg/ha)	21.80	24.14	21.96	16.10	84.20
T_4 (120 : 60 : 80 kg/ha)	26.30	29.76	26.63	15.30	98.02
T_5 (120 : 120 : 80 kg/ha)	26.76	32.91	26.94	21.79	108.40
T_6 (120 : 180 : 80 kg/ha)	39.40	38.66	38.64	31.96	152.00
T_7 (180 : 60 : 80 kg/ha)	41.00	42.43	40.13	29.44	153.00
T_8 (180 : 120: 80 kg/ha)	42.70	45.22	42.46	28.62	159.00
T_9 (180 : 180 : 80 kg/ha)	43.14	46.10	42.80	30.26	162.30
T_{10} (240 : 60 : 80 kg/ha)	44.85	48.16	42.77	29.52	165.30
T_{11} (240 : 120 : 80 kg/ha)	47.61	48.30	47.77	28.98	169.33
T_{12} (240 : 180 : 80 kg/ha)	48.30	48.85	44.98	29.10	171.25
Mean	34.72	37.12	34.28	23.51	129.62
S.Em ±	3.30	2.71	2.71	1.03	7.06
CD at 5%	9.67	7.94	7.94	3.01	20.69

The total seed yield per plant was significantly influenced by different levels of N and P. Maximum total seed yield per plot was noticed in T_{12} (171.25 g) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but significantly differed from rest of the treatments. The treatment T_1 recorded lowest total seed yield per plot (60.6 g). Similar trend in seed yield per plot was noticed in first three pickings, but in fourth picking, the treatment T_6 recorded maximum seed yield (31.96 g) which was on par with T_9, T_7, T_{12}, T_{11}, T_{10}, T_9 and T_8. In the fourth picking the lowest seed yield was noticed in T_1 (8.41 g). The average seed yield per plot was maximum in second picking (37.12 g) which was followed by first (34.12 g), third (34.28 g) and fourth picking (23.50 g). The average total seed yield per plot was 129.62 g.

4.10 Seed yield per hectare (kg)

The data on seed yield per hectare at different pickings and total seed yield per ha as influenced by varied levels of mother plant nutrition are presented in Table 8.

The total seed yield per hectare was significantly influenced by different level of N and P. Maximum total seed yield per ha was noticed in T_{12} (237.87 kg) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but differed significantly from rest of the treatments. The treatment T_1 recorded lowest total seed yield per hectare (84.17 kg). Similar trend was observed in first, second and third pickings, but in fourth picking, the maximum seed yield was recorded in T_6 (44.39 kg) which was on par with T_9, T_{10}, T_7, T_{12}, T_{11} and T_8. The treatment T_1

Table 8. Seed yield per hectare (kg) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	Total seed yield
T_1 (60 : 60 : 80 kg/ha)	22.58	26.24	24.17	11.68	84.17
T_2 (60 : 120 : 80 kg/ha)	25.78	30.56	26.25	17.47	100.06
T_3 (60 : 180 : 80 kg/ha)	30.28	33.53	30.50	22.36	116.95
T_4 (120 : 60 : 80 kg/ha)	36.53	41.34	36.99	21.25	136.15
T_5 (120 : 120 : 80 kg/ha)	37.17	45.71	37.42	30.27	150.57
T_6 (120 : 180 : 80 kg/ha)	54.73	53.71	53.67	44.39	211.13
T_7 (180 : 60 : 80 kg/ha)	56.95	58.94	55.74	40.89	212.52
T_8 (180 : 120: 80 kg/ha)	59.31	62.81	58.98	39.75	220.85
T_9 (180 : 180 : 80 kg/ha)	59.92	64.03	59.45	42.03	225.44
T_{10} (240 : 60 : 80 kg/ha)	62.29	66.89	59.41	41.00	229.60
T_{11} (240 : 120 : 80 kg/ha)	66.13	67.09	66.36	40.25	235.20
T_{12} (240 : 180 : 80 kg/ha)	67.09	67.85	62.48	40.42	237.87
Mean	48.23	51.56	47.62	32.65	180.04
S.Em ±	4.58	3.76	3.76	1.43	9.80
CD at 5%	13.43	11.03	11.03	4.19	28.74

LEGEND

TREATMENTS

$(N : P_2O_5 : K_2O)$

T_1 (60 : 60 : 80 kg/ha)

T_2 (60 : 120 : 80 kg/ha)

T_3 (60 : 180 : 80 kg/ha)

T_4 (120 : 60 : 80 kg/ha)

T_5 (120 : 120 : 80 kg/ha)

T_6 (120 : 180 : 80 kg/ha)

T_7 (180 : 60 : 80 kg/ha)

T_8 (180 : 120: 80 kg/ha)

T_9 (180 : 180 : 80 kg/ha)

T_{10} (240 : 60 : 80 kg/ha)

T_{11} (240 : 120 : 80 kg/ha)

T_{12} (240 : 180 : 80 kg/ha)

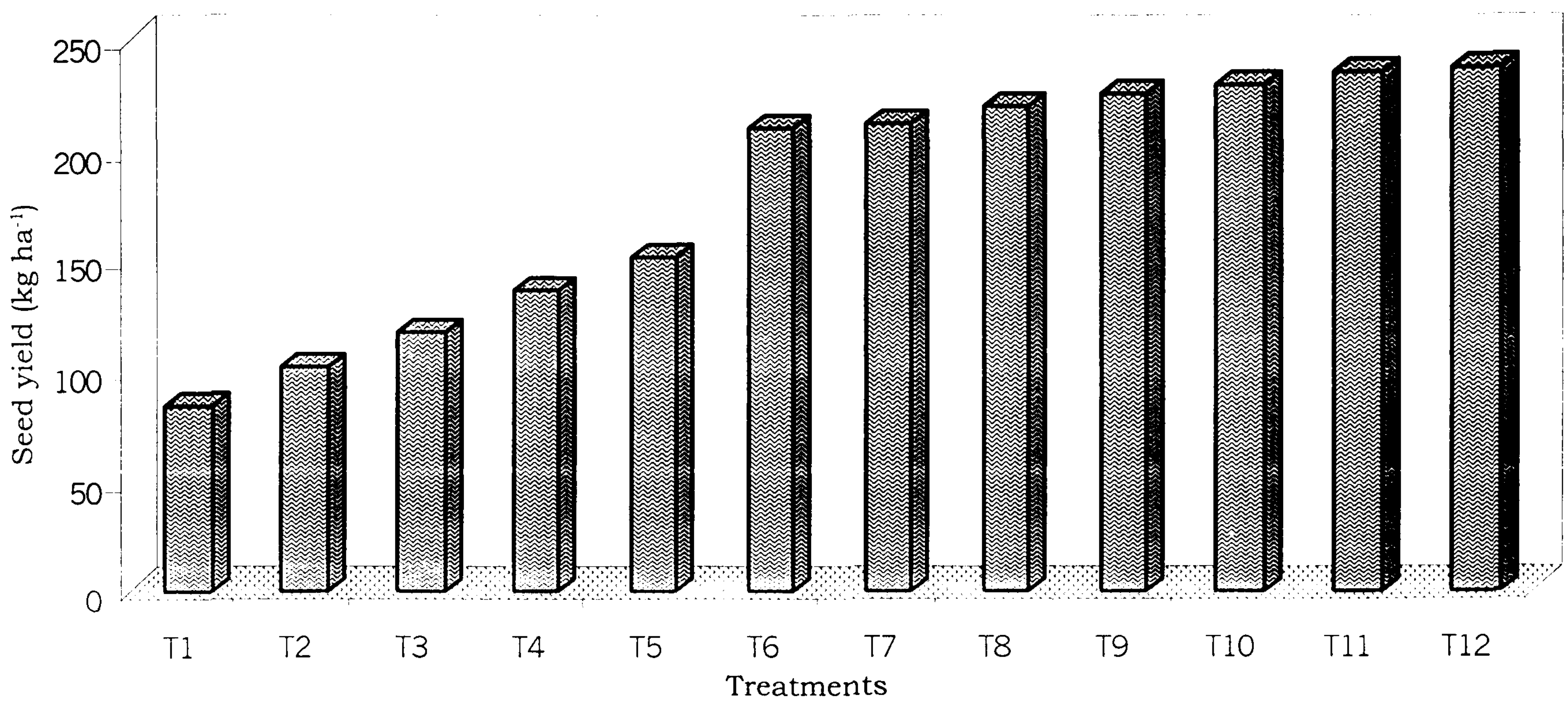


Fig. 3. Seed yield (kg ha^{-1}) as influenced by Mother plant nutrition in tomato Cv. Megha (L-15)

recorded lowest seed yield per hectare (11.68 kg). The average seed yield per hectare was maximum in second picking (51.56 kg) which was followed by first (48.23 kg) and third (47.62 kg) and the lowest seed yield was in fourth picking (32.65 kg). The average total seed yield per ha was 180.04 kg.

4.11 Seed recovery per cent

The data on seed recovery per cent at different pickings and for total yield as influenced by varied levels of mother plant nutrition are presented in Table 11.

The seed recovery per cent was significantly influenced by different level of N and P. The maximum seed recovery per cent was recorded in T_7 (0.70%) which was on par with T_6, T_8, T_9, T_{10}, T_{11} and T_{12} but differed significantly from rest of the treatments in first picking. The lowest and equal seed recovery per cent was recorded in T_1 and T_2 (0.56%). Similar trend was noticed in first, second, third and fourth picking. For seed recovery per cent of total yield, the treatments T_8, T_9, T_{10}, T_{11} and T_{12} recorded significantly maximum and equal values (0.68%) as compared to rest of the treatments except T_7, T_4, T_5 and T_6 which were on par with each other. The average seed recovery per cent was maximum and equal in first, second and fourth pickings (0.63%) followed by third picking. The average seed recovery per cent of total yield was 0.64.

Table 9. Seed recovery per cent as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking (%)	II Picking (%)	III Picking (%)	IV Picking (%)	For total yield (%)
T_1 (60 : 60 : 80 kg/ha)	0.56	0.52	0.57	0.57	0.56
T_2 (60 : 120 : 80 kg/ha)	0.56	0.57	0.56	0.57	0.58
T_3 (60 : 180 : 80 kg/ha)	0.58	0.59	0.57	0.58	0.59
T_4 (120 : 60 : 80 kg/ha)	0.59	0.59	0.56	0.61	0.60
T_5 (120 : 120 : 80 kg/ha)	0.58	0.57	0.62	0.61	0.61
T_6 (120 : 180 : 80 kg/ha)	0.66	0.66	0.67	0.61	0.66
T_7 (180 : 60 : 80 kg/ha)	0.70	0.66	0.67	0.67	0.68
T_8 (180 : 120: 80 kg/ha)	0.66	0.68	0.67	0.66	0.67
T_9 (180 : 180 : 80 kg/ha)	0.66	0.67	0.67	0.67	0.68
T_{10} (240 : 60 : 80 kg/ha)	0.66	0.68	0.67	0.66	0.68
T_{11} (240 : 120 : 80 kg/ha)	0.68	0.68	0.66	0.68	0.68
T_{12} (240 : 180 : 80 kg/ha)	0.68	0.69	0.66	0.69	0.68
Mean	0.63	0.63	0.62	0.63	0.64
S.Em ±	0.04	0.03	0.02	0.04	0.03
CD at 5%	0.11	0.08	0.06	0.10	0.08

4.12 1000 seed weight

The data on thousand seed weight at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 10.

There were significant differences among the treatments due to 1000 seed weight. Maximum 1000 seed weight was noticed in T_6 (4.30 g) in first picking which was on par with T_7, T_8, T_9, T_{10}, T_{11} and T_{12}, but differed significantly with rest of the treatments. The lowest 1000 seed weight was recorded in T_1 (3.04 g).

In second picking, the maximum 1000 seed weight was noticed in T_6 (4.28 g) which was on par with T_7, T_8, T_9 and T_{10} but differed significantly from rest of the treatments. The treatment T_1 recorded lowest 1000 seed weight (3.05 g).

In third picking, the highest 1000 seed weight was noticed in T_6 (3.84 g) which was on par with T_5, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} but differed significantly from rest of the treatments. Similar trend was noticed in fourth picking also.

In composite sample, the highest 1000 seed weight was recorded in T_7 (4.08 g) which was on par with T_6, T_8, T_9, T_{10}, T_{11} and T_{12} but differed significantly with rest of the treatments. The lowest 1000 seed weight was observed in T_1 (2.9 g).

The average 1000 seed weight was maximum in first picking (3.82 g) which was followed by second (3.79 g), third (3.56 g) and lowest average 1000 seed weight was recorded in

Table 10. 1000 seed weight (g) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	3.04	3.05	2.88	2.17	2.90
T_2 (60 : 120 : 80 kg/ha)	3.08	3.25	2.86	2.42	2.98
T_3 (60 : 180 : 80 kg/ha)	3.35	3.30	3.45	2.59	3.20
T_4 (120 : 60 : 80 kg/ha)	3.46	3.38	3.17	2.73	3.26
T_5 (120 : 120 : 80 kg/ha)	3.82	3.90	3.56	2.78	3.81
T_6 (120 : 180 : 80 kg/ha)	4.30	4.28	3.84	3.08	4.10
T_7 (180 : 60 : 80 kg/ha)	4.28	4.24	3.80	3.00	4.08
T_8 (180 : 120: 80 kg/ha)	4.25	4.22	3.78	3.04	4.09
T_9 (180 : 180 : 80 kg/ha)	4.20	4.00	3.80	3.06	4.00
T_{10} (240 : 60 : 80 kg/ha)	4.20	4.00	3.82	3.08	3.98
T_{11} (240 : 120 : 80 kg/ha)	4.00	3.96	3.81	2.99	3.98
T_{12} (240 : 180 : 80 kg/ha)	3.96	3.90	3.82	3.07	3.96
Mean	3.82	3.79	3.56	2.84	3.69
S.Em ±	0.13	0.93	0.11	0.06	0.90
CD at 5%	0.37	0.28	0.31	0.16	0.25

fourth picking (2.84 g). The average 1000 seed weight of composite sample was 3.69 g.

4.13 Germination percentage

The data on per cent seed germination at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 11.

There were significant differences on per cent seed germination among the treatments due to different levels of N and P. In first picking, the highest per cent germination was recorded in T_6 (98.5 %) which differed significantly from T_9, T_{10}, T_{11}, T_{12}, T_1, T_2, T_3 and on par with T_4, T_5, T_7 and T_8. The lowest percentage of germination was recorded in T_1 (89.50 %).

In second picking, the highest per cent germination was recorded in T_6 (97.75 %) which was on par with T_7, T_5, T_8, T_4, T9 and T_3 and differed significantly with rest of the treatments. The lowest germination per cent was recorded in T_1 (84.50 %).

In third picking, the maximum percent germination was observed in T_6 (92.25 %) which differed significantly from T_{12}, T_3, T_2 and T_1 and on par with T_7, T_8, T_9, T_{10}, T_{11}, T_5 and T_4. The treatment T_1 recorded lowest germination per cent (82.25 %).

The treatments showed non significant difference in fourth picking.

In composite sample, the highest per cent germination was recorded in T_6 (92.25 %) which was on par with T_4, T_5,

Table 11. Germination percentage as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	89.50 (71.37)	84.50 (66.91)	82.25 (65.17)	73.25 (58.89)	81.50 (64.52)
T_2 (60 : 120 : 80 kg/ha)	90.75 (73.15)	88.25 (70.22)	82.75 (65.55)	75.75 (60.53)	83.75 (66.27)
T_3 (60 : 180 : 80 kg/ha)	92.25 (74.20)	91.50 (74.18)	84.25 (66.75)	76.50 (61.05)	85.50 (67.62)
T_4 (120 : 60 : 80 kg/ha)	95.75 (78.30)	93.20 (76.22)	87.75 (69.52)	78.25 (62.23)	88.25 (70.00)
T_5 (120 : 120 : 80 kg/ha)	97.25 (80.55)	95.75 (78.36)	90.75 (73.15)	78.75 (62.62)	91.00 (72.54)
T_6 (120 : 180 : 80 kg/ha)	98.50 (83.06)	97.75 (81.61)	92.25 (74.18)	80.50 (63.89)	92.25 (73.89)
T_7 (180 : 60 : 80 kg/ha)	96.25 (79.29)	96.50 (79.35)	91.50 (73.79)	80.50 (63.90)	92.00 (73.57)
T_8 (180 : 120: 80 kg/ha)	96.00 (78.62)	93.75 (75.97)	90.75 (73.15)	78.50 (62.40)	90.25 (71.85)
T_9 (180 : 180 : 80 kg/ha)	93.50 (75.59)	93.25 (75.06)	89.75 (71.68)	75.75 (60.53)	89.75 (71.37)
T_{10} (240 : 60 : 80 kg/ha)	92.25 (74.18)	90.50 (72.83)	90.25 (72.19)	75.25 (60.21)	89.50 (71.09)
T_{11} (240 : 120 : 80 kg/ha)	92.50 (74.74)	90.75 (73.15)	86.50 (68.48)	75.75 (60.54)	87.25 (69.12)
T_{12} (240 : 180 : 80 kg/ha)	92.00 (73.89)	91.25 (73.75)	84.75 (67.10)	75.50 (60.36)	85.50 (67.62)
Mean	93.88 (76.38)	92.27 (74.77)	87.80 (70.06)	77.00 (61.43)	88.04 (69.95)
S.Em ±	1.77	2.18	2.18	1.78	2.10
CD at 5%	4.91	6.28	6.28	NS	6.18

* Figures in the paranthesis indicate arcsine transformed values. NS - Non significant

LEGEND

TREATMENTS

($N : P_2O_5 : K_2O$)

T_1 (60 : 60 : 80 kg/ha)

T_2 (60 : 120 : 80 kg/ha)

T_3 (60 : 180 : 80 kg/ha)

T_4 (120 : 60 : 80 kg/ha)

T_5 (120 : 120 : 80 kg/ha)

T_6 (120 : 180 : 80 kg/ha)

T_7 (180 : 60 : 80 kg/ha)

T_8 (180 : 120: 80 kg/ha)

T_9 (180 : 180 : 80 kg/ha)

T_{10} (240 : 60 : 80 kg/ha)

T_{11} (240 : 120 : 80 kg/ha)

T_{12} (240 : 180 : 80 kg/ha)

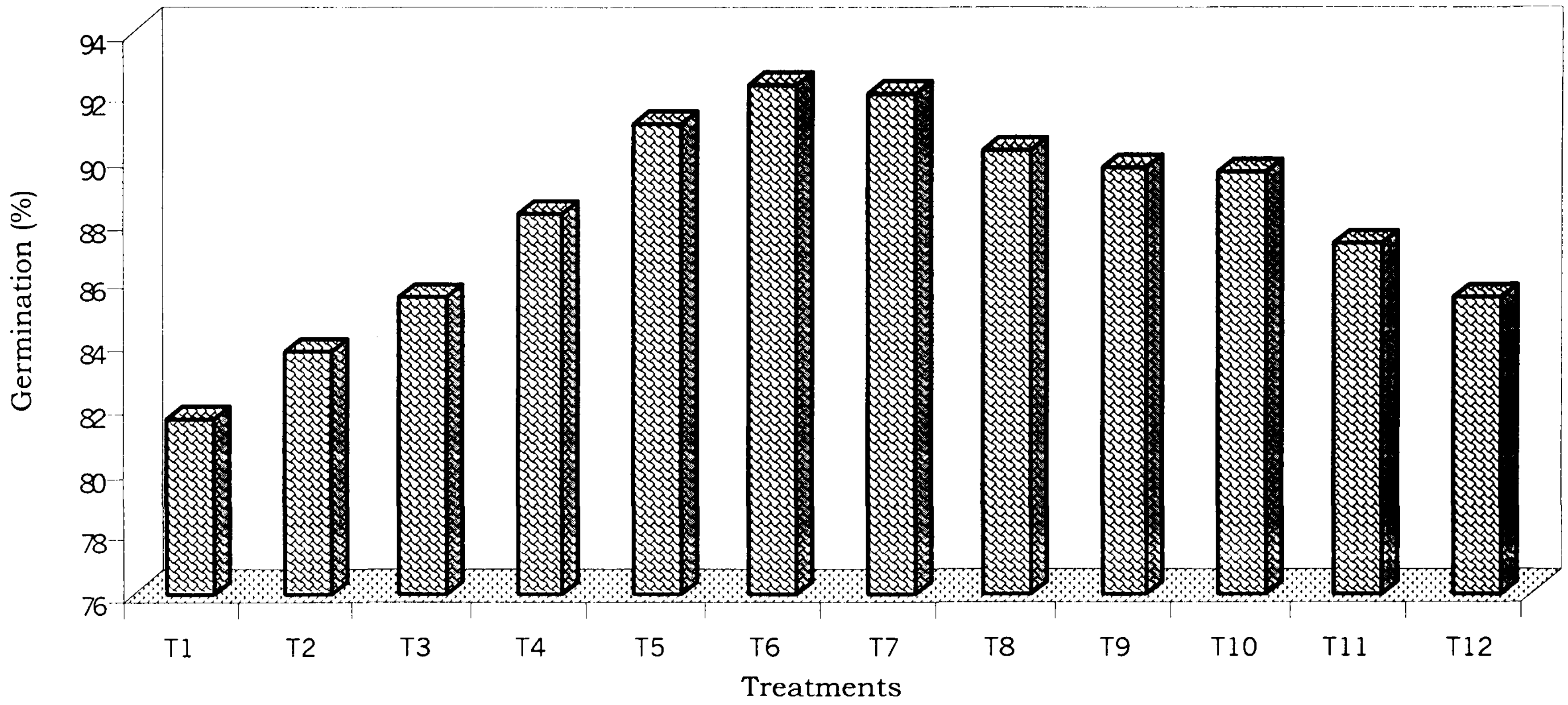


Fig. 4. Germination (%) as influenced by Mother plant nutrition in tomato Cv. Megha (L-15)

T_7, T_8, T_9, T_{10}, T_{11} and T_{12} but differed significantly from rest of the treatments. The lowest per cent germination was noticed in T_1 (81.50 %).

The average per cent germination was maximum in first picking (93.88 %) which was followed by second (92.27 %), third (87.80 %) and fourth picking (77.0 %). The average percent germination of composite sample was 88.04 per cent.

