Responds of vegetable crops to foliar feeding of water soluble fertilizer

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ABSTRACT: Vegetables are important in the human diet as protective food. India is a leading vegetable producing country, in the world. However, the current per capita consumption of vegetable in our country is only 135g as against 300g of vegetables required per day per adult for maintaining good health. It is estimated that by 2020, the countries vegetable demand would be 135 million tonnes. To achieve this target, there is a need to integrate the various technologies right from production to post-harvest management. Exploiting of vigour for increased production of vegetables is becoming a popular method. As in other field crops, vegetable are generally more responsive to fertilizer application and thus produce more biomass through higher photosynthetic activity especially during critical stage of growth. The supply of adequate amount of nutrients is a prerequisite for exploiting the genetic potential of any vegetables. The major nutrients viz., N, P and K are supplied to the crop through soil application. The efficiency of fertilizers applied in soil is low due to various losses and fixation in soil. Foliar application of nutrients eliminates the problems like fixation and immobilization. Hence, foliar nutrition is recognized as an important method of fertilization in modern agriculture. Foliar nutrients usually penetrate the cuticle (or) the stomata of the leaf and enter into the cell. Thus foliar application provides ample scope for utilization of nutrients more efficiently and for correcting the deficiencies rapidly and also helping in the reduction of loss of nutrients.

KEY WORDS: Vegetables, Water soluble fertilizer, Polyfeed, Foliar spray

Commonly available fertilizers such as urea, di-ammonium phosphate (DAP), muriate of potash (MOP) and other complex fertilizers are not totally soluble and leave some residues when dissolved.

**Speciality fertilizer:**

Speciality fertilizers are fully water soluble solid fertilizers, having high content of primary nutrients with low salt index. They may or may not have secondary or micro nutrients. These water soluble fertilizers can advantageously be utilized for foliar feeding and fertigation, thus helping in precision agriculture. Foliar application of water soluble fertilizer plays an important role in supplying the nutrients at critical stages of flowering and fruit development. Today the demand for speciality fertilizers is increasing in most of the horticultural segments in the states of Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat, U.P. and Haryana.

It is theoretically possible to feed a plant completely through the leaves. In practice, however, more number of sprays would be required that would render the process uneconomical. Hence, foliar fertilizers are not a substitute for soil fertilization but an efficient additional means of supplying sudden demand.

<table>
<thead>
<tr>
<th>Speciality fertilizer</th>
<th>Available nutrients % as</th>
<th>Product</th>
<th>NO₃</th>
<th>NH₄</th>
<th>NH₂</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>EC@ 1%</th>
<th>pH@ 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi – K (13-00-46)</td>
<td>13.2</td>
<td>Potassium nitrate</td>
<td>13-00-46</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Polyfeed(19:19:19+MEN)</td>
<td>5</td>
<td>Mono ammonium phosphate</td>
<td>19-19-19 + MEN*</td>
<td></td>
<td></td>
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<tr>
<td>MAP (12-61-00)</td>
<td>-</td>
<td>Mono potassium phosphate</td>
<td>12-61-00</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MKP (00-52-34)</td>
<td>-</td>
<td>NPK blend</td>
<td>00-52-34</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Polyfeed (non-nominated FCO Grade)</td>
<td>-</td>
<td>NPK blend</td>
<td>15-15-30+ME</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>SOP</td>
<td>-</td>
<td>Sulphate of potash</td>
<td>00-00-50</td>
<td></td>
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<tr>
<td>Calcium nitrate</td>
<td>-</td>
<td>Calcium nitrate</td>
<td>15.5-00-00-19</td>
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</tr>
</tbody>
</table>

