CHAPTER III

PATTERNS OF ABSORPTION AND TRANSPORT IN CROP CULTIVARS

PART I:

Absorption and transport of zinc in sorghum cultivars:

The characteristics of Zn absorption and transport were examined using excised roots or intact seedlings, in order to observe differences amongst the cultivars, especially between the hybrids and their parents. It was also felt important to examine if there was any feature in the Zn uptake patterns which could be related to the hybrid vigour. The following experiments were carried out with CSH-7, CSH-8, 36A, 168 and PD-3-1-11.

EXPERIMENT:

1. Absorption of Zn by excised roots from 10 - 100 µM ZnCl₂ or ZnEDDHA over 3 hours. Absorption by excised roots and absorption and transport (in intact plants) of Zn from 50 µM ZnCl₂ or ZnEDDHA during 6 hour period.

2. Absorption and transport of Zn from 10 - 100 µM ZnCl₂ in intact seedlings over 3 hours.

3. Absorption of Zn from 10 - 100 µM ZnCl₂ in the absence and presence of 50 µM FeSO₄, CuSO₄ or KH₂PO₄ by excised roots.
RESULTS AND DISCUSSION:

The absorption rates of Zn from different concentrations of ZnCl₂ and ZnEDDHA are shown in Figure 4 and are found to follow a biphasic pattern in all cases. In the case of ZnCl₂, the rates of absorption in the steady phase which begins from 30 μM in all cultivars were higher in 36A and CSH-7, than others. This feature is also noted for uptake from ZnEDDHA. A significant reduction in the absorption is observed for ZnEDDHA compared to ZnCl₂. These patterns of uptake do not reveal a significant difference between cultivars. On the other hand there is a great similarity in the patterns between CSH-7 and 36A, particularly in ZnCl₂.

Figure 5 shows the absorption and transport of Zn in intact seedlings. The absorption rates are more or less similar in all cases. However, there is similarity in first phase of absorption between CSH-7 and CSH-8 and in the second phase which begins at about 20 μM ZnCl₂ in contrast to others having it from 40 μM. The amount of Zn transported to shoot is only about one-hundredth of what is absorbed by roots in general. The transport to shoot in CSH-7 and CSH-8 are much higher than in their parents, and this is clear evidence for heterosis in Zn transport in the hybrids. Amount transported to shoot appears to be important in the hybrids, because if it was insufficient in the leaves, it would have resulted in chlorosis. The studies on Zn-deficiency
Fig. 4: Absorption of Zn by excised roots of 5 cultivars of sorghum from different concentrations of ZnCl$_2$ or ZnEDDHA (10 to 100 μM) during 3 hours.
Fig. 5: Absorption and transport of Zn by intact seedlings of sorghum from different concentrations of ZnCl$_2$ (10 to 100 µM) over 3 hours.
stress tolerance described in Chapter V show a heterosis in these hybrids. Figure 6 shows the inverse plot of the absorption curve of figure 5 and Table 3 gives the values of $V_{\text{max}}$ and $K_m$ of different experiments.

The patterns of absorption by excised roots and by roots of intact seedlings are generally similar. However, the rates in intact plants are only half that in excised roots. This difference is likely to be due to the interference of the transport process, with Zn absorption.

