MATERIAL AND METHODS

The present investigation entitled effect of zinc on growth fruiting and quality of litchi (Litchi Chinensis Sonn.) Cv. Calcuttia was carried out at Horticultural Experiment and Training Centre Saharanpur (U.P.) during year 1997-98, 98-99, 99-2000. The experiment was undertaken on 25 years old litchi tree of uniform vigour and growth located in model nursery of the research station in a single block. Details of the materials used and methodology adopted during the course of this investigation are described in this chapter.

SOIL CHARACTERISTICS:

Composite soil samples from 0 to 30 cm. depth of soil were collected from field of the experimental site before application of fertilizer. The samples were analysed for physico-chemical characteristics. The soil was sandy loam and well drained. The level of organic carbon in soil is medium. While low in available nitrogen, phosphorus and potash.

Table - Physico-Chemical Characteristics of the Soil of Experimental Field.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Particular</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mechanical analysis of soil.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Percent on oven dry basis)</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Sand</td>
<td>59.8</td>
</tr>
<tr>
<td>b.</td>
<td>Fine Sand</td>
<td>17.9</td>
</tr>
<tr>
<td>c.</td>
<td>Silt</td>
<td>11.8</td>
</tr>
<tr>
<td>d.</td>
<td>Clay</td>
<td>10.5</td>
</tr>
<tr>
<td>2.</td>
<td>Bulk density (g/cc)</td>
<td>1.51</td>
</tr>
<tr>
<td>3.</td>
<td>Field capacity</td>
<td>17.7</td>
</tr>
<tr>
<td></td>
<td>(Percent moisture in oven dry basis)</td>
<td></td>
</tr>
</tbody>
</table>
4. Organic carbon (%) 0.71
5. Available nitrogen (Kg/ha⁻¹) 183.00
6. Available Phosphorus (Kg/ha⁻¹) 23.50
7. Available potash (Kg/ha⁻¹) 201.00
8. Electrical conductivity (mmhos/cm) 0.089
9. pH 7.02

Climate and weather condition:

Saharanpur is located between 28.53°N latitude and 77.33°E longitude at an altitude of 270.5 meters above the sea level. The climate of this region is generally semi and subtropical which has extremes of hot and dry summer and very cold winters. The month of June being the hottest with maximum temperature ranging from 40°C to 45°C. From July to September, the temperature decreases and drops rapidly till it attains minimum value ranging between 20.0°C and 7.9°C with extrem of 27.2°C to 1.7°C during cold in month of January. From February onwards, the daily maximum and minimum temperature increases up to June. The mean annual rainfall is about 700mm, of which the major portion (about 78%) is received during the monsoon months (July to September) and rest during the winter months. The mean wind velocity is about 9 Km per hour in the month of June and 5 Km per hour in January during each years of experimentation.

Meteorological data for the period of investigation as recorded at the meteorological observatory of Horticultural experiment and training centre Saharanpur, located just nearer to the experimental sites are presented in Table No. 89. The experiment was laid out in randomised block design. The
levels of zinc sulphate were given as below:

1. **Soil application**

   (Applied as half in the month of Oct. and half in Feb.)

   a. \( S_1 \) (150 gm/tree/year)
   
   b. \( S_2 \) (250 gm/tree/year)
   
   c. \( S_3 \) (350 gm/tree/year)

2. **Foliar application**

   (One spray before flowering and second after fruit set)

   a. \( F_1 \) (0.5%)
   
   b. \( F_2 \) (1.0%)
   
   c. \( F_3 \) (1.5%)

3. **Soil + Foliar application**:

   (Nine possible combinations were applied)

4. **Control**: Only water spray

   The effect of zinc sulphate was tried on single tree for single treatment in three replications. Sixteen possible combinations thus derived for experimentation are described as below:

\[
\begin{align*}
T_1-S_1 & \quad T5-F2 & \quad T9-S1F3 & \quad T13-S3F1 \\
T2-S2 & \quad T6-F3 & \quad T10-S2F1 & \quad T14-S3F2 \\
T3-S3 & \quad T7-S1F1 & \quad T11-S2F2 & \quad T15-S3F3 \\
T4-F1 & \quad T8-S1F2 & \quad T12-S2F3 & \quad T16-Control
\end{align*}
\]
(i) Treatments-16
(ii) Reaplications-3
(iii) Design: Randomized block design.