**Foliar application recommendation of speciality fertilizers on different crops**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Speciality fertilizer</th>
<th>Concentration (%)</th>
<th>Number of sprays</th>
<th>Stage to be sprayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilli</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Flower initiation (60 DAP)</td>
</tr>
<tr>
<td>Tomato</td>
<td>Polyfeed</td>
<td>2.0</td>
<td>2</td>
<td>Fruiting (75 and 90 DAP)</td>
</tr>
<tr>
<td>Bhendi</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Flower initiation (45 DAP)</td>
</tr>
<tr>
<td>Soybean</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Flowering (60 DAP)</td>
</tr>
<tr>
<td>Multi-K</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Fortightly interval from fruit formation (60 and 90 DAS)</td>
</tr>
<tr>
<td>Soybean</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Maximum vegetative (45 DAS)</td>
</tr>
<tr>
<td>Multi-K</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Grain filling (60 DAS)</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Curd initiation (45 DAS)</td>
</tr>
<tr>
<td>Multi-K</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Curd development (60 DAP)</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Flower initiation (45 DAP)</td>
</tr>
<tr>
<td>Multi-K</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Flower development (60 DAP)</td>
</tr>
<tr>
<td>Baby corn</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>2</td>
<td>Knee high (30 DAP)</td>
</tr>
<tr>
<td>Multi-K</td>
<td>Polyfeed</td>
<td>1.0</td>
<td>1</td>
<td>Cob initiation (45 DAS)</td>
</tr>
<tr>
<td>Gherkins</td>
<td>Multi-K</td>
<td>1.0</td>
<td>2</td>
<td>Fortightly interval from fruit formation (25 and 45 DAS)</td>
</tr>
</tbody>
</table>

DAS: days after sowing; DAP: Days After Planting; sprays has to be done at the critical physiological stage indicated sprays dates mentioned are tentative. * In intercropped turmeric, speciality fertilizers spray can be initiated after the harvest of intercrop, whenever intercropping is done.
Effect of water soluble fertilizers (WSF) on yield, quality and economics of vegetable crops:

Growth, the progressive development of a plant occupies a significant place in the profitability of a farming enterprise. The reproductive efficiency and economic yield can be maximized by having adequate vegetative growth and maximum yield attribute. In vegetable crops the growth parameters such as plant height, number of primary branches per plant, days to 50 per cent flowering directly contribute to the economic yield of fruits. Foliar nutrition with different concentrations of water soluble fertilizer on growth attributes showed a progressive increase in growth and development of vegetables compared to soil application alone.

Chilli:

The foliar application of 100 per cent N and K with three sprays of polyfeed (45, 60 and 75 days after sowing) and two sprays of multi K (75 and 120 days after sowing) in chilli cv. PUSA JWALA recorded the highest number of fruits per plant, dry fruit yield and with higher net income and benefit cost ratio (Palaniappan et al., 1999). The highest yield was noticed in chilli upto 21.1 per cent over control by combined spray of polyfeed and multi K (Agro India, 2000).

Capsicum:

The application of NPK 17:10:27 with 5 sprays recorded the highest mean fruit yield and maximum benefit cost ratio (AICRP (VS), Annual report 2002-03). Application of NPK (19:09:19) with 5 sprays recorded the highest fruit yield 75.46 q ha⁻¹ under IIVR condition, whereas under Pantnagar condition NPK (19:19:19) with five sprays recorded the highest fruit yield of 197.3 q ha⁻¹ (AICRP (VS), Annual report 2002-03). Application of NPK 17:10:27 with three sprays recorded maximum benefit cost ratio and highest fruit yield in ‘Nishat-I’ cultivar (AICRP (VS), Annual report 2004-05).

Tomato:

The per cent increase in yield of tomato due to foliar spray of multi K was 11.3 and benefit cost ratio was 3.71 per cent, whereas combined spray of polyfeed and multi K increased the yield up to 18.7 per cent (NARDI Annual report 2000). Foliar feeding of water soluble fertilizers had significant effect on marketable fruit yield of tomato. Five sprays of 0.5 per cent NPK 15:15:30 gave significantly higher fruit yield over control and at par with NPK 19:19:19 three sprays. The maximum net return and B:C ratio was recorded in the treatment NPK 15:15:30 with five sprays followed by NPK 19:19:19 three sprays (Yadav et al., 2004).