Figure 7 shows the absorption of Zn by excised roots from 50 \( \mu M \) ZnCl$_2$ over 6 hours. The isotherms for absorption are very similar in the parent cultivars, 36A, 168 and PD-3-1-11 and differ from CSH-7 and CSH-8, particularly in the initial 3 hour-period in which, it is more rapid in the hybrids. The absorption by excised roots (Figure 7) in 36A, 168 and CSH-7 shows a second rise after 3 hours which is absent in PD-3-1-11 and CSH-8. However, the rates are less in those by intact roots than in excised roots (Figure 8). This secondary rise at 3 hours has been observed in Mn (136). Further, this rise is absent when the absorption is from ZnEDDHA. Probably some transitional changes occur after a few hours of absorption which is eliminated by EDDHA. A significant feature is a reduction of uptake in ZnEDDHA. In contrast, the transport to shoot is much higher in ZnEDDHA in all cultivars.
Fig. 6: Lineweaver Burk plot for rate of absorption (1/V) and substrate concentration (1/S).
Fig. 7: Time-course of the absorption of Zn by excised roots of 5 cultivars of sorghum during 6 hours from 50 μM ZnCl₂.
Table III
The $V_{\text{max}}$ and $K_m$ values obtained from different experimentation of Zn absorption and transport by excised roots and intact seedlings of 5 cultivars of sorghum. Values were calculated from the $1/V$ and $1/S$ plot.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>$V_{\text{max}}$ (µmoles/gm/3 hours)</th>
<th>$K_m$ (µmoles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Excised roots</td>
<td></td>
<td></td>
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<tr>
<td>With ZnCl$_2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-A</td>
<td>0.833</td>
<td>40.0</td>
</tr>
<tr>
<td>168</td>
<td>0.555</td>
<td>27.8</td>
</tr>
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<td>CSH-7</td>
<td>0.833</td>
<td>38.5</td>
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<tr>
<td>PD-3-1-11</td>
<td>0.714</td>
<td>25.6</td>
</tr>
<tr>
<td>CSH-8</td>
<td>0.625</td>
<td>25.0</td>
</tr>
<tr>
<td>With ZnEDDA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-A</td>
<td>0.385</td>
<td>25.0</td>
</tr>
<tr>
<td>168</td>
<td>0.313</td>
<td>22.2</td>
</tr>
<tr>
<td>CSH-7</td>
<td>0.333</td>
<td>18.5</td>
</tr>
<tr>
<td>PD-3-1-11</td>
<td>0.313</td>
<td>20.8</td>
</tr>
<tr>
<td>CSH-8</td>
<td>0.357</td>
<td>22.7</td>
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<td>II. Intact seedlings</td>
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<td></td>
</tr>
<tr>
<td>Absorption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-A</td>
<td>0.385</td>
<td>40.0</td>
</tr>
<tr>
<td>168</td>
<td>0.250</td>
<td>41.7</td>
</tr>
<tr>
<td>CSH-7</td>
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<td>26.32</td>
</tr>
<tr>
<td>PD-3-1-11</td>
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</tr>
<tr>
<td>CSH-8</td>
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<td>33.30</td>
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<tr>
<td>Transport</td>
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<td></td>
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<tr>
<td>36-A</td>
<td>0.0024</td>
<td>31.25</td>
</tr>
<tr>
<td>168</td>
<td>0.0024</td>
<td>28.57</td>
</tr>
<tr>
<td>CSH-7</td>
<td>0.0038</td>
<td>52.63</td>
</tr>
<tr>
<td>PD-3-1-11</td>
<td>0.0025</td>
<td>41.67</td>
</tr>
<tr>
<td>CSH-8</td>
<td>0.0038</td>
<td>29.41</td>
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</table>
Fig. 8: Time-course of the absorption and transport of Zn by 5 cultivars of sorghum during 6 hours from 50 μM ZnCl₂ or ZnEDDHA.
Absorption and transport of Zn μmoles/gm fr wt.

HOURS
(Figure 8). This shows the effectiveness of ZnEDDHA in the transport of Zn. Furthermore, the transport is found to increase after 5 hours in CSH-7 and CSH-8. An increase is observed in PD-3-1-11 but at an early period of 3 hours. Although the exact significance is not known, it is a feature more beneficial for plants because more Zn is available to the shoot. The absorption of Zn from different concentrations of ZnCl$_2$ by excised roots of sorghum CSH-7, 36A and 166 are presented in Figure 9a. It is found that $50\mu$M FeSO$_4$, CuSO$_4$ and KH$_2$PO$_4$ inhibited the absorption. When the data are plotted as inverse rate (v) and substrate concentration(s), Fe is found to inhibit Zn uptake in a competitive manner (Figure 9b).