5. Detail of method of soil & leaf analysis: Soil analysis

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Analytical parameter</th>
<th>Methodology</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PH</td>
<td>PH Meter</td>
<td>Jackson (1973)</td>
</tr>
<tr>
<td>2</td>
<td>Organic Carbon</td>
<td>Walkley and Black Method</td>
<td>Jackson (1973)</td>
</tr>
<tr>
<td>3</td>
<td>Available N</td>
<td>Alkaline Permagnate</td>
<td>Subbaiah and Asija</td>
</tr>
<tr>
<td>4</td>
<td>Available P</td>
<td>Colorimetry</td>
<td>Olsen and Sommer</td>
</tr>
<tr>
<td>5</td>
<td>Available K</td>
<td>Flame Phototmetry</td>
<td>Jackson (1973)</td>
</tr>
<tr>
<td>6</td>
<td>Available Zn</td>
<td>DTPA</td>
<td>Lindsay and Norvell</td>
</tr>
</tbody>
</table>

Leaf analysis:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Analytical parameter</th>
<th>Methodology</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen</td>
<td>Alkaline Permagnate</td>
<td>Subbaiah and Asia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Method</td>
<td>(1965)</td>
</tr>
<tr>
<td>2</td>
<td>Phosphorus</td>
<td>Colorimetry method</td>
<td>Olsen and Sommer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1982)</td>
</tr>
<tr>
<td>3</td>
<td>Potassium</td>
<td>Flame Photometory</td>
<td>Jackson (1973)</td>
</tr>
<tr>
<td>4</td>
<td>Zinc</td>
<td>DTPA</td>
<td>ANON (1994c)</td>
</tr>
</tbody>
</table>

Carbohydrate level: The total carbohydrate level consist of total sugar and starch. Total sugar was estimated in the same process as described under fruit analysis. Analysis of starch was adoped by Loomis and Shull (1937).
Growth characters:

(a) Emergence of new shoots/season: No. of shoots were recorded from the each treated plant and calculated the percentage.

(b) Length of shoot: Ten tagged shoots were selected from each treatment which emerge at the same date. Shoot length was recorded with the help of steel measuring tape from the point of emergence of shoots to growing point i.e., tip of the leaf.

(c) Girth of the shoot: The girth of shoot was measured with the help of vernier callipers at the base point.

(d) Number of leaflets in the shoot: The all leaflets of the tagged shoot of each treatment was counted and recorded.

Flowering characters:

The flowering characters of the plant of each treatment was observed as followes:

(a) Percent shoot flowered: The total number of shoots and the flowered shoots were counted and calculate the percent flowered shoots and recorded.

(b) Ratio of M/F flowers: The total no. of male and hermaphodite flower of ten panicle of each treatment were recorded and average ratio of M/F flowers was calculated of each treatment.

(c) Time of emergence of flowering shoot: The date of start of emergence of panicle was recorded of each treatment.
(d) **Length of panicle:** The length of panicle was observed as same as length of shoot.

**Fruiting Characters:**

The fruiting characters of the plants of each treatment was observed as follows:

(a) **Percent fruit set:** The total no. of flowers of ten panicles of each treatment were counted and calculated the average percent fruit set.

(b) **Percent fruit retention:** The same procedure is applied as percent fruit set and data was recorded.

(c) **Yield:** At the time of harvesting, the weight of total fruits per tree was recorded in kg of each treatment.

**Quality of the fruits:**

(a) **Percent fruit cracking:** Ten bunches of the each treated plant were selected and creacked fruits were counted and calculated the percent fruit cracking.

(b) **Average fruit weight:** Average weight of ten fruits was taken to find average fruit weight.

(c) **Average volume of fruits:** Volume of fruit is calculated by dipping ripe fruits in half water filled measuring cylinder. Water displaced by fruits was recorded as volume of fruits then calculate the average fruit volume.

(d) **Average fruit length:** The length of ten fruits was observed with the help of vernier calliper and calculated the average length.
(e) **Average fruit width**: The same procedure as fruit length was applied and observed the average fruit width.

(f) **Skin, Seed, Pulp Percentage**: Skin, seed and pulp of ten fruits weighed. Then calculate the percentage weight of skin, seed and pulp of one fruit.

(g) **Colour of the fruits**: Collect fifty fruits of each treatment and evaluated by a panel of judges.

(h) **Total soluble solids**: Total soluble solids of fruit pulp was recorded with the help of hand refractometer (A.O.A.C. 1960).

(i) **Acidity**: The acidity percent in the fruit juice was analysed by using A.O.A.C. method (A.O.A.C. 1960).

(j) **Total sugar**: The acid hydrolysis of non reducing sugar method was adopted in the determination of total sugar (Lane and Eynon 1953).

(k) **Reducing sugars**: Reducing sugar determined on a known volume of juice taken in a volumetric flask, diluted with distilled water and clarified by saturated lead acetate and volume made up. Reducing sugar present in the solution was determined by method described by Lane and Eynon (1953).

(l) **Non reducing sugars**: The difference of total sugars and reducing sugars was recorded as non reducing sugars.

(m) **Ascorbic acid**: By using A.O.A.C. method (A.O.A.C. 1960).

**Statistical analysis**: All the collected data of various characters were analysed statistically in randomized block design. The critical difference (C.D.) at 5% level of significance were calculate for the significant difference between the treatment means. The variance table of the observation have been given whenever it was essential.