The foliar application of NPK 19:19:19 five times recorded maximum plant height (105.3 cm), more number of branches (12.2), more number of fruits per plant and heavier fruit (52.6 g), the highest fruit yield of 72.83 t ha⁻¹ with highest B:C ratio of 5.06 (AICRP (VS), Annual report 2004-05). Chapagain and Weisman (2004) observed that foliar spraying of Nutri-Vant-peak (contains 95 % MKP) at one per cent concentration increased the plant height, leaf potassium (44.54 mg g⁻¹) and phosphate content (9.40 mg g⁻¹), marketable yield of tomato grown under green house condition. Fruit quality of plant sprayed with Nutri-Vant-Peak was superior. Foliar application of water soluble fertilizers in tomato produced taller plants, more number of branches, more number of fruits per plant and heavier fruits than control which received recommended dose of fertilizer alone (AICRP (VS), Annual report 2005-06).

Brinjal:

Foliar spray of NPK 19:19:19 with five sprays recorded the highest fruit with highest B:C ratio (AICRP(VS), Annual report 2002-03). Experiment conducted at Junagarh condition revealed that foliar feeding of water soluble fertilizer containing 17:10:27 with three sprays recorded maximum yield of 282.22 q ha⁻¹. Whereas in Faizabad condition maximum yield (395.56 q ha⁻¹) with highest B:C ratio was obtained from water soluble fertilizer containing NPK 17:10:27 with five sprays (AICRP(VS), Annual report 2002-03).

Foliar spray of multi K increased the yield up to 9.5 per cent and B:C ratio was 3.17 per cent (AICRP(VS), Annual report 2002-03). Foliar application of polyfeed (19:19:19) on brinjal thrice at 30, 40 and 50 days after transplanting registered the highest fruit yield over control (Batra et al., 2002).

Karpagam et al. (2004) stated that foliar spray of different grades of water soluble fertilizers increased the growth, yield and quality parameters in brinjal hybrid. Among the different grades of water soluble fertilizers, foliar application of five sprays of NPK 19:19:19 along with the normal recommended dose recorded the highest plant height, number of branches, leaf area index, dry matter production, number of fruits per plant, fruit weight
Experiment conducted on the effect of foliar feeding of water soluble fertilizers in brinjal hybrid ‘Neelima’ at KAU, Vellanikara revealed that foliar application of water soluble fertilizers had a significant effect on the growth and yield and the highest mean yield was obtained with five sprays of multi K given at an interval of 10 days starting from 30 days after planting (AICRP (VS), Annual report 2005-06).

Similarly, five foliar spray of polyfeed NPK 19:19:19 recorded the highest fruit yield of 49.20 t ha$^{-1}$ in brinjal hybrid COBH-1 under Coimbatore condition (AICRP (VS), Annual report, 2005-06). Whereas, experiment conducted at Junagarh condition revealed that foliar feeding with water soluble fertilizers could not exert any significant effect on fruit of brinjal cultivar Gujarat Brinjal Long I. However, numerically the highest fruit yield was recorded with five sprays of NPK 17:10:27 (AICRP (VS), Annual report 2003-04).

Okra:

Manjunatha (2004) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an increase in plant height, number of leaves, number of branches, fruit length, fruit girth, individual fruit weight and number of fruits per plant. Quality traits of fruits like ascorbic acid content (16.92 %) and crude protein (23.19 %) also increased due to foliar nutrition of water soluble fertilizers.

Sundaram and Kanthaswamy (2005) studied the response of okra to foliar feeding of water soluble fertilizers. They found that foliar application of polyfeed NPK 19:19:19 five sprays along with recommended dose of fertilizers recorded the maximum fruit weight and yield per plant. The increase in yield was 69.35 per cent over control.

Similarly, in an experiment conducted at Kerala Agricultural University, Vellanikara, the highest fruit yield was obtained with foliar application of NPK 19:19:19 in okra cultivar Aruna (AICRP(VS), Annual report 2005). Foliar application of water soluble fertilizers had a significant effect on the growth and yield of okra. Among the different treatments, five foliar sprays of NPK 17:10:27 recorded the highest fruit yield of 465.9 q ha$^{-1}$ under Karaikal condition (AICRP(VS), Annual report 2006).