4.14 Seedling root length

The data on root length at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 12.

Mother plant nutrition significantly influenced the root length in all the pickings. In first picking treatment T_{12} recorded highest root length (5.98 cm) which was on par with T_{11}, T_{10}, T_9, but differed significantly with rest of the treatments. Treatment T_1 recorded lowest root length (3.32 cm).

In second picking T_{12} recorded the highest root length (5.83 cm) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6 but significantly differed with rest of the treatments. The lowest root length was recorded in T_1 (3.4 cm). Similar trend was noticed in third picking.

In fourth picking, T_8 recorded the highest root length (4.98 cm) which was significantly superior over rest of the treatments. The treatment T_1 recorded lowest root length (2.98 cm).

Table 12. Root length (cm) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	3.32	3.40	3.11	2.98	3.21
T_2 (60 : 120 : 80 kg/ha)	3.55	3.58	3.31	3.02	3.40
T_3 (60 : 180 : 80 kg/ha)	4.08	3.93	3.73	3.16	3.68
T_4 (120 : 60 : 80 kg/ha)	4.53	4.28	4.16	3.32	3.96
T_5 (120 : 120 : 80 kg/ha)	4.89	4.86	4.58	3.58	4.20
T_6 (120 : 180 : 80 kg/ha)	5.46	5.62	5.00	4.06	5.20
T_7 (180 : 60 : 80 kg/ha)	5.40	5.68	5.02	4.00	5.02
T_8 (180 : 120: 80 kg/ha)	5.49	5.52	5.26	4.98	5.18
T_9 (180 : 180 : 80 kg/ha)	5.76	5.70	5.29	4.16	5.20
T_{10} (240 : 60 : 80 kg/ha)	5.78	5.90	5.47	4.22	5.40
T_{11} (240 : 120 : 80 kg/ha)	5.93	5.92	5.42	4.29	5.42
T_{12} (240 : 180 : 80 kg/ha)	5.98	583	5.44	4.30	5.44
Mean	5.05	5.02	4.65	3.75	4.60
S.Em ±	0.12	0.16	0.14	0.11	0.14
CD at 5%	0.33	0.45	0.44	0.31	0.42

In composite sample, T_{12} recorded significantly highest root length (5.44 cm) over other treatments except T_7, T_8, T_9, T_{10} and T_{11} which were on par with each other. The lowest root length of 3.21 cm was observed in T_1.

The average root length was maximum in first picking (5.05 cm) which was followed by second (5.02), third (4.65 cm) and fourth picking (3.75 cm). The average root length of composite sample was 4.6 cm.

4.15 Seedling shoot length

The data on shoot length at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 13.

The shoot length was significantly influenced by different levels of N and P. The highest shoot length was recorded in T_{11} (8.7 cm) which was on par with T_{12}, T_9, T_{10}, T_8, T_7, T_6 and T_5. The lowest shoot length was recorded in T_1 (5.29 cm) in first picking.

In second picking, the maximum shoot length was recorded in T_{12} (8.98 cm) which was on par with T_{11}, T_{10}, T_9, T_8, T_7 and T_6, but differed significantly from rest of the treatments. The lowest shoot length was noticed in T_1 (5.3cm) Similar trend was noticed in third picking.

In fourth picking, T_{10} recorded the maximum shoot length (7.17 cm) which was on par with T_{12}, T_{11} and T_8 but significantly superior over rest of the treatments. The lowest shoot length was recorded in T_1 (3.86 cm).

Table 13. Shoot length (cm) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	5.29	5.30	4.98	3.86	4.79
T_2 (60 : 120 : 80 kg/ha)	5.80	6.78	5.98	4.98	4.98
T_3 (60 : 180 : 80 kg/ha)	6.94	7.20	6.21	5.12	5.85
T_4 (120 : 60 : 80 kg/ha)	7.28	7.53	6.48	5.35	6.20
T_5 (120 : 120 : 80 kg/ha)	8.52	7.93	6.63	5.38	6.58
T_6 (120 : 180 : 80 kg/ha)	8.56	8.54	7.91	6.00	7.20
T_7 (180 : 60 : 80 kg/ha)	8.60	8.50	7.90	6.28	7.10
T_8 (180 : 120: 80 kg/ha)	8.59	8.68	7.98	6.86	7.12
T_9 (180 : 180 : 80 kg/ha)	8.64	8.88	8.00	6.50	7.22
T_{10} (240 : 60 : 80 kg/ha)	8.62	8.79	7.96	7.17	7.34
T_{11} (240 : 120 : 80 kg/ha)	8.70	8.90	7.95	7.00	7.38
T_{12} (240 : 180 : 80 kg/ha)	8.68	8.98	8.02	7.10	7.53
Mean	7.85	7.99	7.16	5.96	6.51
S.Em ±	0.12	0.19	0.20	0.16	0.18
CD at 5%	0.37	0.56	0.59	0.45	0.55

In composite sample, the highest shoot length recorded in T_{12} (7.53 cm) which was on par with T_6, T_7, T_8, T_9, T_{10} and T_{11} but differed significantly with rest of the treatments. The treatment T_1 recorded lowest shoot length (4.79 cm).

The average shoot length was maximum in second picking (7.99 cm) which was followed by first (7.85 cm), third (7.16 cm) and fourth picking (5.96 cm). The average shoot length of composite sample was (6.51 cm).

4.16 Seedling vigour index

The data on vigour index at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 14.

Significant differences were observed for vigour index due to different levels of N and P. maximum vigour index was noticed in T_6 (1384) in first picking which was on par with T_{11}, T_8, T_7 and T_9, but significantly differed from rest of the treatments. The lower vigour index (767) was recorded in T_1.

In second picking also the treatment T_6 recorded highest vigour index (1384) which was on par with T_7, T_9, T_{12}, T_{11} but differed significantly from rest of the treatments. Treatment T_1 recorded significantly lowest vigour index (735).

In third picking, T_{10} recorded highest vigour index (1271) which was on par with T_8, T_9, T_6 and T_7, but differed significantly from rest of the treatments. The treatment T_1 recorded significantly lowest vigour index (690).

In fourth picking, T_{11} recorded highest vigour index (867) which was on par with T_{12}, T_{10}, T_8, T_7 and differed

Table 14. Seedling vigour index as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	767	735	690	501	652
T_2 (60 : 120 : 80 kg/ha)	848	914	753	606	702
T_3 (60 : 180 : 80 kg/ha)	1016	1018	898	633	815
T_4 (120 : 60 : 80 kg/ha)	1130	1104	1003	678	896
T_5 (120 : 120 : 80 kg/ha)	1304	1224	1188	705	981
T_6 (120 : 180 : 80 kg/ha)	1384	1384	1250	809	1144
T_7 (180 : 60 : 80 kg/ha)	1347	1368	1246	827	1115
T_8 (180 : 120: 80 kg/ha)	1351	1331	1256	850	1110
T_9 (180 : 180 : 80 kg/ha)	1346	1359	1250	807	1143
T_{10} (240 : 60 : 80 kg/ha)	1328	1327	1271	857	1140
T_{11} (240 : 120 : 80 kg/ha)	1353	1344	1221	867	1116
T_{12} (240 : 180 : 80 kg/ha)	1348	1351	1196	860	1108
Mean	1210	1204	1102	750	990
S.Em ±	16.53	15.80	15.80	15.70	14.90
CD at 5%	48.50	46.40	46.30	45.90	42.80

LEGEND

TREATMENTS

($N : P_2O_5 : K_2O$)

T_1 (60 : 60 : 80 kg/ha)

T_2 (60 : 120 : 80 kg/ha)

T_3 (60 : 180 : 80 kg/ha)

T_4 (120 : 60 : 80 kg/ha)

T_5 (120 : 120 : 80 kg/ha)

T_6 (120 : 180 : 80 kg/ha)

T_7 (180 : 60 : 80 kg/ha)

T_8 (180 : 120: 80 kg/ha)

T_9 (180 : 180 : 80 kg/ha)

T_{10} (240 : 60 : 80 kg/ha)

T_{11} (240 : 120 : 80 kg/ha)

T_{12} (240 : 180 : 80 kg/ha)

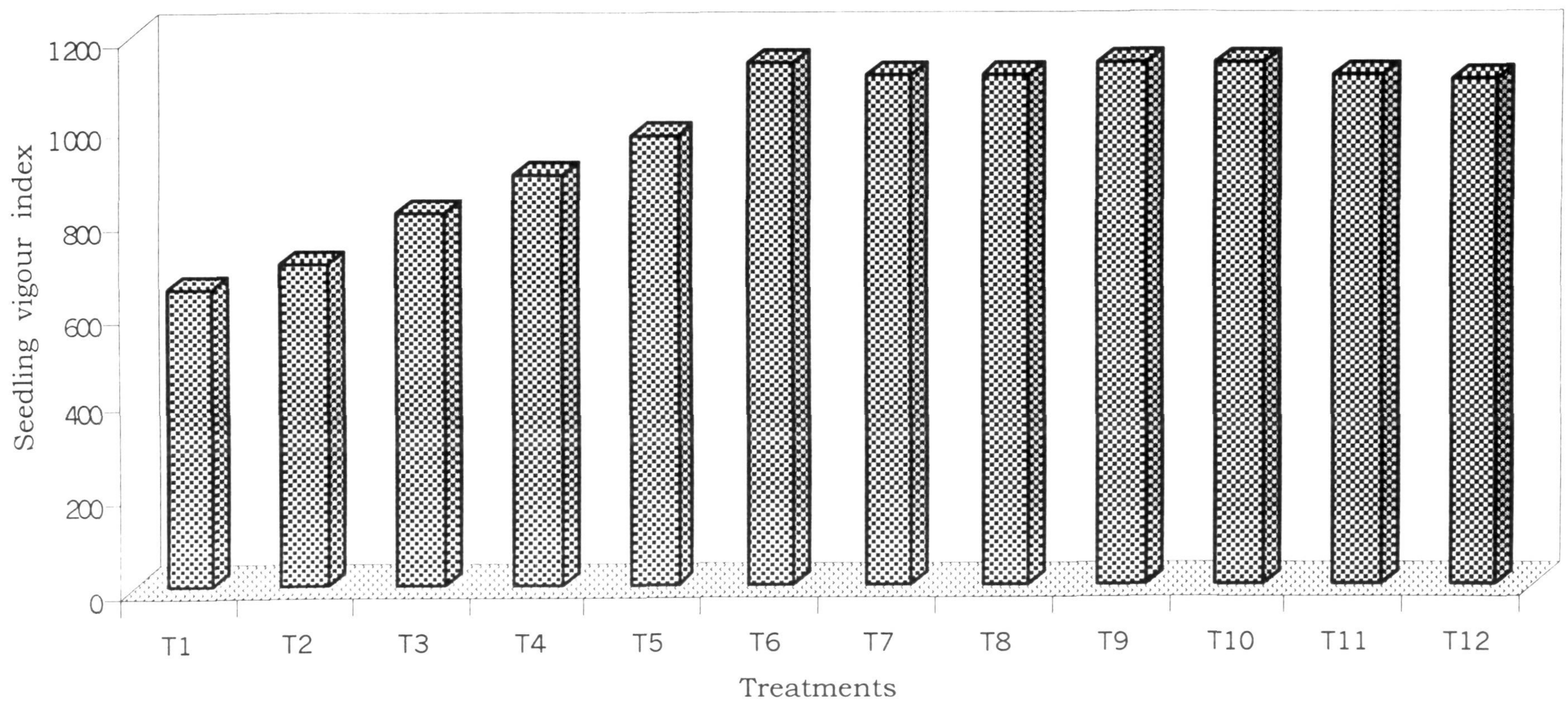


Fig. 5. Seedling vigour index as influenced by Mother plant nutrition in tomato Cv. Megha (L-15)

significantly from rest of the treatments. The treatment T_1 recorded lowest vigour index (501).

In composite sample, T_9 noticed significantly higher vigour index (1143) over other treatments except T_6, T_7, T_8, T_{10}, T_{11} and T_{12} which was on par with each other. The lowest vigour index was noticed in T_1 (652).

The average vigour index was maximum in first picking (1210) followed by second (1204) and third picking (1102) and lowest vigour index was noticed in fourth picking (750). The average vigour index of composite sample was 990.

4.17 Seedling dry weight (mg)

The data on seedling dry weight at different pickings and for composite sample as influenced by varied levels of mother plant nutrition are presented in Table 15.

The seedling dry weight was significantly influenced by increased levels of N and P in all the pickings. In first picking, the maximum and equal seedling dry weight was recorded in T_9 and T_{10} (32.5 mg) which were on par with T_6, T_8, T_{11}, T_{12} and T_7, but differed significantly from rest of the treatments. The lowest seedling dry weight was noticed in T_1 (18.25 mg).

In second picking, the maximum and equal seedling dry weight was recorded in T_7, T_{10} and T_{11} (32.0 mg) which were on par with T_6, T_9, T_{12} and T_8 but significantly differed from rest of the treatments. The treatment T_1 recorded significantly lower seedling dry weight (18.5 mg).

Table 15. Seedling dry weight (mg) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	18.25	18.50	16.50	15.25	16.58
T_2 (60 : 120 : 80 kg/ha)	22.25	21.25	17.25	16.50	17.50
T_3 (60 : 180 : 80 kg/ha)	26.50	27.50	20.00	18.00	22.25
T_4 (120 : 60 : 80 kg/ha)	28.75	27.75	22.50	18.75	25.50
T_5 (120 : 120 : 80 kg/ha)	29.50	28.50	24.25	20.50	26.25
T_6 (120 : 180 : 80 kg/ha)	32.25	31.75	28.00	25.25	29.50
T_7 (180 : 60 : 80 kg/ha)	32.00	32.00	28.25	25.00	29.25
T_8 (180 : 120: 80 kg/ha)	32.25	31.50	28.00	25.25	29.00
T_9 (180 : 180 : 80 kg/ha)	32.50	31.75	27.75	25.50	28.75
T_{10} (240 : 60 : 80 kg/ha)	32.50	32.00	28.00	24.75	28.50
T_{11} (240 : 120 : 80 kg/ha)	32.25	32.00	28.25	25.50	28.25
T_{12} (240 : 180 : 80 kg/ha)	32.25	31.75	28.25	25.75	28.25
Mean	29.27	28.85	24.75	22.17	25.79
S.Em ±	0.72	0.65	0.50	0.54	0.58
CD at 5%	2.07	1.87	1.43	1.55	1.76

In third picking, maximum and equal seedling dry weight was noticed in T_7, T_{11} and T_{12} (28.25 mg) which were on par with T_6, T_8 and T_{10} but differed significantly from rest of the treatments. The lowest seedling dry weight was noticed in T_1 (16.5 mg). Similar trend was noticed in fourth picking.

In composite sample, T_7 recorded significantly higher seedling dry weight (29.5 mg) over rest of the treatments except T_6, T_8, T_9, T_{10}, T_{11} and T_{12} which were on par with each other. The lowest seedling dry weight (16.58 mg) was noticed in T_1.

The average seedling dry weight was maximum in first picking (29.27 mg) which was followed by second (28.85 mg), third (24.75 mg) and fourth picking (22.17 mg), average seedling dry weight of composite sample was 16.58 mg.

4.18 Electrical conductivity (dSm^{-1})

The data on EC of seed leachate at different pickings and for composite sample as influenced by various levels of mother plant nutrition are presented in Table 16.

Significant differences were observed for EC due to different level of N and P. The lowest EC was noticed in T_6 (0.9 dSm^{-1}) which was on par with T_5, T_7 and T_8 but differed significantly from rest of the treatments in first picking. The highest EC was observed in T_1 (1.19 dSm^{-1}).

In second picking, the least EC was recorded in T_6 (0.97 dSm^{-1}) which was on par with T_5 and T_7 but differed significantly from rest of the treatments. The T_1 recorded highest EC (1.22 dSm^{-1}).

Table 16. Electrical conductivity of seed lenchates (dSm^{-1}) as influenced by mother plant nutrition in tomato Cv. Megha (L-15).

Treatments ($N : P_2O_5 : K_2O$)	I Picking	II Picking	III Picking	IV Picking	composite sample
T_1 (60 : 60 : 80 kg/ha)	1.19	1.22	1.36	1.85	1.22
T_2 (60 : 120 : 80 kg/ha)	1.14	1.21	1.32	1.80	1.21
T_3 (60 : 180 : 80 kg/ha)	1.08	1.20	1.28	1.77	1.19
T_4 (120 : 60 : 80 kg/ha)	0.99	1.11	1.20	1.71	1.06
T_5 (120 : 120 : 80 kg/ha)	0.96	0.99	1.10	1.68	0.99
T_6 (120 : 180 : 80 kg/ha)	0.90	0.97	1.10	1.62	0.94
T_7 (180 : 60 : 80 kg/ha)	0.91	0.99	1.12	1.64	0.94
T_8 (180 : 120: 80 kg/ha)	0.93	1.00	1.13	1.65	0.96
T_9 (180 : 180 : 80 kg/ha)	0.95	1.01	1.15	1.67	0.97
T_{10} (240 : 60 : 80 kg/ha)	0.96	1.03	1.16	1.68	0.99
T_{11} (240 : 120 : 80 kg/ha)	0.96	1.04	1.16	1.70	0.99
T_{12} (240 : 180 : 80 kg/ha)	0.96	1.04	1.18	1.70	1.00
Mean	0.91	0.97	1.18	1.70	1.03
S.Em ±	0.02	0.03	0.02	0.03	0.03
CD at 5%	0.07	0.08	0.08	0.09	0.07

In third picking T_5 and T_6 recorded significantly least value for EC (1.10 dSm^{-1}) over other treatments except T_7 which were on par with each other. The T_1 recorded highest EC (1.36 dSm^{-1}).

In fourth picking, the least EC was observed in T_6 (1.62 dSm^{-1}) which was on par with T_4, T_5, T_7 and T_8 but differed significantly from rest of the treatments. The highest EC was noticed in T_1 (1.85 dSm^{-1}).

In composite sample T_6 recorded significantly least EC (0.94 dSm^{-1}) over other treatments except T_5 and T_7 which were on par with each other.

The average EC was least in first picking (0.91 dSm^{-1}) followed by second, third and last picking (0.97, 1.18 and 1.7 dSm^{-1}, respectively). The average EC of composite sample was 1.03 dSm^{-1}.

Experiment II : Effect of chemical spray on seed yield and quality in tomato

4.2.1 Plant height

The data on plant height at harvest as influenced by chemicals and stages of spray are presented in Table 17.

Stage of spray had nonsignificant influence on plant height whereas, chemicals spray had a significant effect on plant height.

Spraying the chemical at 50 per cent flowering stage (S_1) recorded the higher plant height (94.4 cm) which was on par with fruit setting stage – S_2 (91.5 cm).

Plant height differed significantly due to chemical spray, application of GA_3 100 ppm (C_1) recorded significantly higher plant height (123.0 cm) as compared to other chemicals and control. This was followed by NAA 50 ppm (113.2 cm) the lowest plant height was noticed in control (71.0 cm).

The first order interactions exhibited significant effect on plant height for the chemicals at same stage. The C_1 at S_1 and S_2 stage (125.3 and 120.8 cm, respectively) gave significantly maximum plant height compared to other chemicals spray. This was followed by C_3 at S_1 and S_2 (115.7 cm and 110.6 cm, respectively). The lowest plant height was noticed in C_8 at S_1 and S_2 (70.6 and 71.3 cm, respectively).

The interactions for stages of spray at same or different chemicals influenced the plant height significantly. S_1C_1 recorded significantly higher plant height (125.3 cm) compared to other combinations except S_2C_1 (120.8 cm) which was on par with each other.

4.2.2 Number of branches per plant

The data on number of primary, secondary and tertiary branches as influenced by chemicals and stages of spray are presented in Table 17.

Stages of spray had nonsignificant influence on number of primary branches per plant but had significant influence on number of secondary and tertiary branches per plant. S_1 recorded significantly higher secondary and tertiary branches per plant (7.3 and 3.8, respectively) compared to S_2 (6.0 and 3.3, respectively).

The number of branches per plant differed significantly due to chemical spray. All the chemicals increased the number of branches per plant compared to control. GA_3 100 ppm (C_1) recorded significantly more number of primary branches (2.0), secondary branches (9.1) and tertiary branches per plant (4.6) over other chemicals and control except NAA 50 ppm (C_3) and IAA 50 ppm (C_2) which were on par with each other. The lowest number of primary, secondary and tertiary branches per plant were recorded in control (1.2, 5.3 and 2.4, respectively).

The interactions of chemicals at the same stage exhibited significant effect on number of branches per plant. C_1 at S_1 recorded significantly more number of primary, secondary and tertiary branches per plant (2.2, 10.4 and 5.2, respectively) over other combinations except S_1C_1, S_1C_2, S_1C_3 for primary branches, and S_1C_1, S_1C_3 for tertiary branches which were on par with each other. The lowest number of primary, secondary and tertiary branches per plant were recorded in S_1C_8 (1.3, 5.3 and 2.4, respectively). Similarly C_1 at S_2 recorded significantly more number of primary, secondary and tertiary branches per plant (1.8, 7.8 and 4.1, respectively) except S_2C_2, S_2C_3 for primary branches, S_2C_3 for secondary branches and S_2C_2, S_2C_3, S_2C_4 for tertiary branches which were on par with each other. The lowest number of primary, secondary and tertiary branches per plant (1.2, 5.4 and 2.4, respectively) recorded in S_2C_8.