PART II:

Absorption and transport of zinc in M-35 and M-47, a drought resistant and a drought susceptible sorghum cultivar:

Sorghum is one of the major cereal crops grown in Maharashtra state and other parts of India as well, and several varieties have been selected and released to farmers to suit the regions which differ greatly in their receipt of water through the monsoons. A larger area of the state lies in the region receiving less and unpredictable rains and a very popular variety, M-35 possessing superior grain quality is under extensive cultivation, especially under no irrigation regime. A variety, M-47
Fig. 9a: Effect of 50 μM FeSO₄, CuSO₄ or KH₂PO₄ on the absorption of Zn from different concentrations of ZnCl₂ (10 to 100 μM) over 3 hours by excised roots of 3 cultivars of sorghum.

Fig. 9b: Lineweaver Burk plot of the values of Fig. 9a, showing the nature of inhibitory effect of Fe, Cu and P on Zn absorption.
is generally grown in kharif season when moisture supply through the monsoon is either adequate or supplemented by irrigation. Wide spread occurrence of micronutrient deficiencies have been recorded in recent years in sorghum and Zn deficiency has been identified in several areas of low rainfall. Our objectives for the solution culture experiments are two folds. 1. To examine the nature of interaction between phosphate and zinc in their absorption and transport process, and 2. To obtain differences if any, between two sorghum varieties in Zn uptake.

**EXPERIMENT:**

1. Absorption and transport of Zn from different concentrations of ZnCl₂ (30-130μM) by excised roots and in intact seedlings over 3 hours.

2. Time-course of Zn absorption and transport for 6 hours by excised roots and in intact seedlings from 50μM ZnCl₂.

3. Effect of different concentrations of KH₂PO₄ (0 to 10 mM) on the absorption and transport of Zn by excised roots and in intact seedlings, from 50μM ZnCl₂.

4. Effect of different concentrations of ZnCl₂ (0 to 100μM) on the absorption and transport of PO₄ from 0.1 mM KH₂PO₄ by excised roots and intact seedlings.
RESULTS AND DISCUSSION:

Figure 10 and 11 show the results of experiments with excised roots and intact seedlings. Zinc uptake by excised roots of both M-35 and M-47 showed a biphasic pattern up to 90 μM ZnCl₂ and secondary inflection thereafter. Further, the rate of uptake by M-47 was higher than M-35. Absorption pattern of Zn in intact roots resembles that of excised roots. But the secondary rise above 90 μM in the excised roots, was absent in the case of intact seedlings (Figure 11). The rate of transport of Zn in M-47 was higher than in M-35, at 30 μM and nearly the same as in M-35 from 30 to 90 μM. However, it was found to steadily increase from 90 to 130 μM in M-35.

The time-course of Zn absorption by excised roots and absorption and transport in intact seedlings is shown in figures 12 and 13. The absorption pattern by excised roots and roots of intact seedlings was same with phase transitions taking place at about the same time intervals. Uptake is biphasic with an initial rapid phase up to 2 hours and steady phase thereafter. The transport pattern also shows the transition phase which are very conspicuous in M-47 than in M-35. Further, the transport of Zn to the shoot of M-47 was very much greater than that of M-35 (Figure 13).

The interaction between Zn and other elements on their mutual absorption was studied. Figure 14 and 15 illustrate the
Fig. 10: Absorption of Zn from different concentrations of ZnCl$_2$ (30 to 130 uM) by excised roots of M-35 and M-47 sorghum cultivars.
Fig. 11: Absorption and transport of Zn from different concentrations of ZnCl₂ (30 to 130 μM) in intact seedlings of M-35 and M-47 over 3 hours.
Absorption and transport of $^{65}$Zn in moles/gm/3hr.