Venkataraman (2007) stated that foliar nutrition of water soluble fertilizer NPK (19:19:19) at 0.5 per cent concentration five times with recommended dose of NPK (200:100:100 kg ha$^{-1}$) exhibited an increase in plant height, number of branches per plant, fruit length, fruit girth, number of fruits per plant, fruit weight, quality characters like ascorbic acid, crude protein. The physiological parameters like leaf area index, dry matter production, crop growth rate and relative growth rate also increased in this treatment. N, P and K uptake were also increased in this same treatment.

Onion:

The use of recommended dose of fertilizer along with foliar spray of polyfeed 19:19:19 one per cent at 15, 30 and 45 DAP and multi K one per cent at 60, 75 and 90 DAP gave higher bulb yield in onion cv. ‘AGRIFOUND LIGHT RED’ under Karnal condition. Maximum net return was also obtained in the same treatment (AICRP(VS), Annual report 2005).

Garlic:

The studies conducted in garlic variety ‘Agrifound White’ at Nasik revealed that application of NPK @ 100:50:50 kg ha$^{-1}$ and spraying of polyfeed 1.0 per cent at 15, 30 and 45 and multi K 1.0 per cent at 60, 75 and 90 DAS performed better in giving bigger sized bulb and yield (AICRP(VS), Annual report, 2005).

Gherkins:

The increase in yield of gherkins due to foliar sprays of multi K and polyfeed was 26.7 and 18.7 per cent over control and the B:C ratio was 2.67 and 2.50, respectively. Whereas, combined spray of polyfeed and multi K increase the yield up to 19.8 per cent (AICRP(VS), Annual report 2000).

Cabbage:

In cabbage, significantly higher seed yield of 11.573 q ha$^{-1}$ was produced by foliar application of polyfeed NPK 19:19:19 and NPK 13:00:45 (11.228 q ha$^{-1}$) and both were at par (AICRP(VS), Annual report 2006).

Cauliflower:

In cauliflower, the highest curd yield (168.33 q ha$^{-1}$) was recorded with five sprays of polyfeed NPK 19:19:19 which was significantly better than the control (130.00 q ha$^{-1}$). Three sprays of polyfeed (19:19:19) produced the second highest yield (AICRP(VS), Annual
Effect of foliar feeding of macro nutrients and other substances on growth and yield in vegetables crops:

**Chilli**

Muralidharan *et al.* (2002) reported application of vipul 0.1 per cent EC at 300 ml ha⁻¹ recorded maximum dry pod yield, quality attributes and enhanced the uptake of major nutrients.

Joshi and Singh (2003) stated that application of paclobutrazol (PP333) @ 300ppm recorded maximum fruit yield per plant and weight of seeds per fruit. Hatwar *et al.* (2003) reported the application of Zn, Fe and B @ 0.1 per cent recorded highest growth attributes and yields. Application of NAA 100 ppm recorded maximum plant growth, whereas, CCC 1000ppm recorded more dry matter and yield (Gollagi *et al.*, 2006).

Gore *et al.* (2007) stated that maximum growth and yield was obtained from application of Nova charge 25ml per 100ml. Bharad *et al.* (2007) reported application of 0.50 per cent ZnSO₄ + 0 per cent FeSO₄ recorded maximum growth and yield.

Maheshwari and Haripriya (2008) stated application of vermicompost @ 5 t ha⁻¹ and groundnut cake @ 250 kg ha⁻¹ along with foliar spray of panchagavya 3 per cent for four times recorded maximum yield in hot pepper.

**Tomato**

Alan and Padem (1994) reported that application of palarosate 0.07 per cent recorded maximum dry matter content and vit-C. Reddy *et al.* (2004) stated that application of enriched carboxylic acid recorded maximum growth characters, maximum yield and quality in tomato. Tamilselfi *et al.* (2005) observed foliar spray of multiplex 100ppm recorded maximum growth and yield.

Kumari and Sharma (2006) stated that foliar application of boron @ 100ppm and repeated spray at 10 days interval twice from 30 DAT onwards, recorded the highest growth, seed yield with net returns and B:C ratio. Dhanasekaran and Bhuvaneswari (2007) observed foliar application of micronutrient NAA and enriched PCA to the plant supplied with 125 per cent NPK recorded highest fruit yield.