Table 17. Plant height at harvest (cm) and number of primary, secondary and tertiary branches per plant as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Plant height at harvest			No. of primary branches			No. of secondary branches			No. of tertiary branches		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	125.3	120.8	123.1	2.2	1.8	2.0	10.4	7.8	9.1	5.2	4.1	4.6
C_2 - IAA 50 ppm	102.5	96.8	99.7	1.8	1.6	1.7	7.3	6.0	6.6	4.2	3.6	3.9
C_3 - NAA 50 ppm	115.7	110.6	113.2	2.0	1.7	1.8	8.6	6.6	7.6	4.6	3.9	4.2
C_4 - 2,4-D 1 ppm	92.3	91.8	92.1	1.6	1.4	1.5	7.0	5.8	6.4	3.8	3.3	3.5
C_5 - Ethrel 200 ppm	88.9	86.2	87.6	1.5	1.3	1.4	6.5	5.6	6.0	3.6	3.0	3.3
C_6 - TIBA 10 ppm	84.8	80.8	82.8	1.7	1.3	1.5	6.8	5.5	6.1	3.7	3.1	3.4
C_7 - DAP 2%	75.3	73.6	74.4	1.4	1.2	1.3	6.2	5.5	5.8	3.0	2.8	2.9
C_8 - Control	70.6	71.3	71.0	1.3	1.2	1.2	5.3	5.4	5.3	2.4	2.4	2.4
Mean	94.4	91.5	93.0	1.6	1.4	1.5	7.3	6.0	6.6	3.8	3.3	3.5
For comparing means of	S.Em±	CD at 5%		S.Em±	CD at 5%		S.Em±	CD at 5%		S.Em±	CD at 5%	
Stages (S)	0.5	NS		0.1	NS		0.1	0.7		0.1	0.2	
Chemicals (C)	2.2	6.3		0.1	0.3		0.3	0.9		0.2	0.6	
C at same stage	3.1	8.9		0.2	0.4		0.5	1.4		0.3	0.8	
S at same or different C	2.9	8.5		0.2	0.4		0.4	1.3		0.2	0.7	

S_1 - 50% flowering stage S_2 - Fruit setting stage

NS - Non significant

The interaction of stages of spray at same or different chemicals influenced the number of branches per plant significantly. S_1C1 recorded significantly more number of primary, secondary and tertiary branches per plant (2.2, 10.4 and 5.2, respectively) over rest of the combinations except S_1C_2, S_1C_3 and S_2C_1 for primary and tertiary branches which were on par with each other. The lowest number of primary, secondary and tertiary branches per plant (1.2, 5.3 and 2.4, respectively) recorded in S_2C_8, S_1C_8 and S_2C_8, respectively.

4.2.3 Number of fruits per plant

The data on number of fruits per plant at different pickings and total number of fruits per plant as influenced by chemicals and stages of spray are presented in Table 18.

Irrespective of chemicals and stages of spray, average number of fruits per plant were maximum in second picking (9.2) followed by first, third and last picking (8.9, 7.2 and 7.2, respectively). The average total number of fruits per plant from all the four pickings was 32.5.

Stages of spray significantly influenced the number of fruits per plant. S_1 recorded significantly higher number of fruits per plant (10.1, 10.2, 7.9 and 7.7) in first, second, third and fourth picking respectively compared to S_2 (7.7, 8.3, 6.6 and 6.6, respectively). The total number of fruits per plant were also significantly maximum in S_1 (35.9) compared to S_2 (29.2).

The number of fruits per plant differed significantly due to chemicals spray. All the chemicals increased the number of fruits per plant compared to control. GA_3 100 ppm (C_1) recorded significantly more number of fruits per plant (11.6, 12.3, 8.8 and 8.7) in first, second, third and fourth picking, respectively over other chemicals and control except NAA 50 ppm (C_3) in second picking, IAA 50 ppm (C_2), NAA 50 ppm (C_3), 2,4-D 1 ppm (C_4) in third and fourth picking which were on par with each other. The total number of fruits per plant were also significantly higher in GA_3 100 ppm (41.5) over other chemicals and control except NAA 50 ppm (C_3) which were on par with each other. The lowest number of fruits per plant were noticed in control (24.20).

The interactions of chemical spray at the same stage exhibited significant effect on number of fruits per plant. C_1 at S_1 recorded significantly more number of fruits per plant (13.2, 13.9, 9.9 and 9.8) in first, second, third and fourth picking respectively except S_1C_2, S_1C_3 in first, second, third and fourth picking which were on par with each other. The lowest number of fruits per plant were noticed in S_1C_8 (6.8, 6.9, 5.3 and 5.2) in first, second, third and fourth picking respectively. Similarly C_1 at S_2 recorded significantly more number of fruits per plant (9.9, 10.6, 7.8 and 7.5) in first, second, third and fourth picking respectively except S_2C_3 in first picking, S_2C_2, S_2C_3 and S_2C_4 in second picking, and S_2C_2, S_2C_3, S_2C_4, S_2C_5, S_2C_6 and S_2C_7 in last picking which was on par with each other. In third picking there were no significant differences among the chemicals at S_2 stage. The total number of fruits were significantly more in C_1 at S_1 and

Table 18. Number of fruits per plant as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Number of fruits per plant														
	I Picking			II Picking			III Picking			IV Picking			Total No. of fruits		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	13.2	9.9	11.6	13.9	10.6	12.3	9.9	7.8	8.8	9.8	7.5	8.7	47.0	35.9	41.5
C_2 - IAA 50 ppm	11.6	7.8	9.7	11.3	8.3	9.7	8.7	7.0	7.8	8.5	6.9	7.7	39.9	30.1	35.0
C_3 - NAA 50 ppm	11.8	8.7	10.2	12.2	9.8	11.0	9.1	7.3	8.2	9.1	7.4	8.2	42.1	33.2	37.7
C_4 - 2, 4-D 1 ppm	10.4	7.6	9.0	10.5	8.2	9.3	7.9	6.7	7.3	7.9	6.9	7.4	36.4	29.5	32.9
C_5 - Ethrel 200 ppm	9.6	7.5	8.6	9.9	8.0	9.0	7.7	6.5	7.1	7.6	6.7	7.2	34.9	28.7	31.8
C_6 - TIBA 10 ppm	9.4	6.9	8.2	9.1	7.8	8.5	7.7	6.0	6.8	7.4	6.1	6.7	33.7	26.8	30.2
C_7 - DAP 2%	7.9	6.9	7.4	7.7	6.9	7.3	6.5	5.8	6.2	6.5	5.8	6.1	28.7	25.4	27.0
C_8 - Control	6.8	6.7	6.8	6.9	6.5	6.7	5.3	5.6	5.5	5.2	5.3	5.2	24.3	24.1	24.2
Mean	10.1	7.7	8.9	10.2	8.3	9.2	7.9	6.6	7.2	7.7	6.6	7.2	35.9	29.2	32.5

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.3	1.6	0.2	1.1	0.1	0.4	0.1	0.8	0.2	1.5
Chemicals (C)	0.4	1.2	0.7	1.9	0.5	1.5	0.4	1.3	1.4	4.1
C at same stage	0.6	1.7	0.9	2.7	0.7	2.2	0.6	1.8	2.0	5.8
S at same or different C	0.6	1.8	0.9	2.6	0.7	2.0	0.6	1.7	1.9	5.5

S_1 - 50% flowering stage S_2 - Fruit setting stage

S_2 (47 and 35.9, respectively) which were on par with C_3 at S_1, C_2 and C_3 at S_2, respectively. The lowest total number of fruits per plant were noticed in C_8 at S_1 and S_2 (24.3 and 24.1, respectively).

The interactions of stages of spray at same or different chemicals influenced the number of fruits per plant significantly. S_1C_1 recorded significantly more number of fruits per plant (13.2, 13.9, 9.9 and 9.8) in first, second, third and fourth picking, respectively over rest of the combinations except S_1C_2, S_1C_3 in first and second picking, S_1C_2, S_1C_3, S_1C_4 and S_1C_5 in third picking and S_1C_2, S_1C_3 in last picking which were on par with each other. The lowest number of fruits per plant were noticed in S_1C_8 (5.3 and 5.2) in third and fourth picking, respectively and S_2C_8 in first and second picking (6.7 and 6.5, respectively). S_1C_1 recorded significantly higher total number of fruits per plant (47.0) over other combinations except S_1C_3 which were on par with each other. The lowest total number of fruits per plant were noticed in S_2C_8 (24.2).

4.2.4 Fruit yield per plant

The data on fruit yield per plant at different pickings and total fruit yield per plant as influenced by chemicals and stages of spray are presented in Table 19.

Irrespective of chemicals and stages of spray average fruit yield per plant was maximum in second picking (441.2 g) followed by first, third and fourth picking (424.6 g, 349.2 g and 343.3 g, respectively). The average total fruit yield per plant from all the four pickings was 1.55 kg.

The stages of chemical spray significantly influenced the fruit yield per plant. The 50 per cent flowering stage (S_1) recorded significantly higher fruit yield per plant (480.6 g, 489.3 g, 368.9 g and 373.6 g) in first, second, third and fourth picking, respectively compared to S_2 (368.6, 393.1, 368.9 and 373.6 g, respectively). The total fruit yield per plant was also maximum in S_1 (1.71 kg) compared to S_2 (1.39 kg).

The chemicals spray significantly influenced the fruit yield per plant. All the chemicals increased the fruit yield per plant compared to control. GA_3 100 ppm (C_1) recorded significantly highest fruit yield per plant (578.3, 612.5, 431.0 and 441.6 g) in first, second, third and fourth picking, respectively over other chemicals and control except NAA 50 ppm (C_3) in third and fourth picking which were on par with each other. The lowest fruit yield was recorded in control (304.3, 303.0, 235.6 and 247.0 g) in first, second, third and fourth picking respectively. The total fruit yield per plant was also significantly highest in GA_3 100 ppm (2.06 kg) over other chemicals and control. The control recorded 1.09 kg.

The first order interactions exhibited significant influence on fruit yield per plant for the chemicals at the same stage. S_1C_1 recorded significantly lowest fruit yield per plant (660, 695, 487 and 493.3 g) in first, second, third and last picking respectively except S_1C_2, S_1C_3 in third picking and S_1C_3 in last picking which were on par with each other. The lowest fruit yield per plant was noticed in S_1C_8 (306.3, 312, 234 and 239.6 g) in first, second, third and fourth picking respectively. Similarly S_2C_1 recorded significantly highest fruit yield per plant (496.6, 530, 375 and 390 g) in first, second, third and last picking respectively except S_2C_3 in second picking, S_2C_2, S_2C_3, S_2C_4 and S_2C_5 in third picking and S_2C_2, S_2C_3 and S_2C_4 in final picking which were on par with each other. The lowest fruit yield per plant was recorded in S_2C_8 (302.3, 294, 237.3 and 254.3) in first, second, third and last picking respectively. The total fruit yield per plant was significantly highest in C_1 at S_1 and S_2 (2.33 and 1.79 kg, respectively) except C_3 at S_2 which was on par with each other. The lowest total fruit yield per plant was noticed in C_8 at S_1 and S_2 (1.09 and 1.08 kg, respectively).

The interactions for stages of spray at same or different chemicals had a significant influence on the fruit yield per plant. S_1C_1 recorded significantly highest fruit yield per plant (660.0, 695.0, 487.0 and 493.3 g) in first, second, third and fourth picking, respectively over other combinations and control except S_1C_3 in third and fourth picking which were on par with each other. S_2C_8 recorded lowest fruit yield per plant (306.3, 294.0, 247.0) in first, second and fourth picking respectively except third picking where S_1C_8 was recorded lowest fruit yield (2.34). The total fruit yield per plant was also significantly maximum in S_1C_1 (2.33 kg) over other

Table 19. Fruit yield per plant as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Fruit yield per plant (g)												Total fruit yield (kg)		
	I Picking			II Picking			III Picking			IV Picking					
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	660.0	496.6	578.3	695.0	530.0	612.5	487.0	375.0	431.0	493.3	390.0	441.6	2.33	1.79	2.06
C_2 - IAA 50 ppm	557.0	373.3	465.2	539.0	397.0	468.0	405.0	332.6	368.8	415.3	331.6	373.5	1.91	1.44	1.67
C_3 - NAA 50 ppm	575.3	424.0	499.6	597.0	479.6	538.3	446.6	361.3	401.5	444.0	359.0	401.5	2.06	1.62	1.84
C_4 - 2, 4-D 1 ppm	497.6	364.0	430.8	535.3	392.3	463.8	380.6	332.3	356.5	380.3	323.0	351.6	1.76	1.41	1.58
C_5 - Ethrel 200 ppm	451.0	355.0	403.0	466.3	375.3	420.8	359.0	315.6	337.3	363.6	303.6	333.6	1.64	1.40	1.49
C_6 - TIBA 10 ppm	439.6	325.0	382.3	429.0	364.6	396.8	347.0	287.6	317.3	359.3	281.6	320.5	1.57	1.25	1.41
C_7 - DAP 2%	358.3	309.0	333.6	341.3	312.0	326.6	295.0	261.6	278.3	294.0	261.0	277.5	1.32	1.14	1.23
C_8 - Control	306.3	302.3	304.3	312.0	294.0	303.0	234.0	237.3	235.6	239.6	254.3	247.0	1.09	1.08	1.09
Mean	480.6	368.6	424.6	489.3	393.1	441.2	368.9	329.4	349.2	373.6	312.9	343.3	1.71	1.39	1.55

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	4.5	27.7	5.4	33.0	5.8	35.3	5.1	31.2	0.03	0.19
Chemicals (C)	11.5	33.5	21.1	61.1	20.5	59.6	18.9	54.9	0.04	0.13
C at same stage	16.3	47.3	29.8	86.5	29.0	84.3	26.7	77.6	0.06	0.18
S at same or different C	15.9	46.2	28.4	82.4	27.8	80.6	25.5	74.1	0.07	0.19

S_1 - 50% flowering stage S_2 - Fruit setting stage

combinations and control. The lowest first yield per plant was recorded in control S_2C_8 (1.08 kg).

4.2.5 Fruit yield per plot

The data on fruit yield per plot at different pickings and total fruit yield per plot as influenced by chemicals and stages of spray are presented in Table 20.

Irrespective of chemicals and stages of spray the mean fruit yield per plot was maximum in second picking (5.10 kg) followed by first (4.35 kg), third (4.25 kg) and fourth picking (2.88 kg). The average total fruit yield per plot from all the four pickings was 16.61 kg.

The stages of spray significantly influenced the fruit yield per plot. The S_1 recorded significantly higher fruit yield per plot (4.58, 5.50, 4.47 and 3.05 kg) in first, second, third and fourth picking respectively compared to S_2 (4.12, 4.70, 4.03 and 2.71). The total fruit yield per plot was also maximum in S_1 (17.65 kg) compared to S_2 (15.58 kg).

The chemicals spray influenced the fruit yield per plot significantly. All the chemicals increased the fruit yield per plot compared to control. GA_3 100 ppm (C_1) recorded significantly highest fruit yield per plot (5.11, 5.76, 5.06 and 3.75 kg) in first, second, third and fourth picking respectively over other chemicals and control except NAA 50 ppm (C_3) in first, NAA 50 ppm (C_3) and 2,4-D 1 ppm (C_4) in second picking, IAA 50 ppm (C_2), NAA 50 ppm (C_3) 2,4-D 1 ppm (C_4) in third and IAA 50 ppm (C_2) and NAA 50 ppm (C_3) in last picking which were on par with each other. The lowest fruit yield of 3.79, 4.56, 3.64 and 2.38 kg were noticed in control at first, second, third and fourth picking respectively. The total fruit yield per plot was highest in GA_3 100 ppm (19.68 kg) which was significantly superior over other chemicals and control. The control recorded fruit yield per plot of 14.37 kg.

The first order interactions exhibited significant influence on fruit yield per plot for the chemicals at same stage. S_1C_1 recorded significantly higher fruit yield per plot (5.32, 6.12, 5.28 and 4.34 kg) in first, second, third and fourth picking respectively except S_1C_2, S_1C_3, S_1C_4, S_1C_5 and S_1C_6 in first, second, third and in fourth picking S_1C_2 and S_1C_3 which were on par with each other. Similarly S_2C_1 recorded significantly highest fruit yield per plot (4.90, 5.40, 4.84 and 3.16 kg) in first, second, third and fourth picking respectively except S_2C_3 in first picking and S_2C_2, S_2C_3 in second picking, in third and fourth picking there was no significant difference among the chemicals at S_2. The lowest fruit yield per plot was noticed in S_1C_8 (3.78, 4.80, 3.55 and 2.42 kg) and S_2C_8 (3.8, 4.32, 3.74 and 2.34) in first, second, third and last picking respectively. The total fruit yield per plot was significantly highest in C_1 at S_1 and S_2 (21.06 and 18.30 kg respectively) except S_1C_3 which was on par with each other. The lowest total fruit yield per plot was observed in C_8 at S_1 and S_2 (14.55 and 14.2 kg respectively).

The interactions for stages of spray at same or different chemicals influenced the fruit yield per plot significantly S_1C_1 recorded significantly maximum fruit yield per plot (5.32,

Table 20. Fruit yield per plot (kg) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Fruit yield per plot (kg)														
	I Picking			II Picking			III Picking			IV Picking			Total fruit yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	5.32	4.90	5.11	6.12	5.40	5.76	5.28	4.84	5.06	4.34	3.16	3.75	21.06	18.30	19.68
C_2 - IAA 50 ppm	4.95	3.98	4.46	5.40	4.64	5.02	4.90	3.78	4.34	3.47	3.00	3.23	18.72	15.40	17.06
C_3 - NAA 50 ppm	5.10	4.35	4.72	6.00	4.95	5.47	5.00	4.25	4.62	3.56	2.73	3.14	19.65	16.28	17.96
C_4 - 2, 4-D 1 ppm	4.59	4.31	4.45	5.83	4.92	5.37	4.90	4.20	4.55	2.12	2.70	2.41	17.71	16.13	16.92
C_5 - Ethrel 200 ppm	4.50	4.00	4.25	5.48	4.68	5.08	4.30	3.98	4.14	2.93	2.64	2.78	17.21	15.30	16.25
C_6 - TIBA 10 ppm	4.48	3.90	4.19	5.40	4.45	4.92	4.23	3.80	4.01	2.88	2.85	2.86	16.99	15.00	15.99
C_7 - DAP 2%	3.96	3.75	3.85	5.00	4.29	4.64	3.64	3.70	3.67	2.73	2.26	2.49	15.33	14.00	14.66
C_8 - Control	3.78	3.80	3.79	4.80	4.32	4.56	3.55	3.74	3.64	2.42	2.34	2.38	14.55	14.20	14.37
Mean	4.58	4.12	4.35	5.50	4.70	5.10	4.47	4.03	4.25	3.05	2.71	2.88	17.65	15.58	16.61

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.06	0.39	0.08	0.49	0.02	0.12	0.01	0.17	0.13	0.78
Chemicals (C)	0.21	0.63	0.20	0.59	0.30	0.89	0.20	0.80	0.47	1.38
C at same stage	0.30	0.89	0.28	0.83	0.43	1.26	0.29	1.13	0.67	1.95
S at same or different C	0.29	0.85	0.28	0.81	0.41	1.18	0.27	1.06	0.64	1.86

S_1 - 50% flowering stage S_2 - Fruit setting stage

6.12, 5.28 and 4.34 kg) in first, second, third and last picking respectively over other combinations and control except S_1C_2, S_1C_3, S_2C_1 in first and second picking, S_1C_1, S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_2C_1, S_2C_3 and S_2C_4 in last picking which were on par with each other. The S_1C_8 in first and third picking (3.78 kg and 3.55 kg) and S_2C_8 in second and last picking (4.32 kg and 2.34 kg) recorded lowest fruit yield per plot. The total fruit yield per plot was also significantly highest in S_1C_1 (21.06 kg) which was superior over rest of the combinations except S_1C_3 which was on par with S_1C_1. The lowest total fruit yield per plot was noticed in S_2C_8 (15.58 kg).

4.2.6 Fruit yield per hectare

The data on fruit yield per hectare as influenced by chemicals and stages of spray at different picking and total fruit yield per hectare are presented in Table 21.

Irrespective of chemicals and stages of spray, the average fruit yield per hectare was maximum in second picking (7.09 t) followed by first, third and last picking (6.04, 5.91 and 4.00 t respectively). The average total fruit yield per hectare from all the four pickings was 23.08 t.

The stages of spray influenced significantly the fruit yield per hectare. The S_1 recorded significantly highest fruit yield per hectare (6.37, 7.64, 6.22 and 4.24 t) in first, second, third and fourth picking respectively compared to S_2 (5.73, 6.53, 5.60 and 3.76 t respectively). The total fruit yield per hectare was also highest in S_1 (24.52 t) compared to S_2 (21.64 t).

The chemical spray influenced the fruit yield per hectare significantly. All the chemicals increased the fruit yield compared to control. GA_3 100 ppm (C_1) noticed significantly highest fruit yield per hectare (7.09, 7.33, 7.02 and 5.20 t) in first, second, third and last picking respectively over other chemicals and control except NAA 50 ppm (C_3) in first and second picking, IAA 50 ppm (C_2), NAA 50 ppm (C_3) and 2,4-D 1 ppm (C_4) in third picking and IAA 50 ppm (C_2) in last picking, which were on par with each other. The lowest fruit yield per hectare (5.26, 6.33, 5.06 and 3.3 t) recorded in first, second, third and fourth picking respectively. The total fruit yield per hectare was significantly highest in GA_3 100 ppm (27.34 t) over rest of the chemicals including control. The control recorded fruit yield per hectare of 19.97 t.