**Shoot**
- **M-47**
- **M-35**

**Root**

ZnCl$_2$, $\mu$M
Fig. 12: Zn absorption from 50 μM ZnCl$_2$ by excised roots of M-35 and M-47 during 6 hours.
Absorption of 65Zn \( \mu \)moles/gm over HRS.

- `M-47` curve (dashed line)
- `M-35` curve (solid line)
Fig. 13: Time course of absorption and transport of Zn in intact seedlings of M-35 and M-47 during 3 hours from 50 μM ZnCl₂.
Fig. 14: Effect of different concentrations of $\text{KH}_2\text{PO}_4$ on the absorption of Zn from $50\,\mu\text{M} \text{ZnCl}_2$ by excised roots of M-35 and M-47 over 3 hours.
Fig. 15: Effect of different concentrations of KH$_2$PO$_4$ on the absorption and transport of Zn from 50 μM ZnCl$_2$ in intact seedlings of M-35 and M-47 over 3 hours.
Absorption and transport of $\text{Zn}^{2+}$ moles/gm/3 hr

Absorption and transport of $\text{Zn}^{2+}$ moles/gm/3 hr

KH$_2$PO$_4$, mM
effect of different concentrations of KH$_2$PO$_4$ in the absorption of Zn by excised roots and intact seedlings. Increasing concentrations of KH$_2$PO$_4$ reduced the absorption of Zn by excised roots of both the cultivars at the same rate. The inhibition rate is greater in the low concentrations of KH$_2$PO$_4$ than in higher concentration (Figure 14). However, the rate of inhibition of Zn uptake by roots of intact seedlings was more up to 5 mM KH$_2$PO$_4$, above which it was much less. Further, the absorption and transport of Zn in the presence of KH$_2$PO$_4$ was higher in M-47 than in M-35 (Figure 15).

The effect of varying concentrations of ZnCl$_2$ on the absorption of phosphate by the excised roots and intact seedlings are illustrated in figures 16 and 17. The rate of phosphate absorption decreased greatly with concentrations of ZnCl$_2$ up to 20 $\mu$M and the decrease was less above 20 $\mu$M. There was not much difference between the cultivars (Figure 16). However, there were significant differences in the inhibition of phosphate absorption by roots of intact seedlings (Figure 17). There were also differences between the cultivars in the influence of Zn on the transport of phosphate. However, the inhibition of phosphate absorption and transport was greater between 20 and 50 $\mu$M ZnCl$_2$ in M-47.

The results on the absorption of Zn by excised roots and intact seedlings showed a difference between the cultivars,
Fig. 16: Effect of different concentrations of $\text{ZnCl}_2$ on the absorption of phosphate from 0.1 mM $\text{KH}_2\text{PO}_4$ by excised roots of M-35 and M-47 during 3 hours.
Absorption of $P$ moles/gm/3hr

![Graph showing absorption of 32P μmoles/gm/3hr with ZnCl$_2$ concentration in μM.](image-url)
Fig. 17: Effect of different concentrations of ZnCl$_2$ on the absorption and transport of phosphate from 0.1 mM KH$_2$PO$_4$ by intact seedlings of M-35 and M-47 during 3 hours.
Absorption and transport of $^{32}\text{P}$ μmoles/gm/3hr

**Shoot**

- M-47
- M-35

**Root**

Absorption and transport of $^{32}\text{P}$ μmoles/gm/3hr vs. ZnCl$_2$, μM.
and M-47 which is a drought susceptible variety showed an increase in absorption than M-35, the drought resistant cultivar. The rate of transport of Zn in M-47 was higher than in M-35 at 30/μM, and was nearly same as in M-35 from 30 to 90/μM (Figure 10). However, the initial more rapid uptake by M-47 was compensated by similar rapid uptake from 90 to 130/μM in M-35.

The time-course of Zn absorption showed a biphasic pattern in the first two hours with an initial rapid phase followed by a steady one, a feature explained by Hooymans (67) as due to the filling up of the cytoplasmic and vacuolar compartments within the cells of the roots. The inflections in the absorption pattern after 2 hours was observed not only in excised roots but also in transport in intact seedlings (Figure 12 & 13). The results show that Zn transport to shoot in sorghum is greatly regulated by the absorption by roots, as has been reported for Fe in wheat (87).