Application of recommended dose of fertilizer + 0.05 per cent Zn + ethephon 1000ppm recorded maximum growth, TSS with B:C ratio. Whereas, lycopene and juice recovery was maximum with the application of RDF + 0.5 per cent Ca + ethephon 1000ppm (Patil *et al.*, 2006).

Padan *et al.* (2008) reported Bio-K 1ml/lit of water + RDF of NP and 50 per cent of K recorded better growth, yield and quality in tomato.

Pawar *et al.* (2008) stated that application of 200 g compost per 15 kg soil with Fulvic acid two sprays showed better effect on plant growth.

**Okra**

Singh and Kumar (2005) observed that application of 200ppm NAA with 2 per cent urea recorded maximum fruit yield. Nawalkar *et al.* (2007) stated that application of 50 per cent RDF with spraying of 1300ppm CCC recorded maximum growth and yield. Dhanasekaran *et al.* (2007) reported application of humic acid 0.3 per cent recorded maximum growth and yield.

**Soybean**

Application of boron through soil and foliar spray recorded maximum growth and yield (Cirak *et al.*, 2006).


**Cucumber**

Foliar application of one per cent urea, 1.5 per cent DAP and 1.5 per cent KCl along with ¾th of soil recommended level of NPK was found to be the best with regard to yield. The NPK content was also very high in this treatment (Karuppaiah *et al.*, 2001).

**Onion**

Application of 100:50:50 kg NPK ha⁻¹ along with FYM @ 15 t ha⁻¹ and foliar spray of polyfeed one per cent at 15, 30 and 45 DAP and multi-K one per cent at different intervals recorded maximum bulb yield under Karnal condition (NH RDF Annual report 2005).

Sangeetha and Singaram (2007) reported that combined application of RDF of inorganic fertilizer and lignite humic acid @ 20 kg ha⁻¹ resulted in maximum growth and bulb yield.

Effect of foliar and soil application of N, P and K on growth and yield in vegetable crops:

**Plant height**

Application of N @ 300 kg ha⁻¹ and K 120 kg ha⁻¹ recorded maximum plant height in chilli.
Vitkar et al. (2007) stated that application of 50 per cent RDF along with 50 per cent nitrogen through neem cake recorded maximum plant height in chilli. Singegol et al. (2007) reported application of higher level of nitrogen @ 150 kg ha\(^{-1}\) and phosphorus @ 75 kg ha\(^{-1}\) recorded maximum plant height in chilli. Application of NPK along with FYM recorded maximum plant height in sweet pepper under mid hill condition (Yadav et al., 2007).

Chapagain and Weisman (2004) observed that foliar spraying of Nutri-vant-peak (contain 95 % MKP) at one per cent concentration increased the plant height in tomato. Foliar application of water soluble fertilizers in tomato produced taller plants (AICRP(VC), Annual report 2006). Manolikar et al. (2007) stated that application of 100 per cent FYM and 50 per cent RDF recorded maximum plant height in tomato. Foliar application of five sprays of NPK 19:19:19 along with the normal recommended dose recorded the highest plant height in brinjal (Karpagam et al., 2004).

Application of nitrogen @ 150 kg ha\(^{-1}\) recorded maximum plant height in bhendi (Dwivedi et al., 1994). Sannigrahi and Borah (2000) observed that the treatment which received 50 per cent recommended dose fertilizer along with FYM @ 10 t ha\(^{-1}\) recorded the maximum plant height in bhendi and similar result was noticed by Kadam et al. (2006) in moringa. Application of 75 per cent nitrogen through recommended dose of fertilizer with vermicompost @ 5 t ha\(^{-1}\) gave the maximum plant height in bhendi (Tripathy et al., 2004).