The interactions for chemicals at same stage showed significant influence on fruit yield per ha. C_1 at S_1 (7.38, 8.5, 7.33 and 6.02 t) recorded significantly highest fruit yield per ha in first, second and third and fourth picking respectively except S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_1C_6 in first, second and third picking, S_1C_3 in fourth picking which were on par with each other. The lowest fruit yield was noticed in S_1C_8 (5.25, 6.66, 4.93 and 3.36) in first, second, third and last picking respectively. Similarly S_2C_1 recorded significantly highest fruit yield per ha (6.8, 7.5, 6.72 and 4.39 t) in first, second, third and fourth picking respectively except S_2C_3, S_2C_4 in first, S_2C_2, S_2C_3, S_2C_4 in second and last picking and in third picking the difference was non significant among the

Table 21. Fruit yield per hectare (tonnes) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Fruit yield per hectare (t)														
	I Picking			II Picking			III Picking			IV Picking			Total fruit yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	7.38	6.80	7.09	8.50	7.50	8.00	7.33	6.72	7.02	6.02	4.39	5.20	29.25	25.42	27.34
C_2 - IAA 50 ppm	6.87	5.52	6.20	7.50	6.44	6.97	6.80	5.25	6.03	4.82	4.17	4.49	26.00	21.39	23.69
C_3 - NAA 50 ppm	7.08	6.04	6.56	8.33	6.87	7.60	6.94	5.90	6.42	4.95	3.79	4.37	27.29	22.61	24.95
C_4 - 2, 4-D 1 ppm	6.38	5.98	6.18	8.09	6.83	7.46	6.80	5.83	6.32	2.94	3.75	3.35	24.60	22.41	23.50
C_5 - Ethrel 200 ppm	6.25	5.55	5.90	7.61	6.50	7.05	5.97	5.52	5.75	4.07	3.67	3.86	23.90	21.25	22.58
C_6 - TIBA 10 ppm	6.22	5.41	5.82	7.50	6.18	6.84	5.87	5.27	5.57	4.00	3.96	3.98	23.60	20.83	22.22
C_7 - DAP 2%	5.50	5.20	5.35	6.94	5.95	6.45	5.05	5.13	5.09	3.79	3.14	3.46	21.30	19.45	20.37
C_8 - Control	5.25	5.27	5.26	6.66	6.00	6.33	4.93	5.19	5.06	3.36	3.25	3.30	20.21	19.72	19.97
Mean	6.37	5.73	6.04	7.64	6.53	7.09	6.22	5.60	5.91	4.24	3.76	4.00	24.52	21.64	23.08

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.09	0.55	0.11	0.69	0.03	0.17	0.02	0.10	0.17	1.08
Chemicals (C)	0.30	0.87	0.28	0.82	0.43	1.24	0.28	0.82	0.66	1.92
C at same stage	0.42	1.23	0.40	1.16	0.60	1.75	0.40	1.16	0.93	2.71
S at same or different C	0.41	1.18	0.39	1.13	0.57	1.64	0.38	1.09	0.89	2.58

S_1 - 50% flowering stage S_2 - Fruit setting stage

chemicals at S_2. The total fruit yield per ha was significantly highest in C_1 at S_1 and S_2 (29.25 and 25.32 t respectively) except S_1C_3 which was on par with S_1C_1. The lowest total fruit yield per ha was recorded in S_1C_8 (20.21 t) and S_2C_8 (19.72 t).

The interactions for stages of spray at same or different chemicals influenced the fruit yield per hectare significantly. S_1C_1 recorded significantly highest fruit yield per hectare (7.38, 8.50, 7.33 and 6.02) in first, second, third and fourth picking respectively over other combinations except S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_1C_6 and S_2C_1 in first and second picking S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_1C_6, S_2C_1, S_2C_3, S_2C_4 in third picking and S_1C_3 in fourth picking which were on par with each other. The S_1C_8 in first and third picking (5.25 and 4.93 t) and S_2C_8 in second and last picking (6.00 and 3.25 t) recorded lowest fruit yield per hectare. The total fruit yield per hectare was also significantly highest in S_1C_1 (29.25 t) over other combinations except S_1C_3 which were on par with each other. The lowest fruit yield per ha of 19.72 t was noticed in S_2C_8.

4.2.7 Seed yield per plant (g)

The data on seed yield per plant at different pickings and total seed yield per plant as influenced by chemicals and stages of spray are presented in Table 22.

Irrespective of chemicals and stages of spray average seed yield per plant of 2.44 grams was recorded in second picking followed by first (2.41 g), third (1.98 g) and fourth picking (1.96 g) respectively. The average total seed yield per plant from all the four pickings was 8.69 g.

The seed yield per plant was significantly influenced by stages of spray. S_1 recorded significantly highest seed yield per plant (2.77, 2.65, 2.14 and 2.18 g) in first, second, third and fourth picking respectively compared to S_2 (2.05, 2.22, 1.82 and 1.74 g) respectively. The total seed yield per plant was maximum in S_1 (9.66 g) compared to S_2 (7.72 g).

The chemicals spray significantly influenced the seed yield per plant. All the chemicals increased the seed yield per plant compared to control. GA 100 ppm (C_1) recorded significantly higher seed yield per plant (3.45, 3.56, 2.59 and 2.69 g) in first, second, third and fourth picking, respectively over other chemicals and control. The lowest seed yield per plant (1.62, 1.68, 1.34 and 1.36) was recorded in control (C_8) at first, second, third and last picking, respectively. The total seed yield per plant was also significantly higher in GA_3 100 ppm (12.34 g) over other chemicals and control. The control recorded lowest total seed yield of 5.99 g per plant.

The first order interactions showed significant influence on seed yield per plant for the chemicals at same stage. C_1 at S_1 and S_2 (4.03, 4.05, 3.01 and 3.06 g and 2.87, 3.08, 2.18, 2.33 g) in first, second third and fourth picking, respectively over other combinations except S_1C_3 in last picking and S_2C_3 in second, third and last picking which were on par with each other. The significantly lowest seed yield per plant was recorded in C_8 at S_1 and S_2 (1.66, 1.72, 1.35, 1.32 g and

Table 22. Seed yield per plant (g) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seed yield per plant (g)														
	I Picking			II Picking			III Picking			IV Picking			Total seed yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	4.03	2.87	3.45	4.05	3.08	3.56	3.01	2.18	2.59	3.06	2.33	2.69	14.23	10.46	12.34
C_2 - IAA 50 ppm	3.21	2.03	2.62	2.16	2.22	2.19	2.32	1.82	2.07	2.49	1.84	2.16	10.19	7.93	9.06
C_3 - NAA 50 ppm	3.41	2.36	2.88	3.44	2.70	3.07	2.60	2.06	2.33	2.68	2.08	2.38	12.13	9.25	10.69
C_4 - 2, 4-D 1 ppm	2.83	2.06	2.45	3.01	2.12	2.57	2.16	1.80	1.98	2.23	1.80	2.02	9.69	7.79	8.74
C_5 - Ethrel 200 ppm	2.56	2.00	2.28	2.49	2.04	2.26	2.09	2.43	2.26	2.12	1.64	1.88	9.25	7.43	8.34
C_6 - TIBA 10 ppm	2.42	1.75	2.09	2.33	2.30	2.31	2.00	1.53	1.77	2.02	1.52	1.77	8.77	6.82	7.79
C_7 - DAP 2%	2.06	1.73	1.90	2.00	1.66	1.83	1.65	1.39	1.52	1.58	1.36	1.47	6.96	6.14	6.55
C_8 - Control	1.66	1.59	1.62	1.72	1.65	1.68	1.35	1.32	1.34	1.32	1.40	1.36	6.04	5.95	5.99
Mean	2.77	2.05	2.41	2.65	2.22	2.44	2.14	1.82	1.98	2.18	1.74	1.96	9.66	7.72	8.69

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.02	0.10	0.05	0.30	0.01	0.09	0.03	0.16	0.15	0.90
Chemicals (C)	0.08	0.23	0.10	0.29	0.05	0.15	0.09	0.28	0.48	1.40
C at same stage	0.11	0.32	0.14	0.41	0.07	0.21	0.14	0.39	0.68	1.99
S at same or different C	0.10	0.31	0.14	0.41	0.07	0.20	0.13	0.37	0.66	1.91

S_1 - 50% flowering stage S_2 - Fruit setting stage

1.59, 1.65, 1.32 and 1.40 g) respectively in first, second third and fourth picking. The total seed yield per plant was significantly higher in C_1 at S_1 and S_2 (14.23 and 10.46 g) respectively over other combinations except S_2C_3 (9.25 g) which was on par with S_2C_1. The lowest total seed yield per plant was recorded in C_8 at S_1 and S_2 (6.04 and 5.95 g) respectively.

The interactions for stages of spray at same or different chemicals significantly influenced the seed yield per plant. S_1C_1 recorded significantly highest seed yield per plant (4.03, 4.05, 3.01 and 3.06 g) in first, second, third and fourth picking respectively, over other combinations. The lowest seed yield per plant was noticed in S_2C_8 (1.59, 1.65 and 1.32 g) in first, second and third picking, respectively whereas S_1C_8 in fourth picking recorded lowest seed yield per plant (1.32 g). The total seed yield per plant was also significantly highest in S_1C_1 (14.23 g) over other combinations. The S_2C_2 recorded lowest total seed yield per plant (5.95 g).

4.2.8 Seed yield per plot (g)

The data on seed yield per plot at different pickings and total seed yield per plot as influenced by chemicals and stages of spray are presented in Table 23.

Irrespective of chemicals and stages of spray, the average seed yield per plot was maximum in second picking (29.99 g) followed by first, third and fourth picking (25.58, 24.93 and 16.89 g, respectively). The average total seed yield per plot from all the pickings was (97.4 g).

The seed yield per plot was significantly influenced by stages of spray. S_1 recorded significantly higher seed yield per plot (27.45, 32.72, 26.68 and 18.24 g) in first, second third and last picking respectively, compared to S_2 (23.72, 27.26, 23.16 and 15.55 g, respectively). The total seed yield per plot was maximum in S_1 (105.2 g) compared to S_2 (87.7 g).

The seed yield per plot differed significantly due to chemicals spray. All chemicals increased the seed yield per plot compared to control. GA_3 100 ppm (C_1) recorded significantly higher seed yield per plot (31.21, 35.10, 30.88 and 22.71 g) in first, second third and last picking, respectively over other chemicals and control except NAA 50 ppm (C_3) in second picking and third picking (36.60 and 27.76 g, respectively) which were on par with each other. The lowest seed yield per plot was recorded in control (21.85, 26.27, 20.76 and 13.56 g) in first, second third and last picking, respectively. The seed yield per plant was significantly maximum in C_1 (119.9 g) over other chemicals and control. The lowest seed yield per plot noticed in control (82.4 g).

The interactions of chemicals at the same stage exhibited significant influence on seed yield per plot. C_1 at S_1 and S_2 recorded significantly highest seed yield per plot (32.98, 37.4, 32.72, 26.20 g and 29.44, 32.8, 29.04 and 18.52 g) in first, second third and fourth picking, respectively over other combinations except S_1C_2, S_1C_3 in first, S_1C_3 in

Table 23. Seed yield per plot (g) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seed yield per plant (g)														
	I Picking			II Picking			III Picking			IV Picking			Total seed yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	32.98	29.44	31.21	37.40	32.80	35.10	32.72	29.04	30.88	26.90	18.52	22.71	130.0	109.8	119.9
C_2 - IAA 50 ppm	29.70	23.08	26.39	32.40	26.92	29.66	29.40	21.92	25.66	20.82	17.40	19.11	112.3	89.3	100.8
C_3 - NAA 50 ppm	31.11	25.06	28.08	36.60	29.10	32.85	30.50	25.02	27.76	21.65	16.00	18.82	119.9	95.2	107.5
C_4 - 2, 4-D 1 ppm	29.16	24.00	26.58	34.92	28.04	31.48	29.40	22.94	26.17	12.72	15.08	13.90	106.2	90.1	98.1
C_5 - Ethrel 200 pp	25.82	23.20	24.51	32.33	27.14	29.73	25.37	23.08	24.22	17.28	15.38	16.33	100.8	88.8	94.8
C_6 - TIBA 10 ppm	25.98	22.23	24.10	31.32	25.36	28.34	24.50	21.66	23.08	16.70	16.24	16.47	98.5	85.5	92.0
C_7 - DAP 2%	22.96	21.00	21.98	29.00	24.02	26.51	21.01	20.72	20.86	15.83	12.65	14.24	88.8	78.4	83.6
C_8 - Control	21.92	21.78	21.85	27.85	24.69	26.27	20.59	20.94	20.76	14.03	13.10	13.56	84.4	80.5	82.4
Mean	27.45	23.72	25.58	32.72	27.26	29.99	26.68	23.16	24.93	18.24	15.55	16.89	105.2	89.7	97.4

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.23	1.39	0.29	1.78	0.46	2.78	0.10	0.61	0.31	1.87
Chemicals (C)	0.94	2.72	1.14	3.29	1.34	3.89	0.89	2.56	2.21	6.42
C at same stage	1.32	3.84	1.61	4.66	1.89	5.50	1.25	3.63	3.13	9.08
S at same or different C	1.26	3.65	1.53	4.44	1.83	5.31	1.18	3.41	2.94	8.53

S_1 - 50% flowering stage S_2 - Fruit setting stage

second, S_1C_2, S_1C_3, S_1C_4 in third picking and S_2C_3 in second and third picking and S_2C_2, S_2C_3 in last picking which were on par with each other. The lowest seed yield per plot was observed in C_8 at S_1 and S_2 (21.92, 27.85, 20.59, 14.03 g and 21.78, 24.69, 20.94, 13.10 g, respectively) in first, second third and fourth picking, respectively. The total seed yield per plot was significantly highest in C_1 at S_1 and S_2 (130 and 109.8 g, respectively) followed by C_3 at S_1 and S_2 (119.9 and 95.2 g respectively). The lowest total seed yield per plot was recorded in C_8 at S_1 and S_2 (84.4 and 80.5 g, respectively).

The interactions of stages of spray at same or different chemicals influenced significantly the seed yield per plot. S_1C_1 recorded significantly lowest seed yield per plot (32.98, 37.40, 32.72 and 26.90 g) in first, second third and last picking respectively over other combinations except S_1C_2, S_1C_3 and S_2C_1 in first picking, S_1C_3 and S_1C_4 in second picking and S_1C_2, S_1C_3, S_1C_4 and S_2C_1 in third picking which were on par with each other. The lowest seed yield per plot was noticed in S_2C_8 (21.78, 24.69 and 13.10 g) in first, second and fourth picking, respectively whereas S_1C_8 recorded lowest seed yield per plot in third picking (20.59 g). The total seed yield per plot was also significantly highest in S_1C_1 (130.0 g) over other combinations. The S_2C_8 recorded lowest seed yield per plot (80.5 g).

4.2.9 Seed yield per hectare (kg)

The data on seed yield per hectare at different picking and total seed yield per hectare as influenced by chemicals and stages of spray are presented in Table 24.

Irrespective of chemicals and stages of spray, average seed yield per ha was maximum in second picking (41.7 kg) followed by first, third and fourth picking (35.5, 34.6 and 23.4 kg, respectively). The average total seed yield per hectare from all the four pickings was 135.2 kg.

The seed yield per ha differed significantly due to stages of spray. S_1 (50 per cent flowering stage) recorded significantly highest seed yield per ha (38.1, 45.4, 37.0 and 25.3 kg) in first, second, third and fourth picking, respectively compared to S_2 (32.9, 37.8, 32.2 and 21.6 kg). The total seed yield per ha was also significantly higher in S_1 (145.9 kg) compared to S_2 (124.5 kg).

The seed yield per ha was significantly influenced by chemicals spray. The GA_3 100 ppm recorded significantly highest seed yield per ha (43.3, 48.7, 42.8 and 31.5 kg) in first, second, third and last picking, respectively over other chemicals and control except NAA 50 ppm (C_3) in second picking and third picking (45.6 and 38.5 kg, respectively) which were on par with each other. The lowest seed yield per ha was observed in control (30.3, 36.5, 28.8 and 18.8 kg) in first, second third and last picking, respectively. The total seed yield per hectare was also significantly highest in GA_3 100 ppm (166.5 kg) compared to other chemicals and control. The total seed yield per ha was lowest in control (114.5 kg).

The interactions for stages of spray at same or different chemicals significantly influenced the seed yield per ha. S_1C_1

recorded significantly higher seed yield per ha (45.8, 51.9, 45.4 and 37.3 kg) in first, second third and fourth picking, respectively over other combinations except S_1C_2 S_1C_3 and S_2C_1 in first, S_1C_3 and S_1C_4 in second picking, S_1C_2, S_1C_3, S_1C_4 and S_2C_1 in third picking which were on par with each other. The lowest seed yield per ha was recorded in S_2C_8 (30.2, 34.3 and 18.2 kg) in first, second and last picking, respectively. Whereas in third picking S_1C_8 recorded lowest seed yield per ha (28.6 kg). The total seed yield per hectare was also significantly highest in S_1C_1 (180.5 kg) over other combinations. The S_2C_8 recorded lowest total seed yield per ha (111.8 kg).

The interactions resulted in significant influence on seed yield per ha for the chemicals at same stage. The C_1 at S_1 and S_2 recorded significantly highest seed yield per ha (45.8, 51.9, 41.4, 37.3 kg and 40.9, 45.5, 40.3 and 25.7 kg, respectively) in first, second third and last picking, respectively over other combinations at the same stage, except S_1C_2, S_1C_3, S_1C_4 in first and third picking, S_1C_3 in second picking which were on par with S_1C_1. S_2C_3 in second and third picking and S_2C_2, S_2C_3 in fourth picking which were on par with S_2C_1. The C_8 at S_1 and S_2 recorded lowest seed yield per ha (30.4, 38.6, 28.6, 19.4 kg and 30.2, 34.3, 29.0 and 18.2 kg respectively) in first, second third and last picking. The total seed yield per ha was significantly highest in S_1C_1 and S_1C_2 (180.5 and 152.5 kg, respectively) over other combinations. The lowest total seed yield per ha was

Table 24. Seed yield per hectare (kg) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seed yield per hectare (kg)														
	I Picking			II Picking			III Picking			IV Picking			Total seed yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	45.8	40.9	43.3	51.9	45.5	48.7	45.4	40.3	42.8	37.3	25.7	31.5	180.5	152.5	166.5
C_2 - IAA 50 ppm	41.2	32.0	36.6	45.0	37.3	41.2	40.8	30.4	35.6	28.9	24.1	26.5	156.0	124.0	140.0
C_3 - NAA 50 ppm	43.2	34.8	39.0	50.8	40.4	45.6	42.3	34.7	38.5	30.0	22.2	26.1	166.4	132.2	149.3
C_4 - 2, 4-D 1 ppm	40.5	33.3	36.9	48.5	38.9	33.7	40.8	31.8	36.3	17.6	20.9	19.3	147.5	125.0	136.3
C_5 - Ethrel 200 ppm	35.8	32.2	34.0	44.9	37.6	41.3	35.2	32.0	33.6	24.0	21.3	22.6	140.0	123.3	131.6
C_6 - TIBA 10 ppm	36.1	30.8	33.5	43.5	35.2	39.3	34.0	30.0	32.0	23.1	22..5	22.8	136.8	118.7	127.7
C_7 - DAP 2%	31.9	29.1	30.5	40.2	33.3	36.8	29.1	28.7	28.9	21.9	17.5	19.7	123.3	108.8	116.1
C_8 - Control	30.4	30.2	30.3	38.6	34.3	36.5	28.6	29.0	28.8	19.4	18.2	18.8	117.2	111.8	114.5
Mean	38.1	32.9	35.5	45.4	37.8	41.7	37.0	32.2	34.6	25.3	21.6	23.4	145.9	124.5	135.2

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.3	1.9	0.4	2.5	0.6	3.8	0.1	0.8	0.4	2.5
Chemicals (C)	1.3	3.7	1.5	4.6	1.8	5.4	1.2	3.5	3.0	8.9
C at same stage	1.8	5.3	2.2	6.5	2.6	7.6	1.7	5.0	4.3	12.6
S at same or different C	1.7	5.1	2.1	6.2	2.5	7.3	1.6	4.7	4.0	11.8

S_1 - 50% flowering stage S_2 - Fruit setting stage

LEGEND

CHEMICALS

C_1 GA_3 100 ppm

C_2 IAA 50 ppm

C_3 NAA 50 ppm

C_4 2, 4-D 1 ppm

C_5 Ethrel 200 ppm

C_6 TIBA 10 ppm

C_7 DAP 2%

C_8 Control

STAGES OF SPRAY

S_1 50% flowering stage

S_2 Fruit setting stage

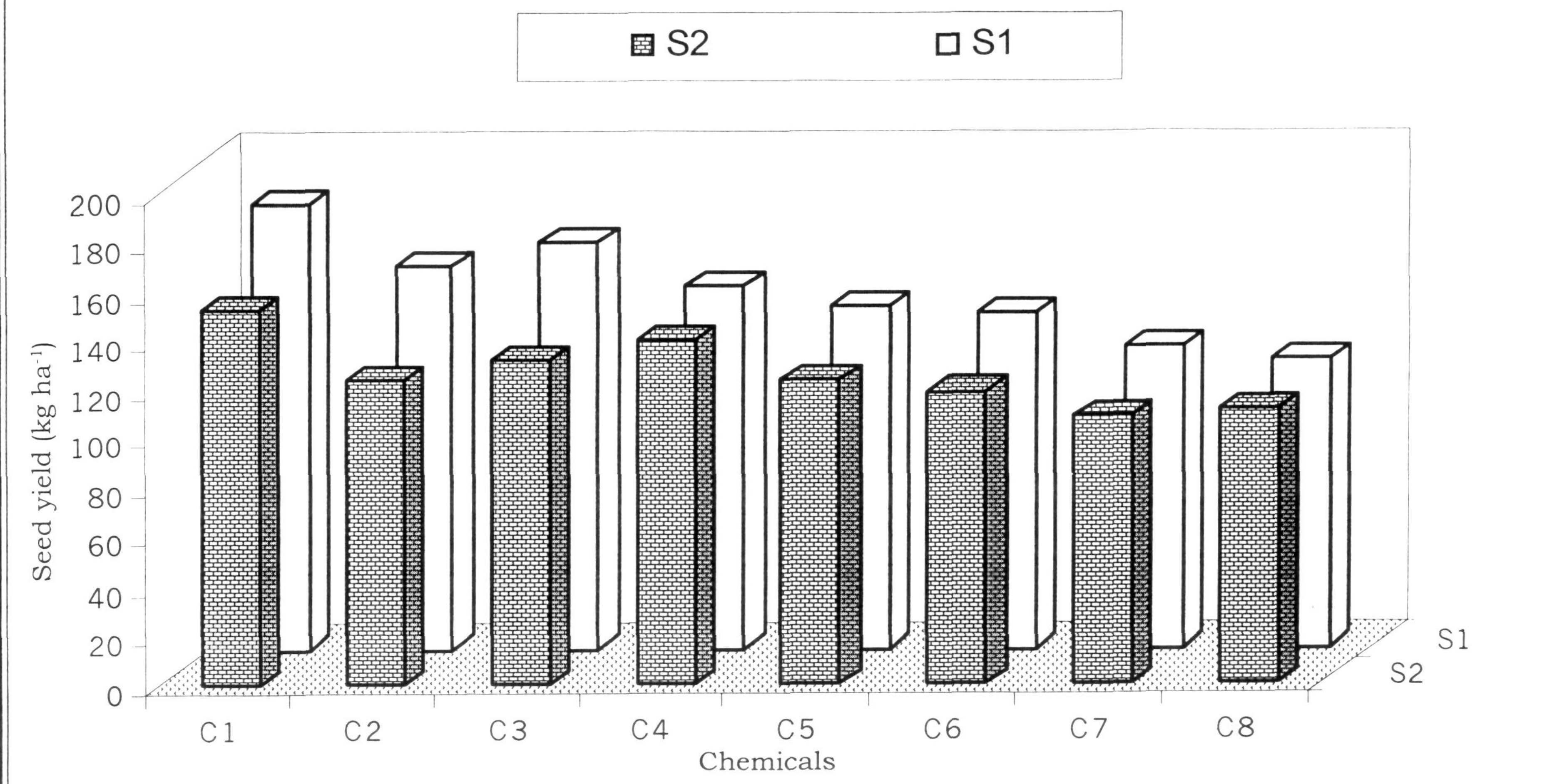


Fig. 6. Seed yield (kg ha^{-1}) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15)

recorded in C_1 at S_1 and S_2 (117.2 and 111.8 kg, respectively).