It is well known that there are mutual interactions in the uptake of Zn and phosphate and generally one inhibited the other (127, 148, 149). Experiments carried out to study the absorption and transport of Zn in the presence of varying concentration of P and vice versa. Phosphate was found to inhibit not only the absorption but also the transport of Zn, the rate of inhibition generally being greater in the lower concentration of
KH$_2$PO$_4$ (Figure 14 & 15) and was more in M-47 than in M-35. This shows that the drought susceptible M-47 could be susceptible to Zn-deficiency when larger amount of phosphate is present in the medium, since this phosphate would inhibit Zn transport to the shoot.

The rate of inhibition of phosphate absorption in the presence of Zn by excised roots was greater in the low concentrations, 10 - 20\muM. There are very little difference between the two cultivars (Figure 16) in the pattern of phosphate uptake although the amount absorbed was less in M-47 than in M-35, throughout. But there were significant differences in the inhibition of phosphate absorption by roots of intact seedlings (Figure 17). It was also found that in M-35, the presence of Zn in the medium had less influence on the absorption and transport of phosphate.

PART III:

Absorption and transport of zinc in young maize seedlings

EXPERIMENT:

1. Absorption and transport of Zn from different concentrations of ZnCl$_2$ (10 to 100\muM) for 3 hours by Ganga-5 and its parent cultivars.

2. Absorption and transport of Zn in Ganga-2 and its parent cultivars from different concentrations of ZnCl$_2$ for 3 hours.
RESULTS AND DISCUSSION:

The absorption and transport of Zn was studied in ten day-old maize seedlings. The results of Zn absorption and transport in Ganga-5, the hybrid and its parent cultivars during 3 hours are shown in Figure 18. The absorption isotherm shows a biphasic pattern with an initial rapid phase up to 30 μM ZnCl₂ and a steady phase thereafter. Further, there was not much difference between the cultivars in the absorption pattern of the roots although these differed quantitatively. However, the transport pattern was almost linear with the concentration.

The 1/V and 1/S plot of the rate of absorption is shown in Figure 19. It is found that the Kₘ values of Ganga-5 and CM-500 are nearly equal i.e. 33.33 μmoles; the Kₘ for CM-202 x CM-111 is 29.41. The hybrid is found to resemble the male parent in the absorption capacity.

Absorption and transport of Zn in another set of maize seedlings Ganga-2 and its parent cultivars and the 1/V and 1/S plot are shown in figures 20 and 21. Absorption and transport increased with ZnCl₂ concentrations and difference amongst cultivars were also observed. Absorption by roots of intact seedlings of Ganga-2 showed a linear pattern in contrast to the biphasic pattern of other two cultivars (Figure 20). The rate of transport in Ganga-2 was slow up to 60 μM ZnCl₂. Further the 1/V and 1/S plot revealed the
Fig. 13: Absorption and transport of Zn from different concentrations of ZnCl₂ by intact seedlings of 3 maize cultivars (Ganga-5 and its parent cultivars) over 3 hours.
Absorption and transport of Zn µmoles/gm/3 hrs

ZnCl₂

Absorption and transport of Zn µmoles/gm/3 hrs

ZnCl₂ (µM)

Absorption and transport of Zn µmoles/gm/3 hrs

ZnCl₂ (µM)
Fig. 19: Lineweaver Burk plot of data from figure 10 showing the $V_{\text{max}}$ and $K_m$ of the absorption of Zn from different concentrations of ZnCl$_2$ by maize seedlings (Ganga-5 and its parents). $V_{\text{max}} = \mu$moles/gm/3 hours and $K_m = \mu$M Zn.
Fig. 2: Absorption and transport of Zn from different concentrations of ZnCl₂ by intact seedlings of 3 maize cultivars (Ganga-2 and its parents) over 3 hours.
Fig. 21: Lineweaver Burk plot of data from figure 20 showing the $V_{\text{max}}$ and $K_m$ of the absorption of Zn from different concentrations of ZnCl$_2$ by maize seedlings (Ganga-2 and its parents). $V_{\text{max}} = \mu$molos/gm/3 hours and $K_m = \mu$M Zn.
differences in the $K_m$ values and $V_{max}$ indicating the differences in their affinity for Zn. It also shows that only the male parent has a higher affinity for Zn compared to the other two cultivars.