Manjunatha (2004) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an increase in plant height on okra. Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an increase in plant height in okra. Kushwaha et al. (2008) reported that application of N @ 100 kg ha\(^{-1}\) and P @ 80 kg ha\(^{-1}\) recorded maximum plant height in bhendi. The maximum plant height in soybean was noticed in the treatment which received recommended dose of fertilizer with vermicompost @ 5 t ha\(^{-1}\), Azospirillum 2 kg ha\(^{-1}\) and ZnSO\(_4\) @ 25 kg ha\(^{-1}\) (Kalayarasan and Vaiyapuri, 2007).

**Number of branches per plant**:

Vitkar et al. (2007) observed application of 50 per cent RDF along with 50 per cent nitrogen through neem cake recorded more number of branches per plant, in chilli. Singegol et al. (2007) stated that application of higher levels of nitrogen @ 150 kg ha\(^{-1}\) and phosphorus @ 75 kg ha\(^{-1}\) recorded more number of branches per plant in chilli. Application of NPK along with FYM recorded more number of branches per plant in sweet pepper under mid hill condition (Yadav et al., 2007).

Foliar application of water soluble fertilizers in tomato produced more number of branches per plant (AICRP(VS), Annual report 2006). Sable et al. (2007) reported application of 50 per cent nitrogen through neem cake and 50 per cent ‘N’ through vermicompost combination recorded more number of branches per plant in tomato. Manolikar et al. (2007) stated that application of 100 per cent FYM along with 50 per cent RDF recorded more number of branches per plant in tomato.

Karpagam et al. (2004) observed application of five sprays of NPK 19:19:19 along with the normal recommended dose recorded the highest number of branches per plant in chilli. Application of nitrogen @ 150 kg ha\(^{-1}\) recorded more number of branches per plant in bhendi. Application of 50 per cent nitrogen through neem cake recorded more number of branches per plant in brinjal.

Application of nitrogen @ 150 kg ha\(^{-1}\) recorded more number of branches per plant in bhendi. Application of 50 per cent nitrogen through neem cake and 50 per cent ‘N’ through vermicompost combination recorded more number of branches per plant in tomato. Manolikar et al. (2007) stated that application of 100 per cent FYM along with 50 per cent RDF recorded more number of branches per plant in tomato.

**Number of fruits per plant**:

In chilli application of N @ 300 kg ha\(^{-1}\) and 120 kg of phosphorus ha\(^{-1}\) recorded more number of fruits per plant. (AICRP(VC), Annual report 2006). Application of higher level of ‘N’ @ 150 kg ha\(^{-1}\) and ‘P’ @ 75 kg ha\(^{-1}\) recorded more number of fruits per plant in chilli. (Singegol et al., 2007).
In sweet pepper Yadav et al. (2007) reported that application of NPK with FYM recorded more number of fruits per plant under mid hill condition.

The number of fruits per plant in tomato was found to be the maximum when compost @ 2 t ha\(^{-1}\) with 30 kg nitrogen ha\(^{-1}\) was applied (Togun et al., 2003). Foliar spray of water soluble fertilizer in tomato produced more number of fruits per plant (AICRP(VC) Annual report, 2006). Application of 100 per cent FYM and 50 per cent RDF recorded more number of fruits per plant in tomato (Manolikar et al., 2007).

The number of fruits per plant in okra was found to be the maximum with application of NPK 19:19:19 at 0.5 per cent concentration five times along with RDF (Manjunatha, 2004). Paramasivam et al. (2005) observed that application of 100 per cent RDF combined with FYM @ 25 t ha\(^{-1}\), composted coirpith @ 12.5 t ha\(^{-1}\) and vermicompost @ 1.5 t ha\(^{-1}\) recorded maximum numbers of fruits per plant in okra.

Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an maximum number of fruits per plant in okra.

Foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an maximum number of fruits per plant in melon (Anitha et al., 2003).

**Fruit weight:**

In chilli Singegol et al. (2007) reported that application of nitrogen @ 150 kg ha\(^{-1}\) and phosphorus @ 75 kg ha\(^{-1}\) recorded higher fruit weight.

The treatment combination of 50 per cent recommended dose of fertilizer with 50 per cent nitrogen through FYM recorded the maximum fruit weight in tomato (Mohd et al., 2002). Togun et al. (2003) found that application of compost 2 t ha\(^{-1}\) with 30 kg N ha\(^{-1}\) through fertilizer gave the maximum fruit weight in tomato.