4.2.10 Seed recovery per cent

The data on seed recovery per cent at different pickings and for total yield as influenced by chemicals and stages of spray are presented in Table 25.

Irrespective of chemicals and stages of spray, the mean seed recovery per cent was maximum in third picking (0.58%) followed by fourth, first and second picking. (0.57%, 0.56% and 0.55%, respectively). The mean seed recovery per cent for total yield was 0.56%.

There was no significant difference among the two stages with respect to seed recovery per cent. However, S_1 recorded numerically higher seed recovery per cent compared S_2 in all the pickings and in total yield.

The seed recovery per cent was significantly influenced by chemicals spray. GA_3 100 ppm (C_1) recorded significantly higher seed recovery per cent (0.6, 0.58, 0.6, 0.61 and 0.6%) in first, second, third, fourth picking and in total yield respectively over other chemicals and control except NAA 50 ppm (C_3) in first, fourth picking and in total yield which were on par with each other. The lowest seed recovery per cent was recorded in control (0.53%) in first picking, Ethrel 200 ppm (0.54%) in second picking, TIBA 10 ppm and IAA 50 ppm (0.56%) in third picking, DAP 2 percent (0.53%) in fourth picking and in total yield.

Table 25. Seed recovery per cent as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seed recovery per cent														
	I Picking			II Picking			III Picking			IV Picking			For total yield		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	0.61	0.58	0.60	0.58	0.58	0.58	0.62	0.58	0.60	0.62	0.60	0.61	0.61	0.58	0.60
C_2 - IAA 50 ppm	0.58	0.54	0.56	0.40	0.56	0.48	0.57	0.55	0.56	0.60	0.55	0.58	0.53	0.55	0.54
C_3 - NAA 50 ppm	0.59	0.56	0.58	0.58	0.54	0.56	0.59	0.57	0.58	0.60	0.58	0.59	0.59	0.57	0.58
C_4 - 2, 4-D 1 ppm	0.56	0.56	0.56	0.56	0.54	0.55	0.57	0.54	0.56	0.59	0.56	0.58	0.55	0.55	0.55
C_5 - Ethrel 200 ppm	0.57	0.56	0.57	0.53	0.54	0.54	0.58	0.77	0.68	0.58	0.54	0.56	0.56	0.53	0.54
C_6 - TIBA 10 ppm	0.55	0.53	0.54	0.54	0.63	0.59	0.58	0.53	0.56	0.56	0.54	0.55	0.56	0.54	0.55
C_7 - DAP 2%	0.57	0.56	0.57	0.58	0.53	0.56	0.56	0.53	0.55	0.54	0.52	0.53	0.53	0.54	0.53
C_8 - Control	0.54	0.52	0.53	0.55	0.56	0.56	0.58	0.56	0.57	0.55	0.55	0.55	0.55	0.55	0.55
Mean	0.57	0.55	0.56	0.54	0.56	0.55	0.58	0.58	0.58	0.58	0.56	0.57	0.56	0.55	0.56

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.003	NS	0.002	NS	0.003	NS	0.002	NS	0.004	NS
Chemicals (C)	0.007	0.02	0.005	0.02	0.006	0.02	0.005	0.02	0.007	0.02
C at same stage	0.01	0.03	0.01	0.02	0.02	0.05	0.02	0.05	0.01	0.03
S at same or different C	0.01	0.03	0.01	0.03	0.01	0.04	0.01	0.03	0.01	0.03

S_1 - 50% flowering stage S_2 - Fruit setting stage

NS - Non significant

The first order interactions exhibited significant influence on seed recovery per cent for the chemicals at same stage. C_1 both at S_1 and S_2 recorded significantly higher seed seed recovery per cent (0.61, 0.58, 0.62, 0.62, 0.61 and 0.58, 0.58, 0.58, 0.6, 0.58%) in first, Second, third, fourth picking and in total yield respectively over other combinations except S_1C_2 and S_1C_3 which were on par with S_1C_1 and S_2C_3.. The lowest seed recovery per cent was noticed in S_1C_8 and S_2C_8 in first, second, third, fourth picking and in total yield (0.54, 0.55, 0.58, 0.55, 0.55 and 0.52, 0.56, 0.56, 0.52, 0.53, respectively).

The interactions for stages of spray at same or different chemicals influenced the seed recovery per cent significantly. S_1C_1 recorded significantly higher seed recovery per cent (0.61, 0.58, 0.62, 0.62 and 0.61%) in first, second, third, fourth picking and in total yield respectively, over other combinations except S_1C_2, S_1C_3, S_2C_1 and S_2C_3 which were on par with each other. The lowest seed recovery per cent was noticed in S_2C_8 in first picking, S_1C_7 in second picking, S_2C_6 in third picking, S_2C_7 in fourth picking and in total yield.

4.2.11 1000 seed weight (g)

The data on thousand seed weight at different pickings and composite sample from all the four pickings as influenced by chemicals and stages of spray are presented in Table 26.

Irrespective of chemicals and stages of spray, the average 1000 seed weight was maximum in first picking (3.82 g) followed by second, third and last picking (3.78, 3.34 and 2.89 g respectively). The average 1000 seed weight of composite sample obtained from all the four pickings was 3.6 g.

The 1000 seed weight differed significantly due to stages of spray. S_1 (50 per cent flowering stage) recorded significantly maximum 1000 seed weight (3.95, 3.91 and 3.50 g) in first, second and third picking, respectively compared to S_2 (3.69, 3.65, 3.18 g respectively) whereas in fourth picking and composite sample, S_1 and S_2 were on par with each other.

1000 seed weight was influenced significantly by chemicals spray. All the chemicals increased the 1000 seed weight compared to control. GA_3 100 ppm (C_1) recorded significantly higher 1000 seed weight (4.21, 4.21, 3.74 and 3.06 g in first, second third and last picking, respectively) over other chemicals and control except IAA 50 ppm (C_2) and NAA 50 ppm (C_3) 2,4-D 1 ppm (C_4) and ethrel 200 ppm (C_5) in first picking, IAA 50 ppm (C_2), NAA 50 ppm (C_3) and 2,4-D 1 ppm (C_4) in second and third picking and IAA 50 ppm (C_2) and NAA 50 ppm (C_3) in last picking which were on par with each other. The GA_3 100 ppm (C_1) recorded significantly highest 1000 seed weight (4.04 g) in composite sample also, compared to other chemicals and control except NAA 50 ppm (C_3) which was on par with GA_3 100 ppm (C_1). The lowest

1000 seed weight was observed in control (3.27, 3.27, 2.92, 2.69 and 3.03) in first, second third and fourth picking and in composite sample respectively.

The first order interactions resulted in significant influence on 1000 seed weight for the chemicals at the same stage. C_1 both at S_1 and S_2 recorded significantly higher 1000 seed weight (4.32, 4.3, 3.9, 3.12, 4.2 g and 4.1, 4.12, 3.58, 3.00 and 4.04 g, respectively) in first, second third, fourth picking and composite sample over other combinations except S_1C_2, S_1C_3, S_1C_4 and S_1C_5 in First, second and third picking, S_1C_3 in last picking and S_1C_2, S_1C_3 in composite sample which were on par with S_1C_1 and S_2C_2, S_2C_3, S_2C_4 and S_2C_5 in first, second third and last picking and S_2C_2, S_2C_3 and S_2C_4 in composite sample which were on par with S_2C_1. The significantly lowest 1000 seed weight was recorded in C_8 (3.24, 3.28, 2.96, 2.68 and 3.05 g) at the S_1 stage and (3.3, 3.26, 2.88, 2.70 and 3.03 g) at the S_2 stage in first, second third fourth picking and composite sample respectively.

The interactions for stages of spray at same or different chemicals influenced the 1000 seed weight significantly. S_1C_1 recorded significantly higher 1000 seed weight (4.32, 4.30, 3.90, 3.12 and 4.20 g) in first, second third, fourth picking and in composite sample respectively, over other combinations except S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_2C_1, S_2C_2 and S_2C_3 in first, second, third picking, S_1C_3, S_2C_1, S_2C_2, S_2C_3 in fourth picking and S_1C_2, S_1C_3 and S_1C_4 in composite sample

Table 26. 1000 seed weight (g) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	1000 seed weight (g)														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	4.32	4.10	4.21	4.30	4.12	4.21	3.90	3.58	3.74	3.12	3.00	3.06	4.20	3.98	4.04
C_2 - IAA 50 ppm	4.21	3.98	4.09	4.18	3.73	3.95	3.82	3.59	3.70	2.91	3.08	3.01	3.80	3.65	3.72
C_3 - NAA 50 ppm	4.28	4.00	4.14	4.22	3.96	4.09	3.88	3.56	3.72	3.11	3.02	3.05	4.10	3.86	3.93
C_4 - 2, 4-D 1 ppm	4.02	3.69	3.85	4.00	3.98	3.99	3.56	3.14	3.35	2.86	3.02	2.94	3.63	3.59	3.61
C_5 - Ethrel 200 ppm	4.00	3.80	3.90	3.96	3.64	3.80	3.62	2.86	3.24	2.88	2.86	2.87	3.85	3.53	3.69
C_6 - TIBA 10 ppm	3.58	3.28	3.43	3.61	3.19	3.40	3.28	2.93	3.10	2.82	2.70	2.76	3.52	3.08	3.30
C_7 - DAP 2%	3.98	3.40	3.69	3.73	3.31	3.52	2.96	2.93	2.94	2.80	2.72	2.76	3.66	3.29	3.47
C_8 - Control	3.24	3.30	3.27	3.28	3.26	3.27	2.96	2.88	2.92	2.68	2.70	2.69	3.05	3.03	3.03
Mean	3.95	3.69	3.82	3.91	3.65	3.78	3.50	3.18	3.34	2.91	2.88	2.89	3.81	3.50	3.60

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.04	0.17	0.03	0.16	0.05	0.21	0.02	NS	0.07	NS
Chemicals (C)	0.13	0.37	0.13	0.38	0.14	0.41	0.03	0.08	0.09	0.29
C at same stage	0.18	0.52	0.19	0.54	0.20	0.58	0.04	0.12	0.14	0.42
S at same or different C	0.17	0.50	0.18	0.52	0.19	0.55	0.05	0.13	0.15	0.44

S_1 - 50% flowering stage S_2 - Fruit setting stage
NS = Non significant

which were on par with each other. The lowest 1000 seed weight was recorded in S_1C_8 in first and last picking (3.24 and 2.68 g, respectively), S2C8 in second, third and composite sample (3.26, 2.88 and 2.70 g, respectively).

4.2.12 Germination percentage

The data on germination percentage at different pickings and for composite sample as influenced by chemicals and stages of spray are presented in Table 27.

Irrespective of chemicals and stages of spray, the mean germination percentage was maximum in first picking (92.74%) followed by second, third and fourth picking (91.3, 86.6 and 75.48%, respectively). The mean germination percentage of composite sample was 90.42 per cent.

The germination percentage differed significantly due to stages of spray. S_1 recorded significantly maximum germination percentage (93.37, 92.31, 87.09, 76.06 and 91.22%) in first, second, third, fourth picking and composite sample respectively compared to S_2 (92.12, 90.7, 86.12, 74.9 and 89.62%, respectively).

The germination percentage was influenced significantly by chemicals spray. All the chemicals increased germination percentage compared to control. GA_3 100 ppm (C_1) recorded significantly higher germination percentage (96.25, 95.0, 90.75, 80.0, 94.0%) in first, second, third, fourth picking and composite sample respectively, over other chemicals except NAA 50 ppm (C_3), IAA 50 ppm (C_2), 2,4-D 1ppm (C_4) in first picking, NAA 50 ppm (C_3) in second, third, fourth and in composite sample which were on par with each other. The lowest germination percentage was noticed in control (89.25, 88.87, 81.12, 73.75 and 88.0%) in first, second, third, fourth picking and composite sample respectively.

The first order interactions exhibited significant influence on germination percentage for the chemicals at the same stage. C_1 both at S_1 and S_2 recorded significantly higher germination percentage (97.25, 96.25, 92.25, 82.0, 95.25 and 95.5, 93.75, 90.25, 78.0, 92.75, respectively) in first, second, third, fourth picking and composite sample, over other combinations except S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_1C_6 in first picking, S_1C_3 in second, third and fourth picking and in composite sample which were on par with S_1C_1 and S_2C_2, S_2C_3, S_2C_4, S_2C_5, S_2C_6 in first picking, S_2C_2, S_2C_3 in second picking, S_2C_3 in third, fourth picking and in composite sample which were on par with S_2C_1. The significantly lowest germination percentage was recorded in C_8 (89.75, 89.25, 81.0, 74.25 and 88.25%) at S1 and (90.25, 88.5, 81.25, 73.25 and 87.75%) at S_2 in first, second, third and fourth picking and in composite sample respectively.

The interactions for stages of spray at same or different chemicals influenced the germination percentage significantly. S_1C_1 recorded significantly higher germination percentage (97.25, 96.25, 92.25, 82.0 and 95.25%) in first, second, third, fourth picking and composite sample respectively, over other combinations except S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_1C_6, S_2C_1, S_2C_2, S_2C_3, S_2C_4 in first picking S_1C_3 in

Table 27. Germination percentage as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	97.00 (79.51)	95.50 (76.89)	96.25 (78.20)	96.25 (78.85)	93.75 (75.53)	95.00 (77.19)	91.25 (72.83)	90.25 (71.83)	90.75 (72.33)	82.00 (64.91)	78.00 (62.04)	80.00 (63.47)	95.25 (77.48)	92.75 (74.44)	94.00 (75.82)
C_2 - IAA 50 ppm	95.50 (78.48)	93.25 (76.37)	94.37 (77.42)	93.75 (75.68)	91.50 (73.08)	92.62 (74.38)	90.50 (72.07)	88.00 (69.74)	89.25 (70.90)	78.00 (62.12)	75.25 (60.17)	76.62 (61.14)	92.75 (74.44)	90.50 (72.05)	91.62 (73.15)
C_3 - NAA 50 ppm	97.25 (80.65)	95.00 (75.95)	96.12 (78.30)	96.00 (78.50)	93.75 (75.79)	94.87 (77.15)	92.25 (73.90)	89.50 (71.14)	90.87 (72.52)	79.75 (63.35)	78.00 (62.03)	78.87 (62.69)	94.75 (76.82)	92.50 (74.11)	93.62 (75.35)
C_4 - 2, 4-D 1 ppm	93.75 (76.02)	91.50 (73.76)	92.62 (74.89)	91.75 (73.37)	89.50 (71.14)	90.62 (72.26)	88.00 (69.74)	86.75 (68.67)	87.37 (69.20)	74.00 (59.34)	76.25 (60.83)	75.12 (60.09)	90.50 (72.05)	88.25 (70.00)	89.30 (70.91)
C_5 - Ethrel 200 ppm	91.50 (71.85)	90.75 (73.06)	91.12 (72.45)	90.50 (72.07)	89.50 (71.11)	90.00 (71.59)	84.50 (66.82)	85.00 (67.26)	84.75 (67.04)	74.25 (59.51)	73.75 (59.19)	74.00 (59.35)	89.25 (70.91)	88.50 (70.18)	88.87 (70.54)
C_6 - TIBA 10 ppm	92.25 (75.24)	90.50 (71.20)	91.37 (73.22)	91.50 (73.10)	90.25 (71.83)	90.87 (72.46)	86.00 (68.03)	86.25 (68.25)	86.12 (68.14)	73.00 (58.69)	72.00 (58.07)	72.50 (58.38)	90.50 (72.05)	89.25 (70.91)	89.87 (71.47)
C_7 - DAP 2%	90.00 (70.62)	90.25 (72.30)	90.12 (71.46)	89.50 (71.14)	88.25 (69.98)	88.87 (70.56)	83.25 (65.83)	82.00 (64.91)	82.62 (65.37)	73.25 (58.85)	72.75 (58.54)	73.00 (58.69)	88.50 (70.18)	87.50 (69.30)	88.12 (69.82)
C_8 - Control	89.75 (72.95)	90.25 (72.08)	90.00 (72.52)	89.25 (70.90)	88.50 (70.19)	88.87 (70.54)	81.00 (64.15)	81.25 (64.35)	81.12 (64.25)	74.25 (59.50)	73.25 (58.85)	73.75 (59.18)	88.25 (70.00)	87.75 (69.56)	88.00 (69.73)
Mean	93.37 (75.66)	92.12 (73.95)	92.74 (74.81)	92.31 (74.20)	90.70 (72.33)	91.30 (73.27)	87.09 (69.17)	86.12 (68.27)	86.60 (68.72)	76.06 (60.78)	74.90 (59.96)	75.48 (60.37)	91.22 (72.74)	89.62 (71.12)	90.42 (71.95)

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.10	0.65	0.35	1.59	0.15	0.68	0.41	1.85	0.32	1.57
Chemicals (C)	2.00	5.82	0.61	1.74	0.46	1.31	0.50	1.43	0.60	1.71
C at same stage	2.84	8.23	0.86	2.46	0.65	1.86	0.71	2.02	0.83	2.40
S at same or different C	2.65	7.70	0.88	2.51	0.63	1.79	0.78	2.23	0.86	2.49

S_1 - 50% flowering stage S_2 - Fruit setting stage
* Figures in the paranthesis indicate arcsine transformed values

LEGEND

CHEMICALS

C_1 GA_3 100 ppm

C_2 IAA 50 ppm

C_3 NAA 50 ppm

C_4 2, 4-D 1 ppm

C_5 Ethrel 200 ppm

C_6 TIBA 10 ppm

C_7 DAP 2%

C_8 Control

STAGES OF SPRAY

S_1 50% flowering stage

S_2 Fruit setting stage

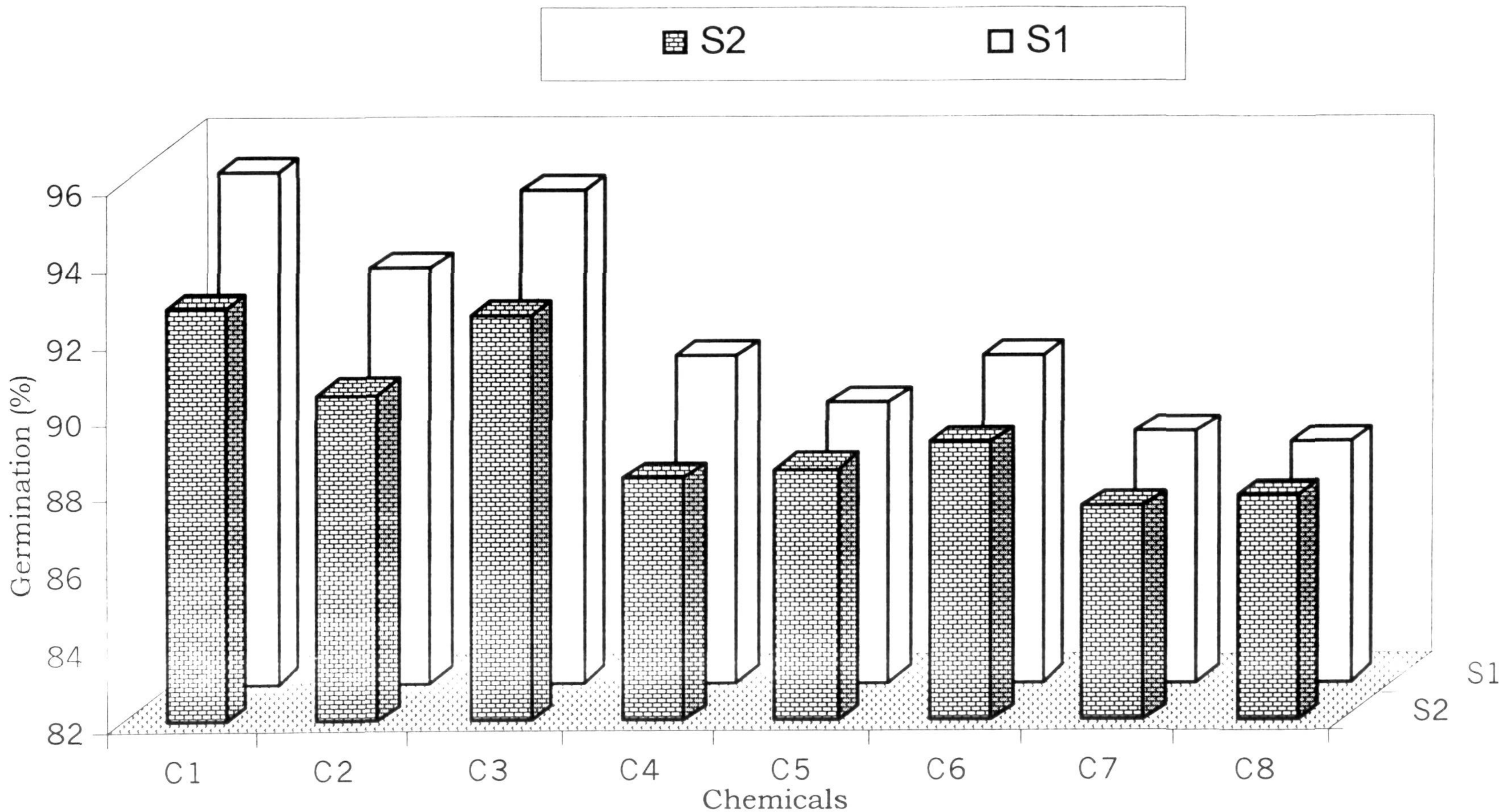


Fig. 7. Germination (%) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15)

second picking S_1C_3, S_2C_1 in third picking, S_1C_3, S_2C_1 in fourth picking and S_1C_3 in composite sample which were on par with each other. The lowest germination percentage was recorded in S_1C_8 (89.75 and 81.00%) in first and third picking respectively, S_2C_8 (88.5, 73.25 and 87.75) in second, fourth picking and in composite sample respectively.