PART IV:

Absorption and transport of zinc in tea seedlings

EXPERIMENT:

1. Absorption and transport of Zn in two cultivars of tea TS-378 and TS-449 from different concentrations of ZnCl$_2$ over 3 hours.

2. Comparative study on the absorption and transport of Zn from either ZnCl$_2$ or ZnEDDHA over 3 hours. The seedlings (TS-378) were grown either with distilled water or half strength Steinberg's nutrient solution (153).

3. The mobility of foliar applied Zn in TS-378.

4. Effect of Al$_2$(SO$_4$)$_3$ on the absorption and transport of Zn from different concentrations of Zn Cl$_2$ during 24 hours.

5. Zn absorption by excised roots and leaf discs of cultivars TS-378 and TS-449. Ten leaf discs approximately weighing 200 mg and 1 cm dia were used for the experiment.
RESULTS AND DISCUSSION:

The tea seedlings were raised in sand, irrigated with half strength Steinberg's nutrient solution (153) and used in the experiments after 3 months. The absorption and transport of Zn from different concentrations of ZnCl$_2$ by two cultivars are presented in figure 22. It was found that the amount of Zn absorbed by the roots of both the cultivars was higher than that transported to the stem and leaves. For example, at 20 $\mu$M ZnCl$_2$, the roots, stem and leaves of TS-378 retained 0.4, 0.002 and 0.001 $\mu$moles. The pattern of absorption by roots and transport to the stem and leaves were very similar in both the cultivars. The only difference found was a slight reduction in the transport to stem in TS-449 above 50 $\mu$M ZnCl$_2$.

Absorption and transport of Zn from ZnCl$_2$ or ZnEDDHA in TS-378 are illustrated in figure 23. The seedlings were raised in distilled water. Zn absorption from ZnEDDHA was less than that from ZnCl$_2$. However, the patterns of their absorption from ZnCl$_2$ or ZnEDDHA to stem and leaves were the same upto 50 $\mu$M ZnCl$_2$, above which it decreased in the case of ZnEDDHA. However, the transport of Zn from ZnCl$_2$ to stem and leaves continued to increase over all concentrations.

The mobility of foliar applied Zn was examined by immersing the terminal half of the middle leaf of a plant having
The rates of absorption and transport of Zn from different concentrations of ZnCl₂ in two cultivars of tea seedlings over a period of 3 hours. The seedlings were grown in sand irrigated with nutrient solution.
Fig. 23: The rates of absorption and transport of Zn from different concentrations of ZnCl$_2$ or ZnEDDHA in tea cultivar TS-370, grown in sand irrigated with distilled water.
Absorption and transport of Zn μmoles/gm/3hrs

LEAVES

STEM

ROOT

Absorption and transport of Zn μmoles/gm/3hrs

ZnCl₂ (μM)  Zn EDDHA (μM)
3 leaves into a beaker containing $^{65}\text{ZnCl}_2$ (Figure 24). The results showed that most of the Zn absorbed was retained in the treated leaf itself (Figure 25). Furthermore, there was a greater translocation of Zn to the lower leaf, while the stem, upper leaf and the root retained only small amounts of Zn. However, the patterns of translocation to these three parts were very similar.