Manjunatha (2004) stated that application of NPK 19:19:19 at 0.5 per cent, five times along with recommended dose of fertilizer recorded maximum fruit weight in okra. Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited maximum fruit weight in okra. Application of ‘N’ @ 150 kg ha\(^{-1}\) and ‘P’ @ 80 kg ha\(^{-1}\) recorded higher fruit weight in okra (Kushwaha et al., 2008).

According to Sreenivas et al. (2000) application of recommended dose of fertilizer with 10 t ha\(^{-1}\) of vermicompost gave the maximum fruit weight in ridged gourd.

Combined application of 50 per cent recommended dose of fertilizer plus vermicompost @ 2 t ha\(^{-1}\) and biofertilizers @ 2 kg ha\(^{-1}\) gave the highest fruit weight in cucumber (Prabu et al., 2006).

**Yield per plant:**

In chilli, Vitkar et al. (2007) found higher fruit yield per plant when applying 50 per cent RDF along with 50 per cent nitrogen through neem cake.

Application of chemical fertilizer and FYM together recorded higher fruit yield per plant in sweet pepper (Yadav et al., 2007).

Manolikar et al. (2007) stated that application of 100 per cent FYM and 50 per cent recorded higher yield per plant in tomato.

Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an maximum fruit yield per plant in okra.

**Ascorbic acid:**

Application of 60 kg potassium ha\(^{-1}\) recorded higher level of ascorbic acid in chilli (Ananthi et al., 2004). Dange et al. (2004) observed that ascorbic acid content of chilli was higher when 50 per cent recommended dose of nitrogen through fertilizer and remaining 50 per cent of nitrogen through FYM was applied. The increase in ascorbic acid content was more, than the plant which received 100 per cent nitrogen through urea.

Ascorbic acid content was highest when applied with 50 per cent RDF and 50 per cent FYM in tomato (Rafi et al., 2002). Sable et al. (2007) stated that application of 50 per cent nitrogen through neem cake and 50 per cent nitrogen through vermicompost recorded more ascorbic acid in tomato.

Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an higher level of ascorbic acid content in okra.
Application of 100 per cent recommended nitrogen through urea registered higher level of ascorbic acid content in brinjal (Prabu et al., 2003) and similar results was reported by Singh and Parmar (2004) in tomato.

Dry matter production:
Sable et al. (2007) reported that application of 50 per cent nitrogen through neem cake and 50 per cent nitrogen through vermicompost combination recorded maximum dry matter production in tomato.

Karpagam et al. (2004) reported that application of NPK 19:19:19 along with normal recommended dose of fertilizer recorded highest dry matter production in okra.

Venkataraman (2007) reported that foliar nutrition of water soluble fertilizer NPK 19:19:19 at 0.5 per cent concentration five times along with recommended dose of NPK exhibited an higher dry matter production in okra.

Anitha Choury et al. (2001) reported that application of 50 per cent of recommended nitrogen through fertilizer plus enriched slurry @ 4.5 t ha⁻¹ gave higher dry matter production in soybean. Application of recommended dose of fertilizer with vermicompost @ 5 t ha⁻¹ Azospirillum @ 2 kg ha⁻¹ and ZnSO₄ @ 25 kg ha⁻¹ recorded the higher dry matter production in soy bean (Kalayarasan and Vaiyapuri, 2007). Application of Azospirillum with 100 per cent N and PK produced maximum dry matter content in onion (Mahanthesh et al., 2008). Ghuge et al. (2007) stated that application of 50 per cent RDF with 50 per cent vermicompost @ 25 t ha⁻¹ recorded highest dry matter production in cabbage.

Conclusion:
Hence, it is concluded that foliar nutrition with highly water soluble fertilizers can eliminate the problems like fixation and immobilization of nutrients. Foliar nutrients usually penetrate the cuticle of the leaf or stomata, enter the cells rapidly and fulfil the nutrient demand of the growing plant and thus ameliorate nutrient deficiencies rapidly.

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