4.2.13 Seedling root length (cm)

The data on root length at different pickings and for composite sample obtained from all the four pickings as influenced by chemicals and stages of spray are presented in Table 28.

Irrespective of chemicals and stages of spray, the average root length was maximum in first picking (5.14 cm) followed by second, third and fourth picking (5.00, 4.57 and 3.96 cm, respectively). The average root length of composite sample was 4.79 cm.

The root length differed significantly due to stages of spray. S_1 recorded significantly maximum root length (5.3, 5.23, 4.7 and 4.07 cm) in first, second, third and fourth picking respectively compared to S_2 (4.97, 4.78, 4.41 and 3.84 cm, respectively). The composite sample did not differ significantly for stage of spray. However, S_1 recorded maximum value (4.97 cm) compared to S_2 (4.62 cm).

The root length was significantly influenced by chemical spray. All the chemicals increased the root length GA_3 100-ppm (C_1) recorded significantly higher root length (5.93, 5.78, 5.09, 4.20 and 5.35) in first, second, third, fourth picking and in composite sample respectively over other chemicals and control except IAA 50 ppm (C_2) in first picking, IAA 50 ppm (C_2) and NAA 50 ppm (C_3) in third, fourth picking and composite sample, which were on par with each other. The lowest root length was recorded in control (4.17, 4.20, 4.06, 3.74 and 4.19 cm) in first, second, third, fourth picking and composite sample respectively.

The first order interactions exhibited significant influence on root length for the chemicals at the same stage. C_1 at S_1 and S_2 recorded significantly highest root length (6.02, 5.98, 5.28, 4.4, 5.42 cm and 5.84, 5.59, 4.9, 4.0, 5.28 cm, respectively) in first, second, third, fourth and composite sample over other combinations except S_1C_2, S_1C_3 in first, third picking and composite sample, S_1C_2, S_1C_3, S_1C_4 in second and fourth picking which were on par with S_1C_1 and S_2C_2 in first and second picking, S_2C_2, S_2C_3 in third picking and composite sample, were on par with S_2C_1. There was no significant difference among the chemicals at S_2 in fourth picking.

The interactions of stages of spray at the same or different chemicals influenced the root length significantly. S_1C_1 recorded significantly highest root length (6.02, 5.98, 5.28 and 4.40 cm) in first, second, third and last picking respectively, over other combinations except S_1C_2, S_1C_3, S_2C_1 in first picking, S_1C_2, S_1C_3 and S_2C_1 in second picking, S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_2C_1, S_2C_2 and S_2C_3 in third and fourth picking which were on par with each other. In composite

Table 28. Root length (cm) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Root length (cm)														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	6.02	5.84	5.93	5.98	5.59	5.78	5.28	4.90	5.09	4.40	4.00	4.20	5.42	5.28	5.35
C_2 - IAA 50 ppm	5.86	5.26	5.56	5.64	5.01	5.32	5.00	4.78	4.89	4.30	4.02	4.16	5.20	4.94	5.07
C_3 - NAA 50 ppm	5.88	5.08	5.48	5.66	4.96	5.31	5.13	4.84	4.98	4.32	3.98	4.15	5.75	4.97	5.36
C_4 - 2, 4-D 1 ppm	4.83	4.51	4.67	4.96	4.20	4.58	4.78	4.26	4.52	3.96	3.64	3.80	4.63	4.15	4.39
C_5 - Ethrel 200 ppm	5.23	4.82	5.02	5.08	4.68	4.88	4.83	4.38	4.60	3.98	3.82	3.90	4.98	4.42	4.70
C_6 - TIBA 10 ppm	5.03	4.88	4.96	5.00	4.68	4.84	4.26	4.00	4.13	3.82	3.80	3.81	4.72	4.44	4.58
C_7 - DAP 2%	5.48	5.12	5.30	5.26	5.00	5.13	4.32	4.26	4.29	3.95	3.80	3.91	4.95	4.56	4.75
C_8 - Control	4.06	4.28	4.17	4.28	4.12	4.20	4.00	4.12	4.06	3.86	3.63	3.74	4.15	4.23	4.19
Mean	5.30	4.97	5.14	5.23	4.78	5.00	4.70	4.41	4.57	4.07	3.84	3.96	4.97	4.62	4.79

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.06	0.25	0.05	0.22	0.06	0.28	0.03	0.12	0.05	NS
Chemicals (C)	0.14	0.40	0.14	0.42	0.13	0.37	0.12	0.33	0.10	0.30
C at same stage	0.20	0.57	0.20	0.59	0.18	0.53	0.16	0.47	0.14	0.43
S at same or different C	0.19	0.55	0.20	0.57	0.18	0.53	0.16	0.45	0.14	0.43

S_1 - 50% flowering stage S_2 - Fruit setting stage
NS - Non significant

sample S_1C_3 recorded significantly higher root length (5.75 cm) over other combinations except S_1C_2, S_1C_3 and S_2C_1 which were on par with each other. The lowest root length was noticed in S_1C_8 (4.06, 4.00 and 4.15) in first and third picking and composite sample respectively. Whereas S_2C_8 recorded lowest root length in second and fourth picking (4.12 and 3.63 cm, respectively).

4.2.14 Seedling shoot length (cm)

The data on shoot length at different pickings and for composite sample as influenced by chemicals and stages of spray are presented in Table 29.

Irrespective of chemicals and stages of spray, the average shoot length was maximum in first picking (7.92 cm) followed by second, third and fourth picking (7.80, 7.23 and 6.49 cm, respectively). The average shoot length of composite sample was 7.67 cm.

The shoot length was significantly influenced by stages of spray. S_1 noticed significantly higher shoot length (8.22, 8.06, 7.56 and 7.96 cm) in first, second and third picking and composite sample respectively compared to S_2 (7.63, 7.53, 6.91 and 7.39). In fourth picking S_1 and S_2 were on par with each other.

The shoot length differed significantly due to chemicals spray. Application of GA_3 100 ppm (C_1) recorded significantly higher shoot length (8.65, 8.50, 7.62, 6.81 and 8.33 cm) in first, second, third, fourth picking and composite sample respectively over other chemicals and control except IAA 50 ppm (C_1), NAA 50 ppm (C_2), 2,4-D 1 ppm (C_4) and Ethrel 200 ppm (C_5) in third picking, IAA 50 ppm (C_2) and NAA 50 ppm (C_3) in fourth picking and NAA 50 ppm (C_3) in composite sample, which were on par with each other. The lowest shoot length was noticed in control (7.67, 7.29, 6.92, 6.37 and 7.26 cm) in first, second, third, fourth picking and composite sample respectively.

The interactions resulted in significant influence on shoot length for the chemicals at the same stage. C_1 at S_1 and S_2 recorded significantly highest shoot length (9.13, 9.0, 8.12, 7.52, 8.88 cm and 8.18, 8.0, 7.12, 6.1, 7.79 cm, respectively) in first, second, third, fourth picking and in composite sample respectively over other combinations except S_1C_2, S_1C_3, S_1C_4 in third picking and S_1C_2, S_1C_3 in fourth picking which were on par with S_1C_1 and S_2C_3 in first picking, S_2C_2, S_2C_3 in second, fourth and in composite sample and in third picking S_2C_1, S_2C_2, S_2C_3 and S_2C_4 which were on par with S_2C_1. The lowest shoot length was recorded in C_8 at S_1 and S_2 (7.98, 7.38, 7.0, 6.46, 7.28 cm and 7.36, 7.20, 6.85, 6.28, 7.25 cm, respectively) in first, second, third, fourth picking and in composite sample.

The interaction for stages of spray at same or different chemicals influenced the shoot length significantly. S_1C_1 recorded significantly higher shoot length (9.13, 9.00, 8.12, 7.52 and 8.88 cm) in first, second, third, fourth picking and in composite sample respectively over rest of the combinations except S_1C_2, S_1C_3 and S_1C_4 in third picking and

Table 29. Shoot length (cm) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Shoot length (cm)														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	9.13	8.18	8.65	9.00	8.00	8.50	8.12	7.12	7.62	7.52	6.10	6.81	8.88	7.79	8.33
C_2 - IAA 50 ppm	8.24	7.76	8.00	8.20	7.83	8.01	8.00	7.02	7.51	7.28	5.86	6.57	7.90	7.73	7.81
C_3 - NAA 50 ppm	8.32	7.83	8.07	8.30	7.64	7.97	7.91	7.00	7.45	7.16	5.90	6.53	8.10	7.80	7.95
C_4 - 2, 4-D 1 ppm	7.92	7.60	7.76	7.93	7.39	7.66	7.88	6.64	7.26	7.00	5.48	6.24	7.81	7.09	7.45
C_5 - Ethrel 200 ppm	8.00	7.28	7.64	7.98	7.40	7.69	7.49	6.83	7.16	7.12	5.73	6.42	7.88	7.15	7.51
C_6 - TIBA 10 ppm	8.16	7.38	7.77	8.00	7.23	7.61	6.98	6.91	6.94	6.84	5.80	6.32	8.00	7.13	7.56
C_7 - DAP 2%	8.00	7.63	7.81	7.73	7.60	7.66	7.12	6.94	7.03	7.08	6.20	6.64	7.83	7.25	7.54
C_8 - Control	7.98	7.36	7.67	7.38	7.20	7.29	7.00	6.85	6.92	6.46	6.28	6.37	7.28	7.25	7.26
Mean	8.22	7.63	7.92	8.06	7.53	7.80	7.56	6.91	7.23	7.06	5.92	6.49	7.96	7.39	7.67

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.10	0.47	0.04	0.20	0.04	0.16	0.06	NS	0.04	0.16
Chemicals (C)	0.14	0.38	0.15	0.44	0.14	0.41	0.10	0.30	0.13	0.39
C at same stage	0.19	0.55	0.22	0.63	0.20	0.58	0.15	0.42	0.18	0.55
S at same or different C	0.20	0.59	0.21	0.60	0.19	0.56	0.15	0.43	0.17	0.53

S_1 - 50% flowering stage S_2 - Fruit setting stage
NS - Non significant

S_1C_2 and S_1C_3 in fourth picking which were on par with each other. The lowest shoot length (7.36, 7.20, 6.85, 6.28 and 7.25 cm) was noticed in first, second, third, fourth picking and in composite sample respectively.

4.14 Seedling vigour index

The data pertaining to seedling vigour index at different pickings and for composite sample as influenced by chemicals and stages of spray are presented in Table 30.

Irrespective of chemicals and stages of spray, the average vigour index value was maximum in first picking (1208) followed by second, third and fourth picking (1172, 1024 and 788 respectively). The average vigour index value of composite sample was 1103.

The seedling vigour index values differed significantly due to stages of spray. S_1 recorded significantly higher vigour index values (1257, 1229, 1070, 844 and 1150) in first, second, third and fourth picking and in composite sample respectively compared to S_2 (1160, 1116, 978, 731 and 1056).

Significant differences were observed in seedling vigour index values due to chemical spray. All chemicals increased the vigour index values compared to control. GA_3 100 ppm (C_1) recorded significantly highest vigour index value (1403, 1358, 1150, 872 and 1257) in first, second, third, fourth picking and in composite sample respectively over other chemicals and control except IAA 50 ppm (C_2) and NAA 50 ppm (C_3) in third picking which were on par with each other.

The lowest vigour index values was noticed in control (1065, 1021, 890, 745 and 986) in first, second, third, fourth picking and in composite sample respectively.

The first order interactions showed significant influence on seedling vigour index for the chemicals at the same stage. Significantly highest vigour index was recorded in C_1 at S_1 and S_2 (1469, 1442, 1226, 977, 1333 and 1338, 1274, 1075, 767, 1182 respectively) in first, second, third, fourth picking and in composite sample, over other combinations except S_1C_2, S_1C_3 in first and third picking and S_2C_2, S_2C_3 in first, third and fourth picking which were on par with S_1C_1 and S_2C_2 respectively. Significantly lowest vigour index was noticed in C_8 at S_1 and S_2 (1080, 1041, 891, 766, 983 and 1050, 1001, 890, 725, 990, respectively) in first, second, third, fourth picking and in composite sample.

The interactions for stage of spray at same or different chemicals influenced the seedling vigour index significantly S_1C_1 noticed significantly higher vigour index values (1469, 1442, 1226, 977 and 1333) in first, second, third, fourth picking and in composite sample respectively over rest of the combinations except S_1C_1 and S_1C_2 in first and third picking which were on par with each other. The S_2C_8 recorded lowest vigour index value (1050, 1001, 890, 725 and 990) in first, second, third, fourth picking and composite sample respectively.

Table 30. Seedling vigour index as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seedling vigour index														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	1469	1338	1403	1442	1274	1358	1226	1075	1150	977	767	872	1333	1182	1257
C_2 - IAA 50 ppm	1346	1232	1289	1297	1174	1235	1176	1047	1111	903	763	833	1185	1118	1151
C_3 - NAA 50 ppm	1380	1226	1303	1340	1181	1260	1195	1059	1127	890	765	827	1241	1158	1199
C_4 - 2, 4-D 1 ppm	1148	1085	1116	1182	1037	1109	1114	945	1029	811	703	757	1104	969	1036
C_5 - Ethrel 200 ppm	1210	1098	1154	1181	1081	1131	1046	952	999	824	704	764	1125	997	1061
C_6 - TIBA 10 ppm	1216	1111	1163	1189	1074	1131	966	940	953	778	691	734	1128	1022	1075
C_7 - DAP 2%	1213	1141	1177	1162	1111	1136	952	918	935	808	734	771	1105	1018	1061
C_8 - Control	1080	1050	1065	1041	1001	1021	891	890	890	766	725	745	983	990	986
Mean	1257	1160	1208	1229	1116	1172	1070	978	1024	844	731	788	1150	1056	1103

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	3.8	23.3	3.2	19.4	4.5	27.8	3.6	22.2	3.8	27
Chemicals (C)	30.7	89.2	13.6	39.5	19.7	57.2	10.0	28.9	13.9	41
C at same stage	43.5	126.2	19.3	55.9	27.9	80.8	14.1	41.0	18.6	55
S at same or different C	40.9	118.9	18.3	53.1	26.4	76.8	13.7	39.7	20.0	61

S_1 - 50% flowering stage S_2 - Fruit setting stage

LEGEND

CHEMICALS

C_1 GA_3 100 ppm

C_2 IAA 50 ppm

C_3 NAA 50 ppm

C_4 2, 4-D 1 ppm

C_5 Ethrel 200 ppm

C_6 TIBA 10 ppm

C_7 DAP 2%

C_8 Control

STAGES OF SPRAY

S_1 50% flowering stage

S_2 Fruit setting stage

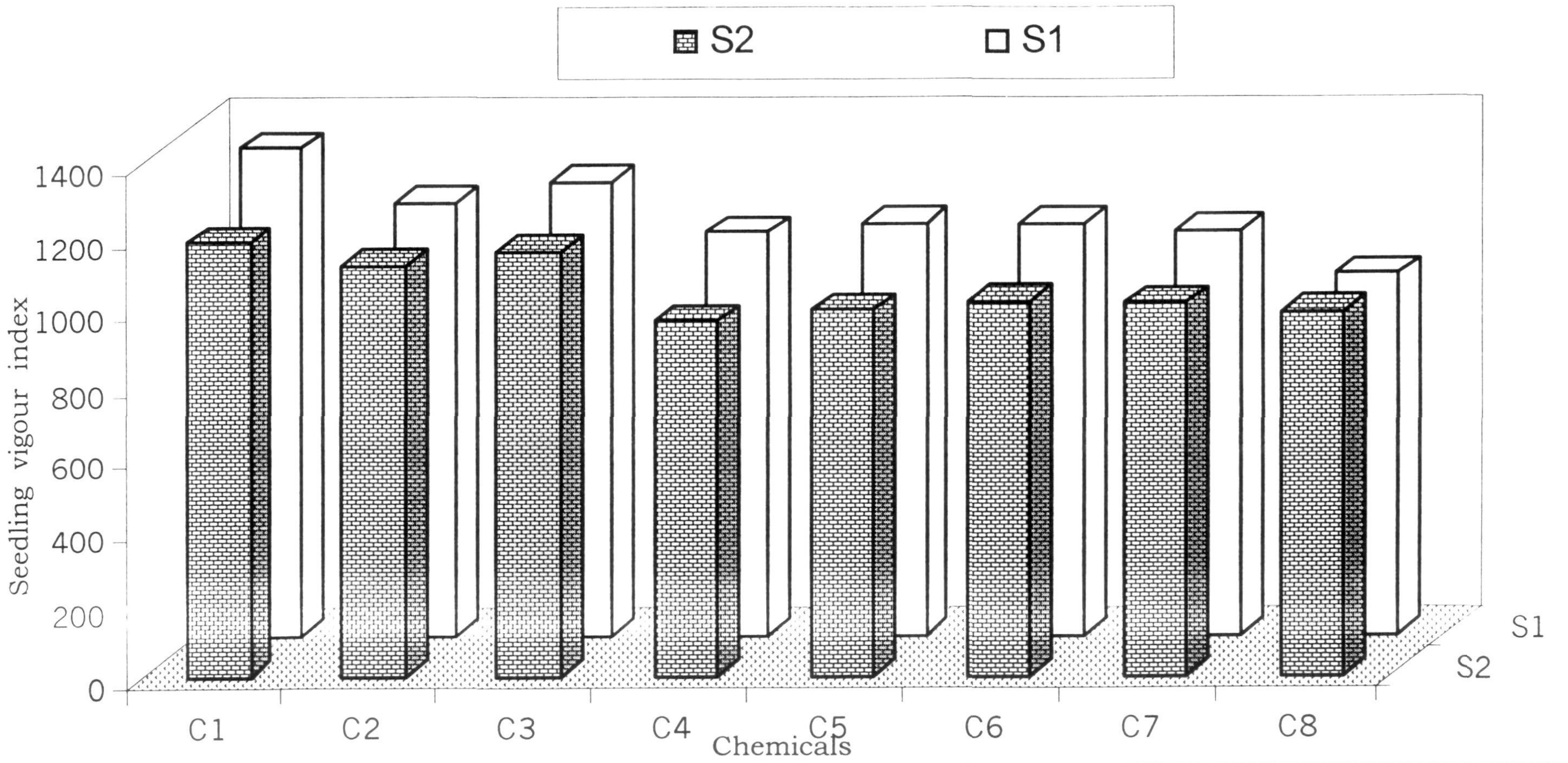


Fig. 8. Seedling vigour index as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15)

4.2.15 Seedling dry weight (mg)

The data pertaining to seedling dry weight at different pickings and for composite sample as influenced by chemicals and stages of spray are presented in Table 31.

Irrespective chemicals and stages of spray the average seedling dry weight was highest in first picking (26.34 mg) followed by second, third and fourth picking (25.53, 24.92 and 22.03 mg respectively). The composite sample recorded average seedling dry weight of 23.7 mg.

The seedling dry weight was significantly influenced by stages of spray. S_1 recorded significantly maximum seedling dry weight (27.72, 27.34, 24.93, 22.87 and 25.30 mg) in first, second, third, fourth picking and in composite sample respectively, compared to S_2.

The seedling dry weight differed significantly due to chemicals spray. All chemicals increased the seedling dry weight compared to control. GA_3 100 ppm (C_1) recorded significantly highest seedling dry weight (29.62, 29.62, 27.12, 24.87 and 28.00 mg) in first, second, third, fourth picking and in composite sample respectively over rest of the chemicals and control except NAA 50 ppm (C_3) in third picking and IAA 50 ppm (C_2) in composite sample which were on par with each other. The control (C_8) recorded lowest seedling dry weight (20.87, 21.00, 19.62, 18.25 and 19.50 mg) in first, second, third, fourth picking and composite sample respectively.

The interactions for chemicals at same stage influenced the seedling dry weight significantly. C_1 at S_1 ad S_2 recorded significantly higher seedling dry weight (31.5, 31.75, 28.0, 26.25, 29.50 mg and 27.72, 27.50, 26.25, 23.50, 26.0 mg, respectively) in first, second, third, fourth picking and in composite sample respectively, over other combinations except S_1C_3 in first, third and fourth picking, S_1C_2, S_1C_3, S_1C_4 and S_1C_5 in composite sample which were on par with S_1C_1 and S_2C_2, in second picking, S_2C_2, S_2C_3 in third picking and S_2C_2 and S_2C_4 in composite sample which were on par with S_2C_1. The lowest seedling dry weight was observed in C_8 (20.5, 21.25, 19.25, 18.0, 19.25 mg) at S1 and (21.25, 20.75, 20.00, 18.5, 19.25 mg) at S_2 in first, second, third, fourth picking and composite sample respectively.

The interactions for stages of spray at same or different chemicals influenced the seedling dry weight significantly. S_1C_1 recorded significantly higher seedling dry weight (31.5, 31.75, 28.0, 26.25 and 29.5 mg) in first, second, third, fourth picking and in composite sample respectively over other combinations except S_1C_3 in first picking, S_1C_3 and S_2C_3 in third picking, S_1C_3 in fourth picking and S_1C_2, S_1C_3, S_1C_4, S_1C_5, S_2C_1 and S_2C_2 in composite sample which were on par with each other. The lowest seedling dry weight was noticed in S_1C_8 (20.5, 19.25, 18.00 and 19.25 mg) in first, third, fourth picking and in composite sample respectively. In second picking the lowest value was noticed in S_2C_8 (20.75 mg).