Studies with the absorption and transport of Zn in the absence and presence of 50 µM Al$_2$($\text{SO}_4$)$_3$ revealed that Al decreased Zn uptake and translocation (Figure 26). The rate of decrease in translocation to stem and leaves increased with the concentrations of Zn. The reciprocal plot of concentration versus rate indicated a non-competitive type of inhibition (Figure 26 inset). The results further showed that the presence of Al in the root medium did not significantly affect the translocation of Zn in the leaves.

Zn absorption by excised roots of TS-378 and TS-449 is found to be linear up to 50 µM ZnCl$_2$ and there is a secondary rise above 70 µM (Figure 27). There is considerable similarity in the patterns of absorption by excised roots and leaf discs and also between the cultivars.
Fig. 24: The experimental set up for studying the foliar absorption and transport of Zn in tea seedling. The middle leaf is held immersed into the absorption medium by means of a glass rod.
Fig. 25: Foliar absorption and translocation of Zn from different concentrations of ZnCl$_2$. The middle leaf was treated with the experimental solution for 3 hours.
Absorption and transport of Zn μmoles/gm/3hrs

![Graph showing absorption and transport of Zn μmoles/gm/3hrs](image)

- **Treated Middle Leaf**
- **Upper Leaf**
- **Lower Leaf**
- **Stem**
- **Root**

**X-axis:** Zn Cl₂ (μM)

**Y-axis:** Absorption and transport of Zn μmoles/gm/3hrs
Fig. 26: Effect of 50 μM aluminium sulphate on the absorption and transport of Zn from different concentrations of ZnCl₂. Inset shows the reciprocal plot of rate versus concentration in the absence and presence of Al.
Absorption and transport of Zn μmoles/gm/24h

LEAVES

STEM

ROOT

$\text{ZnCl}_2$

$\text{ZnCl}_2 + 50 \mu\text{M Al}_2(\text{SO}_4)_3$

Absorption and transport of Zn μmoles/gm/24hrs

ZnCl$_2$(μM)
Fig. 27: Absorption of Zn by excised roots and leaf discs of two cultivars of tea from different concentrations of ZnCl₂.
PART V:

Absorption and transport of Zinc in peanut seedlings

EXPERIMENT:

1. Absorption and transport of Zn from different concentrations of ZnSO₄ (0.05 to 0.5 mM) over 3 hours. The values were expressed on dry weight basis.

2. Time-course studies on the absorption and transport of Zn from 0.1 mM ZnSO₄ during 24, 48 and 72 hours. The seedlings used in these two experiments were grown for 15 days in Haagland's nutrient solution minus Zn (66).

RESULTS AND DISCUSSION:

Figure 28 shows the absorption of Zn by roots and transport to stem and leaves after 3 hours. The absorption pattern from different concentrations of ZnSO₄ is biphasic with an initial rapid phase and a steady phase at concentrations above 0.3 mM. The pattern is typical of those of ions which are carrier-mediated and energy dependent (40, 43). On the other hand, the transport to stem and leaves follow an exponential pattern, especially from 0.1 mM ZnSO₄.

The results on the time-course of absorption and transport of Zn from 0.1 mM ZnSO₄ reveal that the root absorption is steady up to 48 hours after which there is a secondary
Fig. 2: Absorption and transport of Zn from different concentrations of ZnSO$_4$ by peanut seedlings TG-1 during the period of 3 hours. The absorption values were expressed on dry weight basis.
Absorption and transport of Zn μmoles/gm. dry wt./3 hrs.

ZnS₄ (mM)

5 10 15 0.05 0.1 0.03 0.06

ROOT STEM LEAVES
rise. There is also an increase in the rate of transport to the stem and leaves, although the amount transported is very small compared to that absorbed by the roots (Figure 29). The results obtained here (Figure 28 & 29) clearly show that Zn transport in peanut is a serious limitation in Zn nutrition.
Fig. 29: Absorption and transport of Zn from 0.1 mM ZnSO₄ by peanut seedlings during 24, 48 and 72 hours.
Absorption and transport of Zn/μmoles/gm. dry wt.

LEAVES

STEM

ROOT

HOURS