Table 31. Seedling dry weight (mg) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Seedlingdry weight (mg)														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	31.50	27.75	29.62	31.75	27.50	29.62	28.00	26.25	27.12	26.25	23.50	24.87	29.50	26.50	28.00
C_2 - IAA 50 ppm	28.75	25.25	27.00	27.50	26.75	27.12	26.25	26.00	26.12	24.50	21.25	22.87	26.00	25.75	25.87
C_3 - NAA 50 ppm	30.00	24.50	27.25	29.75	22.25	26.00	27.50	27.00	27.25	25.25	22.00	23.62	27.75	20.25	24.00
C_4 - 2, 4-D 1 ppm	28.00	24.25	26.12	29.00	23.50	26.25	24.50	25.75	25.12	23.25	21.50	22.37	27.00	21.50	24.25
C_5 - Ethrel 200 ppm	29.25	25.00	27.12	28.75	22.75	25.75	25.75	24.25	25.00	22.50	20.50	21.50	26.58	20.75	23.62
C_6 - TIBA 10 ppm	28.00	26.25	27.12	26.25	22.50	24.37	25.00	25.50	25.25	22.75	21.50	22.12	24.28	20.50	22.35
C_7 - DAP 2%	25.75	25.50	25.62	24.50	23.75	24.12	23.25	24.50	23.87	20.50	20.75	20.62	22.25	21.75	22.00
C_8 - Control	20.50	21.25	20.87	21.25	20.75	21.00	19.25	20.00	19.62	18.00	18.50	18.25	19.25	19.75	19.50
Mean	27.72	24.96	26.34	27.34	23.72	25.53	24.93	24.90	24.92	22.87	21.18	22.03	25.30	22.09	23.70
For comparing means of	S. Em ±	CD at 5%		S. Em ±	CD at 5%		S. Em ±	CD at 5%		S. Em ±	CD at 5%		S. Em ±	CD at 5%	
Stages (S)	0.09	0.43		0.23	1.06		0.04	0.19		0.25	1.15		0.13	2.46	
Chemicals (C)	0.48	1.37		0.40	1.16		0.30	0.85		0.30	0.88		0.17	3.55	
C at same stage	0.67	1.93		0.57	1.64		0.42	1.21		0.43	1.24		1.65	5.03	
S at same or different C	0.64	1.83		0.58	1.67		0.39	1.13		0.48	1.37		1.55	4.72	

S_1 - 50% flowering stage S_2 - Fruit setting stage

4.2.16 Electrical conductivity (dSm^{-1})

The data on EC of seed leachates of various pickings and composite sample as influenced by chemicals and stages of spray are presented in Table 32.

Irrespective of chemicals and stages of spray, the average EC of seed leachate was lowest in second picking (1.05 dSm^{-1}) followed by first, third and fourth picking (1.12, 1.26 and 1.77 dSm^{-1}, respectively). the composite sample recorded EC of 1.08 dSm^{-1}.

Stages of spray had no significant effect on EC at all the pickings and in composite sample. However, S_1 recorded lower EC (1.10, 1.04, 1.25, 1.76 and 1.07) in first, second, third, fourth picking and composite sample respectively compared to S_2.

Chemicals spray had significant influence on EC at all the pickings and in composite sample. Significantly lowest EC was noticed in GA_3 100 ppm (0.92, 0.86, 1.10, 1.61 and 0.89 dSm^{-1}) in first, second, third, fourth picking and composite sample respectively over other chemicals and control except NAA 50 ppm (C_3) in fourth picking which was on par with GA_3 100 ppm (C_1). The highest EC was noticed in control (1.18 dSm^{-1}) at first picking which was on par with ethrel 200 ppm (C5) DAP 2 per cent (C_7) and TIBA 10 ppm (C_6). In second picking, the highest EC noticed in Ethrel 200 ppm (1.12 dSm^{-1}) which was on par with DAP 2 per cent (C_7) and control (C_8). The third picking C_8 recorded highest EC (1.35 dSm^{-1}) which was on par with Ethrel 200 ppm (C_5). In fourth picking Ethrel 200 ppm (C_5) and DAP 2 per cent (C_7) recorded highest EC (1.84 dSm^{-1}) which was on par with control (C_8). In composite sample DAP 2 per cent (C_7) recorded highest EC (1.15 dSm^{-1}) which was on par with control (C_8).

The interactions for chemicals at same stage showed significant influence on EC of seed leachate. The significantly least EC was observed in C_1 at S_1 (0.86, 0.83, 1.09, 1.57, 0.84 dSm^{-1}) and at S_2 (0.99, 0.90, 1.12, 1.65, 0.95 dSm^{-1}) in first, second, third and last picking and in composite sample respectively over other combinations except S_1C_3 in second, third and fourth picking and S_2C_3 in third and fourth picking which were on par with S_1C_1 and S_2C_1 respectively. The highest value of EC was recorded in C_8 at S_1 (1.19, 1.12, 1.35, 1.82, 1.17) and at S_2 (1.18, 1.13, 1.35, 1.81, 1.14) in first, second, third, fourth picking and in composite sample respectively.

The interactions for stages of spray at same or different chemicals had significant influence on EC. S_1C_1 recorded significantly lowest EC (0.86, 0.83, 1.09, 1.57 and 0.84) in first, second, third, and fourth picking and in composite sample respectively over other combinations except S_2C_1 in second and third picking, S_1C_3 and S_2C_1 in fourth picking which were on par with each other. The highest EC of 1.19 dSm^{-1} was observed in S_1C_8 in first picking, in second picking S_2C_7 and S_2C_8 recorded equal and highest value of EC (1.13 dSm^{-1}). In third picking S_1C_7, S_1C_8 and S_2C_8 recorded highest

Table 32. Electrical conductivity of seed leachate (dSm^{-1}) as influenced by chemicals and stages of spray in tomato Cv. Megha (L-15).

Chemicals spray (C)	Electrical conductivity (dSm^{-1})														
	I Picking			II Picking			III Picking			IV Picking			Composite sample		
	Stages of spray			Stages of spray			Stages of spray			Stages of spray			Stages of spray		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
C_1 - GA_3 100 ppm	0.86	0.99	0.92	0.83	0.90	0.86	1.09	1.12	1.10	1.57	1.65	1.61	0.84	0.95	0.89
C_2 - IAA 50 ppm	1.09	1.12	1.10	1.02	1.08	1.05	1.20	1.28	1.24	1.79	1.80	1.79	1.07	1.09	1.08
C_3 - NAA 50 ppm	1.06	1.08	1.07	0.92	1.01	0.96	1.15	1.20	1.17	1.62	1.73	1.67	0.94	1.06	1.00
C_4 - 2, 4-D 1 ppm	1.12	1.15	1.13	1.09	1.09	1.09	1.27	1.31	1.29	1.80	1.82	1.81	1.10	1.12	1.11
C_5 - Ethrel 200 ppm	1.18	1.18	1.18	1.12	1.12	1.12	1.32	1.35	1.33	1.83	1.85	1.84	1.16	1.16	1.16
C_6 - TIBA 10 ppm	1.15	1.16	1.15	1.10	1.08	1.09	1.30	1.28	1.29	1.81	1.83	1.82	1.13	1.14	1.13
C_7 - DAP 2%	1.17	1.18	1.17	1.12	1.13	1.12	1.35	1.28	1.31	1.83	1.86	1.84	1.15	1.15	1.15
C_8 - Control	1.19	1.18	1.18	1.12	1.13	1.12	1.35	1.35	1.35	1.82	1.81	1.81	1.17	1.14	1.15
Mean	1.10	1.13	1.12	1.04	1.07	1.05	1.25	1.27	1.26	1.76	1.79	1.77	1.07	1.10	1.08

For comparing means of	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%	S. Em ±	CD at 5%
Stages (S)	0.020	NS	0.002	NS	0.003	NS	0.014	NS	0.003	NS
Chemicals (C)	0.010	0.03	0.021	0.060	0.020	0.060	0.021	0.060	0.017	0.053
C at same stage	0.023	0.04	0.030	0.090	0.028	0.084	0.030	0.090	0.025	0.075
S at same or different C	0.023	0.04	0.030	0.080	0.026	0.079	0.032	0.090	0.023	0.070

S_1 - 50% flowering stage S_2 - Fruit setting stage
NS - Non significant

and equal value for EC (1.35 dSm^{-1}). In fourth picking S_2C_7 recorded highest EC (1.86 dSm^{-1}). In composite sample S_1C_8 recorded highest EC (1.17 dSm^{-1}).

DISCUSSION

V. DISCUSSION

Physiological processes in a crop are directly or indirectly controlled by environment under which it is grown. In addition to genotype, soil, cultural practices and their interactions will have profound influence on growth, flowering and productivity of crop plants. In order to suit their requirement, the environment can be modified to certain extent by cultural practices. Hence, an attempt was made in this study to increase the seed yield and quality by way of manipulating cultural processes viz., mother plant nutrition and exogenous application of chemicals to evaluate their impact on the seed yield and quality of tomato. The results obtained in the present investigation have been discussed in this chapter.

EXPERIMENT – I

5.1 Effect of mother plant nutrition on seed yield and quality in tomato

The experiment was carried out on tomato Cv. L-15 to ascertain the effect of mother plant nutrition on crop growth, fruit yield, seed yield and quality parameters during *kharif* 1999. There were 12 treatment combinations with four levels of nitrogen (60, 120, 180, 240 kg/ha) and three levels of phosphorus (60, 120, 180 kg/ha). The results obtained in this study are discussed below.

5.1.1 Effect of mother plant nutrition on growth parameters

The beneficial effect of mother plant nutrition on crop growth, fruit yield, seed yield and quality in several vegetable crops are well documented. In the present study also, the fertilizer levels have shown a greater influence on various crop growth, fruit yield, seed yield and quality parameters as discussed below.

Application of 240 : 180 : 80 kg NPK per ha (T_{12}) recorded significantly higher plant height (114.8 cm) followed by T_{11} (112 cm), T_{10} (111 cm), T_9 (110.9 cm), T_8 (110.9 cm), T_7 (110.7 cm) and T_6 (110.5 cm) which were on par with each other (Table 1). An increase in plant height due to application of higher fertilizer levels might be attributed to the greater uptake of nutrients, which increased the cell division, cell elongation ultimately increased the plant height. A numerical increase in plant height from 110.5 cm (T_6) to 114.8 cm (T_{12}) might have due to limited capacity of the plant to absorb and utilize higher levels of nutrients into the plant system beyond certain limit. (Dharmatti and Kulkarni, 1988). The nitrogen being the constituent of protein and components of protoplasm, might be favourably increased the chlorophyll content of leaves resulting in increased synthesis of carbohydrates (Barooah and Ahmed, 1964). Singegol (1997) opined that phosphorus being essential constituent of cellular protein and nucleic acid might have encouraged meristematic activity of plant. Present results also supports the findings of Baruah *et al.* (1993) in tomato, Parashetti (1991) in brinjal, Revanappa (1993) and Biradar (2000) in chilli.

Number of primary and secondary branches per plant were significantly highest in T_{12} (2.4 and 9.5, respectively) compared to other treatments except T_{11}, T_{10}, T_9, T_8, T_7 and T_6 which were on par with each other (Table 1). The increase in fertilizer level from T_6 to T_{12} resulted in numerical increase in number of branches but it was statistically non significant. Similar trend was noticed with respect to teritary branches per plant. Nitrogen and phosphorus are the major plant nutrients known to have role in synthesis of amino acids and proteins which could increase vertical and lateral growth in terms of number of branches (Dharmatti et al., 1991). The marginal increase in number of branches due to increase in fertilizer level from T_6 to T_{12} might be attributed to minimal level of plant nutrients which are quite sufficient for full expression of number of branches (Doddamani and Panchal., 1989). The increase in number of branches with increased mother plant nutrition was also reported by Barooah and Ahmed (1964), Sharma and Man (1972), Sube singh (1988), and Baruah *et al.* (1993) in tomato, Revanappa (1993) and Biradar (2000) in chilli.

Delay in days taken for 50 per cent flowering was noticed from T_1 (28 days) to T_{12} (34 days) as the levels of fertilizer increased (Table 1), which might be attributed to longer juvenile or vegetative phase of the plant. The results of the present investigation are in conformity with Sharma (1995) in tomato, Revanappa (1993) and Biradar (2000) in chilli.

5.1.2 Effect of mother plant nutrition on fruit yield and yield attributes

The increase in N and P levels resulted in significant increase in total number of fruits per plant (Table 2) from 19.3 (T_1) to 37 (T_6), then the increase was numerical and non significant up to T_{12} (41.5). The increase in number of fruits may be due to adequate nourishment of plants resulting in production of more number of branches, flowers and ultimately the fruits. Similarly Ramakrishna Praseeda (1976) and Baruah *et al.* (1993) in tomato, obtained more number of fruits with higher doses of fertilizers.

The total fruit yield per plant (Table 3) increased significantly with increase in mother plant nutrition from T_1 (807.7 g) to T_6 (1860 g), then the increase was numerical and non significant up to T_{12} (2058.3 g). The similar trend was noticed in per plot (Table 4) and per hectare fruit yield (Table 5). However, numerically highest total fruit yield per plant (24.8 kg) and per hectare (34.5 t) was noticed in T_{12}. This increased fruit yield per plant, per plot and per hectare obtained in the present study might be due to higher number of branches bearing more number of flowers with increased fruit set. Plants receiving higher doses of nutrition showed longer vegetative period and delayed flowering and are capable of greater photosynthetic activity. The photosynthates are utilized for the development of the fruits and finally increasing the yield. The higher fruit yield with higher levels of nutrients have also been reported by Sube singh (1988) and Sharma (1995) in tomato and Biradar (2000) in chilli.

5.1.3 Effect of mother plant nutrition on seed yield and yield attributes

The total seed yield per plant significantly increased with increase in fertilizer levels from 4.52 g (T_1) to 12.33 g (T_6). Further increase in fertilizer levels from T_6 120 : 180 : 80 kg NPK per hectare to 240 : 180 : 80 kg NPK per hectare (T_{12}) resulted in numerical and non significant increase in seed yield per plant (Table 6). Similar trend in seed yield was followed for per plot (Table 7) and per ha (Table 8). However, T_{12} recorded numerically highest seed yield per plant (13.98 g), per plot (171.25 g) and per ha (237.87 kg) which was statistically non significant. The increased seed yield per plant and per ha may be attributed to the increased number of fruits per plant (41.5), fruit yield per plant (1631.4g), 1000 seed weight (3.96g) and higher seed recovery per cent (0.68%). The results of the present study are in confirmity with Dharmatti *et al.* (1992) and Buruah *et al.* (1993) in tomato and Gulshan lal (1992), Vijaykumar *et al.* (1995) and Biradar (2000) in chilli.

The significant increasing trend for yield parameters were noticed only up to certain level of increased doses of fertilizer, that is up to T_6 (120 : 180 : 80 kg NPK/ha) and further increase in values was numerical and non significant. This might be due to limited capacity of the plant system to utilize excess quantity of plant nutrients beyond that level. (Dharmatti *et al.*, 1992).

5.1.4 Effect of mother plant nutrition on seed quality attributes

Significantly the highest 1000 seed weight of composite sample was recorded in T_6 (4.1 g) which was on par with further higher doses of fertlizer levels up to T_{12} (3.96 g). Similar trend was observed in all the pickings due to fertilizer levels (Table 10). Among the pickings, first picking recorded highest mean 1000 seed weight which decreased for further pickings irrespective of mother plant nutrition. The increased 1000 seed weight due to increase in fertilizer level might be due to better fruit development and also higher accumulation of photosynthates and their distribution to the developing ovules. These results are in confirmity with varis and George (1985) and Seno *et al.* (1989) in tomato, Parashetti (1991) in brinjal and Gapsa *et al.* (1995) and Biradar (2000) in chilli.

The T_6 (120 : 180 : 80 kg NPK/ha) recorded significantly highest germination percentage (92.25%) which differed significantly from T_1 to T_5 and T_{12} and rest of the treatments were on par with T_6, in composite sample. Similar trend was noticed in all the four pickings (Table 11). The higher per cent germination in T_6 might be due to higher 1000 seed weight which inturn during germination might have provided adequate food reserves for the resumption of embryonic plant growth. Similarly the increase in per cent germination due to higher nutrition have been reported by George *et al.* (1980), Dharmatti *et al.* (1992) and Eryce and Aydin and Gapsa *et al.* (1995) in tomato and Parashetti (1991) in brinjal.

The seedling vigour for the composite sample was significantly higher in T_6 (1144) compared to rest of the lower and higher doses of fertilizers (652 and 1108 in T_1 and T_{12}, respectively (Table 14). The increase in seedling vigour might be due to increase in shoot length, root length and germination percentage. Such results were also reported by Tekrony and Egli (1977), Parashetti (1991) in brinjal and Biradar (2000) in chilli.

The lower values recorded in final picking due to under development of seeds due to deficiency of mother plant nutrition at later stages of crop growth or due to field weathering as evident with decreased 1000 seed weight and other quality parameter.

The values for electrical conductivity of seed leachate of composite sample decreased with increase in levels of nutrition up to T_6 (0.94 dSm^{-1}) and further increase in EC was non significant. The decline in EC value with increased fertilizers might be attributed strengthening of cell membrane integrity of seed.

EXPERIMENT – II

5.2 Effect of chemical spray on seed yield and quality in tomato.

The experiment was carried out on tomato (Cv. L-15) to ascertain the effect of chemicals viz., GA_3 (100 ppm), IAA (50 ppm), NAA (50 ppm), 2,4-D (1 ppm), Ethrel (200 ppm), TIBA (10 ppm), DAP (2%) and water spray (control) on crop growth, fruit yield, seed yield and quality parameters during kharif, 1999. These chemicals were applied as foliar spray at two stages viz., 50 per cent flowering (S_1) and fruit setting stage (S_2). The results obtained in the study are discussed as below.

5.2.1 Effect of stages of spray on growth parameters in tomato

Between two stages of spraying, application of chemicals at 50 percent flowering stage (S_1) was found to be most beneficial as plant height (94.4 cm) and number of branches were more compared to fruit setting stage S_2 (Table 17). It may be due to the stimulatory action of chemicals on cell division, multiplication and plasticity leading to better growth of plant with high number of branches (Mehta and Mathai, 1975). Pandita *et al.* (1980) ascribed better growth of the plant to excessive production of nitrogen and carbohydrates under the influence of chemicals. Similar increase in plant growth and number of branches were reported by Meharotra *et al.* (1970) in tomato, Gupta *et al.* (1997) in brinjal and Biradar (2000) in chilli.

5.2.2 Effect of stages of spray on fruit yield and yield attributes in tomato

The stages of spraying also found to influence significantly the fruit yield and seed yield parameters. The foliar application of chemicals at S_1 stage recorded significantly the highest total number of fruits per plant (35.9) total fruit yield per plant (1.71 kg), fruit yield per plot (17.65 kg) and fruit yield per ha (24.52 t) (Table 18, 19, 20 and 21). It might be attributed to exogenous supply of growth regulators at critical stage of flowering and fertilization, ovary formation, fruit and seed development etc. which may enhance source to sink relation, accumulation of photosynthates and efficient utilization of food reserves for the development of fruits as reported by Mehta *et al.* (1989) in tomato. Similar increase in fruit yield with chemicals spray have been also reported by Chandra and Shivaraj (1972), Pandita *et al.* (1980) and Revanappa (1993) in chilli.

5.2.3 Effect of stages of spray on seed yield and yield attributes in tomato

Spray S_1 recorded significantly higher total seed yield per plant (9.66 g), per plot (105.2 g) and per ha (145.9 kg) as mentioned in Tables 22, 23 and 24 respectively. It might be due to higher number of fruits per plant, fruit yield and higher seed weight per plant, per plot and per hectare and higher seed recovery per cent. The efficient translocation of photosynthates from source to reproductive parts (seeds) might have enhanced the better filling up of fertilized ovules and there by increased the weight of individual fruit and seed. Such findings were also reported by Singh (1995) in tomato.

5.2.4 Effect of stages of spray on seed quality parameters in tomato

In the present study, the seed quality parameters were influenced by stages of spraying of chemicals at S_1 had beneficial effect in improving the seed quality parameters like 1000 seed weight (3.81 g), germination percentage (91.22%), root length (4.97 cm), shoot length (7.96 cm), seedling vigour index (1150), seedling dry weight (25.30 mg) with lower values for EC of seed leachate (1.07 dSm^{-1}) in composite sample (Tables 26, 27, 28, 29, 30, 31 and 32, respectively). Similar trend was noticed in all the four pickings also. The increase in seed quality parameters might be due to greater accumulation of food reserves in the seeds because of additional supply of chemicals especially at pollination, fertilization and further fruit setting. These findings also supported by Mehta *et al.* (1989) in tomato. Increased seedling vigour might be due to higher root and shoot length of seedling and higher germination percentage recorded at this stage, which further increased the dry weight of seedling. Yadava *et al.* (1980), Sitaram *et al.* (1989) and Biradar (2000).

5.2.5 Effect of chemicals on growth parameters in tomato

Irrespective of stages of spraying all the chemicals found to increase significantly the plant height and number of branches compared to control (Table 17). Among the chemicals, GA_3 (100 ppm) recorded significantly higher plant height (123.1 cm) and number of primary, secondary and tertiary branches (2.0, 9.1 and 4.6, respectively) followed by NAA 50 ppm. This might be attributed to apical dominance effect of auxins. The growth regulators (chemicals) are involved in increasing the photosynthetic activity, efficient translocation and utilization of photosynthetic product and rapid cell elongation and cell division in the growing portion of the plant or stimulation of growth besides increasing uptake of nutrients (Pandita *et al.*, 1980). The stimulatory action of auxin soften the cell wall of the stem and increase its plasticity and thus stimulates the plant growth. (Meharotra *et al.*, 1970, Revanappa, 1993 and Biradar, 2000). Similar beneficial effect of growth regulators on plant height and number of branches were reported by Mehta and Mathai (1975), Pookan *et al.* (1981) and Biradar (2000). On the contrary plant height in DAP (2%) was on par with control and number of branches in DAP (2%), TIBA (10 ppm) and Ethrel (200 ppm) was on par with control. Which might be due to reduction in auxin content in growing tissues and exertion of inhibitory effect by suppressing cell division and cell elongation at meristematic tissues of growing point.

5.2.6 Effect of chemicals on fruit yield and yield attributes in tomato

The total number of fruits per plant, total fruit yield per plant, per plot and per hectare (41.5, 2.06 kg, 19.68 kg and 27.34 t, respectively) was significantly highest with spraying of GA_3 (100 ppm) followed by NAA 50 ppm (Tables 18, 19, 20 and 21, respectively). Increase in number of fruits and fruit yield can be attributed to increase in number of branches, flowers and fruit set and reduced shedding of flowers and fruits. Similar results due to application of GA_3 and NAA in chilli were also reported by Biradar (2000). The growth regulators are involved in inhibition of cellulose and pectinase activity and abscission, production there by decreasing the premature fruit drop.

5.2.7 Effect of chemicals on seed yield and yield attributes in tomato

The significantly higher total seed yield per plant, per plot and per ha were recorded in GA_3 100 ppm (12.34 g, 119.9 g and 166.5 kg, respectively) followed by NAA 50 ppm and IAA 50 ppm (Tables 22, 23 and 24). This increase in seed yield might be attributed to more number of fruits per plant, fruit yield, higher seed recovery per cent and 1000 seed weight. Growth regulators bring certain changes in metabolism during fruit and seed development due to which there would be greater accumulation of food reserves resulting in higher seed yield. Similar results have also been reported by Singh (1995), Singh and Lal (1995) in tomato and Biradar (2000) in chilli.

5.2.8 Effect of chemicals on seed quality parameters in tomato

All the chemicals significantly increased the 1000 seed weight compared to control. Among the chemicals GA_3 100 ppm recorded significantly higher 1000 seed weight (4.04 g) which was on par with NAA 50 ppm (3.93 g) in composite sample. Similar trend was noticed in all the pickings (Table 26). This is attributed to increase in individual seed weight due to beneficial effect of chemicals which bring certain changes in metabolism during fruit seed development, due to which there would be greater accumulation of food reserves Resulting in higher seed yield. Similar reports have been made by Singh (1995) and Singh and Lal (1995).

All the chemicals increased the germination percentage compared to control. The significantly highest germination percentage was recorded in GA_3 100 ppm (94%) which was on par with NAA 50 ppm (93.62%) followed by IAA 50 ppm (73.15%) in composite sample. Similar trend was noticed in all the pickings (Table 27). The increase in germination percentage may be due to increased 1000 seed weight which might have supplied adequate food reserves to resume embryo growth and in addition, to release enzymes responsible for degradation of macromolecules in to micromolecules to be utilized in growth promoting process. Such increase in germination percentage due to chemicals spray are also reported by Balakumar and Balasubramanian (1988) and Singh (1995) in tomato and Revanappa (1993) in chilli.

Seedling vigour index was significantly influenced by all the chemicals compared to control. The maximum vigour index was recorded by GA_3-100 ppm (1257) followed by NAA-50 ppm (1199) and IAA-50 ppm (1151) in composite sample. Similar trend was noticed in all the four pickings (Table 30). This increase in vigour index was due to higher germination percentage, root and shoot length of seedling which inturn increased the seedling vigour index. The results are in agreement with Balakumar and Balasubramanian (1988) in tomato.

The lower EC of seed leachates recorded in these treatments (GA_3-100 ppm and NAA-50 ppm) compared to control may be due to beneficial effect of these chemicals in strengthening the cell membrane integrity (Table 32).

5.2.9 Interaction effect of chemicals and stages of spray on crop growth, fruit yield, seed yield and quality in tomato

Here, two factors viz., stages of spray and chemicals were taken for the study in tomato Meghe (L-15). The plant growth and development is a complex phenomenon resulting from interaction with several factors. The yield can be manipulated by taking advantage of their combined action.

5.2.9.1 Interaction effect of chemicals and stages of spray on growth parameters in tomato

In the present study plant height was significantly higher in GA_3 100 ppm (C_1 – 125.3 cm) followed by NAA 50 ppm (C_3) and IAA 50 ppm (C_2) at both S_1 and S_2 stages. With respect to second order interactions, S_1C_1 recorded significantly higher plant height (125.3 cm) which was followed by S_2C_1, S_1C_3 and S_2C_3 (Table 17). S_1C_8 recorded lowest plant height (70.6 cm), followed by S_2C_8, S_2C_7. The increase in plant height may be due to stimulatory action of chemicals on cell division, multiplication and plasticity leading to better growth of plant (Mehta and Mathai, 1975).

Spraying of GA_3 100 ppm (C_1) at 50 per cent flowering and at fruit setting stage put up significantly more number of branches over other chemicals except NAA 50 ppm (C_3) which was on par with GA_3 100 ppm (C_1) at both S_1 and S_2 (Table 17). S_1C_1 gave significantly more number of primary, secondary and tertiary branches (2.2, 10.4 and 5.2, respectively) which was on par with S_2C_1, S_1C_3 and S_2C_3.

The lowest number of secondary branches were noticed in S_1C_8. The increase in number of branches per plant with GA_3 spray may be due to increase in plant height and excessive production of nitrogen and carbohydrates under the influence of chemicals at this stage (Pandita *et al.*, 1980). Similar increase in number of branches with spraying of chemicals at flowering stage was noticed by Meharotra *et al.* (1970) in tomato, Singh *et al.* (1990) in chilli.

5.2.9.2 Interaction effect of chemicals and stages of spray on fruit yield and yield attributes in tomato

The GA_3 100 ppm (C_1) followed by 50 ppm NAA (C_3) sprayed at both 50 per cent flowering and fruit setting stage recorded significantly higher total number of fruits per plant, total fruit yield per plant, per plot and per ha (Tables 18, 19, 20 and 21). With respect to second order interactions S_1C_1 recorded significantly higher total number of fruits per plant, total fruit yield per plant, per plot and per ha (47.0, 2.33 kg, 21.06 kg and 29.25 t, respectively). Similar trend in fruit yield was also noticed in all the pickings. This increase in fruit yield may be due to increased number of branches per plant, flowers and less flower drop due to spraying of chemicals at 50 per cent flowering stage. Similar results were also reported by Nair *et al.* (1974) in tomato, Pandita *et al.* (1980) and Gollagi (1999) in chilli.

5.2.9.3 Interaction effect of chemicals and stages of spray on seed yield and yield attributes in tomato

The GA_3 100 ppm (C_1) followed by NAA 50 ppm (C_2) at both S_1 and S_2 stage recorded significantly higher total yield per plant, per plot and per ha. With respect to second order interactions, S_1C_1 recorded significantly higher total seed yield per plant, per plot and per ha (14.23 g, 130.0 g and 180.5 kg, respectively). The lowest total seed yield was noticed in S_2C_8 (5.95 g, 80.5 g and 111.8 kg) in per plant, per plot and per ha, respectively (Tables 22, 23 and 24). Similar trend in seed yield was also observed in all the pickings. This increase in seed yield may be due to higher number of fruits per plant, higher fruit yield and higher seed weight per plant, per plot and per ha and higher seed recovery per cent. It might also be attributed to exogenous supply of chemicals (growth regulators) at critical stages of flowering and fertilization, ovary formation, fruit and seed development may enhance source to sink relation there by enhanced the better filling up of fertilized ovules and thereby increased the weight of individual seed (Mehta *et al.*, 1989). Such findings were also reported by Singh (1995) in tomato, Biradar (2000) in chilli.

5.2.9.4 Interaction effect of chemicals and stages of spray on seed quality parameters in tomato

Interactions for chemicals at same stage revealed that, GA_3-100 ppm (C_1) followed NAA-50 ppm (C_3) at both S_1 and S_2 recorded significantly higher, thousand seed weight, germination percentage, root length, shoot length, seedling vigour index, seedling dry weight with lower values of EC of seed leachates in composite sample (Table 26, 27, 28, 29, 30, 31 and 32). Similar trend in seed quality parameters was noticed in all the pickings. With respect to second order interaction for stages of spray at same or different chemicals, S_1C_1 recorded significantly higher seed quality parameters viz., 1000 seed weight (4.2 g), germination percentage (95.95 %), root length (5.42 cm), shoot length (8.88 cm), seedling vigour index (1333), seedling dry weight (29.5 mg) with lower values of EC of seed leachates (0.84 dSm^{-1}) in composite sample. Similar trend in seed quality parameters was noticed in all the four pickings. The increase in seed quality parameters might be due to greater accumulation of food reserves in the seeds because of additional supply of chemicals especially at pollination, fertilization and further fruit setting. Similar results were also reported by Mehta *et al.* (1989), Singh and Lal (1995).

Practical application of results

Based on the results of field and laboratory investigations carried out during the course of study the following recomendations can be made.

1. The optimum dose of NPK for obtaining higher seed yield with good quality seeds would be 180 : 60 : 80 kg NPK per ha, respectively.
2. Tomato seed crop may be sprayed with GA_3-100 ppm or NAA 50 ppm at 50 per cent flowering stage for obtaining higher seed yield with good quality.
3. In tomato, the seeds obtained from first, second and third picking are found to be better in all seed quality parameters compared to fourth picking.

Future line of work

Based on the previous studies and the results obtained from the present investigation, the following suggestions are made for formulating future research programmes.

1. In addition to NPK, secondary nutrients and micronutrients effect may be tried for achieving higher seed yield and quality.
2. The studies on requirement of FYM and vermicompost for seed production may be conducted.
3. There is a scope to standardize concentration and stages of spraying chemicals initiating from seedling stage in tomato.
4. Further studies to understand the effects of mother plant nutrition and chemical spray on seed storability may be initiated.

SUMMARY

VI. SUMMARY

Two field experiments were conducted at Main Research Station, College of Agriculture, Dharwad during kharif season, 1999, to study the effect of mother plant nutrition and chemical spray on seed yield and quality in tomato Cv.Mega (L-15). The experiments were laid out separately (1) To study the effect of mother plant nutrition on seed yield and quality and (2) To study the effect of chemical spray on seed yield and quality. The seed quality parameters were determined in the Department of Seed Science and Technology, University of Agricultural Sciences, Dharwad. The results of the experiments are summarised in this chapter.

Experiment – I

Effect of mother plant nutrition on seed yield and quality in tomato.

a) Growth parameters

Application of 240 : 180 : 80 kg NPK per hectare (T_{12}) recorded significantly higher plant height (114.8 cm), number of primary, secondary and tertiary branches per plant (2.4, 9.5 and 5.5, respectively) and delay in days to 50 per cent flowering (34 days) compared to other treatments except treatments T_6 to T_{11} which were par with each other.

b) Yield parameters

The total number of fruits per plant, fruit yield per plant, per plot and per hectare was significantly higher (41.5, 2058.3g, 24.8kg and 34.5t, respectively) with application of

240 : 180 : 80 kg NPK per hectare (T_{12}) compared to other treatments except treatments T_6 to T_{11} which were on par with each other. The seed recovery per cent was significantly highest with T_7 and which was on par with T_6, T_8, T_9, T_{10}, T_{11} and T_{12}.

c) Seed quality parameters

Application of 120 : 180 : 80 kg NPK per hectare (T_6) recorded significantly higher 1000 seed weight, germination percentage, root length, shoot length, seedling vigour index and seedling dry weight in all the pickings and in composite sample with lower EC but it was on par with treatments T_7 to T_{12}.

The growth, fruit yield and seed yield parameters significantly increased with increase in mother plant nutrition up to T_6 (120 : 180 : 80 kg NPK/ha), then further increase in levels of fertilizers did not result in significant increase. The seed quality parameters were significantly highest with T_6 (120 : 180 : 80 kg NPK/ha) further additional nutrition (T_7 to T_{12}) resulted in numerical decline in values for all seed quality parameters except EC of seed leachates which showed the reverse trend. The net returns were higher in T_{12} and T_7 recorded net returns of Rs. 403660 per hectare.

Experiment – II

Effect of chemical spray seed yield and quality in tomato.

a) Growth parameters

Among the stages of chemical spray S_1 stage (50% flowering stage) recorded significantly higher plant height

(94.42cm), number of primary, secondary and tertiary branches per plant (1.6, 7.3 and 3.8, respectively) compared to S_2 stage (fruit sett ing stage). Irrespective of stage of spray, 100 ppm GA_3 recorded significantly higher plant height (125.3cm), number of primary, secondary and tertiary branches per plant (2.0, 9.1 and 4.6, respectively) compared to other chemicals except NAA 50 ppm which were on par with each other. Interaction effect due to stages of spray and chemicals were significant with respect to plant height and number of branches per plant. S_1C_1 recorded significantly higher plant height (125.3cm), number of primary, secondary and tertiary branches per plant (2.2, 10.4 and 5.2, respectively) compared to other combinations except S_1C_2 and S_2C_1 which were on par with each other.

b) Yield parameters

Among stages of chemical spray S_1 stage recorded significantly higher number of fruits per plant (35.9) fruit yield per plant (1.71 kg) and per hectare (24.52 t) and seed yield per plant (9.66 g) and per hectare (124.5 kg) compared to S_2 stage. Among the chemicals GA_3 100 ppm and NAA 50 ppm recorded significantly higher number of fruits per plant (41.5 and 37.7, respectively) fruit yield per plant (2.06 kg and 1.84 kg, respectively), fruit yield per hectare (27.34 t and 24.95 t, respectively) and seed yield per plant (12.34 g and 10.69 g, respectively) and seed yield per hectare (166.5 kg and 149.3 kg, respectively) compared to other chemicals and control. The seed recovery per cent was also significantly maximum with 100 ppm GA_3 compared to other chemicals and control. Among the interactions S_1C_1 recorded significantly higher number of fruits per plant (47), fruit yield per plant (2.33 kg) and per hectare (29.25 t) and seed yield per plant (14.23 g) and per hectare (180.5 kg) and highest seed recovery per cent (0.61) followed by S_1C_3.

c) Seed quality parameters

Seed quality parameters such as 1000 seed weight, germination percentage, root length, shoot length, seedling vigour index and seedling dry weight were significantly highest with S_1 stage in all the pickings and in composite samples compared to S_2 stage with lower values of EC. Among the chemicals GA_3 100 ppm recorded significantly higher seed quality parameters followed by NAA 50 ppm with lower EC. Among the interactions S_1C_1 recorded significantly higher values for all seed quality parameters followed by S_1C_3 with lower values of EC in all the pickings and in composite seed sample.

Among the four pickings seeds obtained from first, second and third pickings were superior for all seed quality parameters compared to fourth picking. Composite sample falls inbetween first and second picking for all the seed quality parameters studied. The net returns were higher in the combination of S_1C_1 and S_1C_3 followed by S_1C_2 and S_2C_1.

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APPENDICES

Appendix I. Monthly meteorological data for the cropping season and the average of 50 years (1950-1999) at Main Research Station, UAS, Dharwad.

Months	Rainfall (mm)		Temperature (°C.)				Relative humudity (%)	
			Mean maximum		Mean minimum			
	1999-2000	1950-1999	1999-2000	1950-1999	1999-2000	1950-1999	1999-2000	1950-1999
April	14.70	47.52	36.60	37.11	21.10	21.36	65.00	58.66
May	32.80	86.50	32.20	36.73	21.30	21.45	75.00	66.99
June	71.80	115.19	28.00	29.50	21.00	21.21	83.00	81.73
July	113.90	154.52	26.40	27.05	20.80	20.96	89.00	88.32
August	19.70	101.32	27.10	27.11	20.40	20.65	85.00	86.83
September	8.80	106.38	28.30	28.73	20.00	20.17	83.00	83.39
October	161.10	136.62	28.90	30.13	19.80	19.23	79.00	76.60
November	0.00	35.14	29.60	29.36	16.00	15.33	59.00	68.57
December	0.00	5.94	28.90	29.15	13.40	13.42	51.00	64.83
January	0.00	0.10	30.60	29.18	15.10	14.09	48.00	63.30
February	0.00	0.00	32.20	34.66	15.70	15.96	52.00	51.44
Total	422.8	796.68						

Appendix II. Physical and chemical properties of soil from experimental site.

Particulars	Values obtained	Method adopted
A. Physical properties		
Clay (%)	32.70	Hydrometer method (Piper, 1966)
Silt (%)	9.50	Hydrometer method (Piper, 1966)
Fine sand (%)	31.24	Hydrometer method (Piper, 1966)
Coarse sand (%)	26.56	Hydrometer method (Piper, 1966)
B. Chemical properties		
Total N (Kg ha^{-1})	265.00	Modified kjeldal's method (Jackson, 1967)
Available P_2O_5 (Kg ha^{-1})	10.80	Olsen's method (Muhr et al., 1965)
Available K_2O (Kg ha^{-1})	245.00	Flame photometer (Muhr et al., 1965)
pH	6.70	pH meter (Jackson, 1967)

Appendix III. Prices of inputs

Inputs	Prices (Rs)
1. Seeds	2000 per kg
2. Urea	400 per quintal
3. Single super phosphate	300 per quintal
4. Murate of potash	375 per quintal
5. DAP	860 per quintal
6. Men labour	30 per day
7. Women labour	30 per day
8. Bullock pair	150 per day
9. Gibberellic acid (GA_3)	126 per gram
10. IAA	355 per 5 g
11. NAA	139 per 25 g
12. 2, 4-D	152 per 100 g
13. Ethrel	450 per 100 ml
14. TIBA	220 per gram
15. Land rent	100 per season

Appendix - IV. Cost of cultivation and expected returns per hectare as influenced by mother plant nutrition during seed production of tomato Cv. Megha (L-15).

NPK	Total seed yield (Kg/ha)	Total cost of cultivation (Rs./ha) 'ooo	Gross returns (Rs./ha) 'ooo	Net returns (Rs./ha) 'ooo	Cost benefit ratio
T_1 (60:60:80 kg/ha)	84.17	19.51	168.3	148.79	7.63
T_2 (60:120:80 kg/ha)	100.06	20.62	200.1	179.48	8.70
T_3 (60:180:80 kg/ha)	116.95	21.74	233.9	212.16	9.76
T_4 (120:60:80 kg/ha)	136.15	20.02	272.3	252.28	12.60
T_5 (120:120:80 kg/ha)	150.57	21.14	301.1	279.96	13.24
T_6 (120:180:80 kg/ha)	211.13	22.27	422.2	399.93	17.96
T_7 (180:60:80 kg/ha)	212.52	20.54	424.2	403.66	19.65
T_8 (180:120:80 kg/ha)	220.85	21.67	441.7	420.03	19.38
T_9 (180:180:80 kg/ha)	225.43	22.79	450.8	428.01	18.78
T_{10} (240:60:80 kg/ha)	229.60	21.06	459.2	438.14	20.80
T_{11} (240:120:80 kg/ha)	235.20	22.18	470.4	448.22	20.20
T_{12} (240:180:80 kg/ha)	237.86	23.31	475.7	452.39	19.40

Appendix - V. Cost of cultivation and expected returns per hectare as influenced by chemicals and stages of spray during seed production of tomato Cv. Megha (L-15).

NPK	Total seed yield (Kg/ha)	Total cost of cultivation (Rs./ha) 'ooo	Gross returns (Rs./ha) 'ooo	Net returns (Rs./ha) 'ooo	Cost benefit ratio
S_1C_1	180.5	26.75	361.0	331.25	12.38
S_1C_2	156.0	23.96	312.0	289.04	12.06
S_1C_3	166.4	23.51	332.8	312.29	13.28
S_1C_4	147.5	23.00	295.0	274.50	11.93
S_1C_5	140.0	22.97	280.0	259.03	11.27
S_1C_6	136.8	21.28	273.6	252.32	11.85
S_1C_7	123.3	21.00	246.6	226.17	10.77
S_1C_8	117.2	20.50	234.4	214.10	10.44
S_2C_1	152.5	26.75	305.0	275.25	10.29
S_2C_2	124.0	23.96	248.0	225.04	9.40
S_2C_3	132.2	23.51	264.4	243.89	10.37
S_2C_4	125.0	23.00	250.0	229.50	9.97
S_2C_5	123.3	22.97	246.6	225.63	9.82
S_2C_6	118.7	21.28	237.4	216.12	10.15
S_2C_7	108.8	21.00	217.6	197.17	9.38
S_2C_8	111.8	20.50	223.6	203.30	9.90

EFFECT OF MOTHER PLANT NUTRITION AND CHEMICAL SPRAY ON SEED YIELD AND QUALITY IN TOMATO (*Lycopersicon esculentum* Mill.)

Hitendra B. Goudappalavar **2001** V.K.DESHPANDE
Major Advisor

ABSTRACT

Two field experiments were conducted at Main Reserach Station, College of Agriculture, Dharwad during *Kharif* season 1999, to study the effect of mother plant nutrition and chemical spray on seed yield and quality in tomato Cv. Megha (L-15).

The results obtained from experiment-I revealed that the growth parameters viz., plant height and number of branches and the yield parameters viz., number of fruits per plant, fruit yield per plant and per hectare (41.5, 2058.3g and 34.5 t, respectively) and seed yield per plant and per hectare (12.33g and 211.13kg, respectively) were significantly increased with increase in mother plant nutrition upto 120:180:80 kg NPK per hectare, further increase did not show significant result. The seed quality parameters viz., 1000 seed weight, germination percentage, root, shoot length, seedling vigour index and seedling dry weight were also significantly highest with 120:180:80 kg NPK per hectare, except EC of seed leachate which showed reverse trend.

The results of experiment-II revealed that the growth parameters viz., plant height and number of branches per plant, the yield parameters viz., number of fruits per plant, fruit yield per plant and per hectare (35.9, 1.71kg and 24.52 t, respectively) and seed yield per plant and per hectare (9.66g and 124.5kg, respectively) and the seed quality parameters viz., 1000 seed weight germination percentage, root, shoot length, seedling vigour index and seedling dry weight were significantly highest with spraying chemicals at 50 per cent flowering stage compared to fruit setting stage.

Among the chemicals GA_3 (100 ppm) recorded significantly higher values for growth, yield and seed quality parameters compared to other chemicals (IAA 50 ppm, NAA 50 ppm, 2,4-D 1 ppm, Ethrel 200 ppm, TIBA 10 ppm, DAP 2 %) and control.

Among the interactions, spraying GA_3 100 ppm at 50 per cent flowering recorded significantly higher values for growth, yield parameters and seed quality parameters.

In toto, the results indicated that although the application of 120:180:80kg NPK per hectare found better but considering cost benefit ratio, application of 180:60:80 kg NPK per hectare is better for getting higher seed yield with good quality in tomato and seed crop may be sprayed with GA_3 100 ppm at 50 per cent flowering stage.