IV

SUMMARY AND CONCLUSIONS

INTRODUCTION

Mangroves are the subject of attention since 18 th century because of their typical morphological structure. Since then they have been described in various ways. In 20 th century the investigations on mangroves were focussed on ecological and physiological aspects. Considerable work has been done on salt economy, ion regulation, ultrasturcture of salt glands etc. However, it is not fully understood how ions are regulated by mangroves. Therefore, it was thought that attempt can be made to gather some more exprimental data on this aspect which will help understanding ion regulation in mangroves. Hence in the present investigation mangroves seedlings are analysed for their ionic status.

This study had imerged out of the earlier work from our laboratory. The works of Karkar (1984), Karkar and Bhosale (1986) and Kulkarni (1991) indicated higher endogenous salt levels in the young parts rather than mature ones. This observation needed further probe into the studies on ionic distribution. Thus the present investigation was planed.

MATERIAL AND METHODS

For the present study seedlings of seven mangrove species belonging to salt excreting, salt accumulating and salt excluding types were selected. The species are

<u>Avicennia officinalis</u>

<u>Aegiceras corniculatum</u>

<u>Acanthus ilicifolius</u>

Sonneratia alba

Lumnitzera racemosa

Ceriops tagal

Rhizophora mucronata

The seedlings were sampled into young leaves (first pair from top) mature leaves, stem and root. These organs were analysed following routin methods used in our laboratory. In addition a verbal ecological model is considered to compare ionic strategy in different species. The whole aspect is summerised in geometric way.

RESULTS AND DISCUSSIONS

The results of present study are depicted in 19 Tables and 8 Figures. In addition, observations on leaf anatomy are recorded in plates. Transverse sections of leaf of all the seven species were observed. The leaves of Avicennia, Aegiceras and Acanthus show presence of salt glands as they are the salt excerting type of mangroves. However, interesting observation is plentiful presence of oil globules in Acanthus and Avicennia. Therefore, other plants were also carefully observed. It is found that all the species except A. corniculatum possess oil globules in the leaves. This universal occrence is possibely related to adaptation of mangroves to saline conditions.

Moisture percentage and Dry matter

Moisture percentage and dry matter content of different seedlings have been reocrded. It is evident that there is a trend in each of the group where the difference between highest and lowest levels of moisture in the seedlings is similar, here is exception of Avicennia and Lumnitzera. The salt excerting type of mangroves, In different organs of seedlings, contain more or less similar amount of water owing to small difference between levels of stem and leaves. The salt excluding type, Ceriops and Rhizophora, have almost same difference between highest and lowest values. Thus three groups behave differently to accumlate moisture.

Dry matter represents organic matter content and minerals. In case of salt accumulating species mature leaves show higher levels of dry matter in the stem. In case of salt exerting type of plants difinite trend is not seen.

Biomass Content

An attempt has been made to record the biomass of seedlings under investigation. Further, the contribution by each organ to biomass has also been recorded. Salt accumulating mangroves show almost equal share to the biomass by different organs. Whereas in case of salt excluding species major share is due to stem. Similarly, major share is shown by in excreting type in except Avicennia.

Macroelements

Elemental composition of seedlings has been determined in two ways, by wet digestion method and from ash. Sodium

The root and leaves of all plants have higher sodium levels in salt excreting mangroves. In case of accumulating species mature leaves have highest sodium content. The roots of salt excluding species show greater sodium content however, same level is found in the mature leaves of C. tagal. Possibly there exist a check or barrier for sodium translocation between the roots and other organs of R. mucronata. This is not seen with C. tagal. So far as leaf age is concerned higher levels are obtained in mature leaves except R. mucronata. At seedling stage sodium is obsorbed in large amounts, may be either it is required or there is no check at seedling stage. The later case seems to be not possible as unchecked sodium uptake may harm the seedlings. Data has been analysed for distribution of different elements in a single seedling. The total sodium present in a single seedling of all mangrove species is as follows A. officinalis 18.43mg which is 26.8 % of total minerals investigated and about 20 % of ash. Similarly for other species these figures respectively are :

A. corniculatum	5.66 mg ,	30.0 % ,	23.7 %
A. ilicifolius	6.66 mg ,	43.0 % ,	44.1 %
S. alba	4.34 mg ,	40.2 % ,	36.8 %
L. racemosa	0.82 mg ,	2.06 % ,	70.14 %
C. tagal	12.5 mg ,	2.06 % ,	70.14 %
R. mucronata	287.41 mg ,	26.4 % ,	18.55 %

Though A. ilicifolius is a salt excreting mangrove it accumulates sodium. This observation supports classification of A. ilifolius as accumulating type by Joshi and Bhosale (1982).

Potassium

It is found that young leaves contain higher levels of potassium compared to mature ones except in L. racemosa. However, when all the organs are considered highest levels are found in stem or root except in Ceriops. The study shows that even at seedling stage luxury uptakee of potassium is not evident. Potassiam doesnot show perticular trend with respect to its distribution in different organs. The per seedling values of potassium range between 0.42 mg (L. recemosa) to 75.13 mg (R. mucronata). As compared to sodium, K values are very low.

Sodium / Potassium (Na/K)

Young leaves of almost all seedlings show a drop in Na/K ratio than mature ones. In comparison with other organs mature leaves behave as store houses for Na or accumulate less potassium resulting in high Na/K ratios. Thus it can be seen that it is not only Na or K that is important from the piont of view of metabolic processes but is the relative amount of these two monovalent cations, which is more important.

Calcium

Only the seedlings representing salt excluding type follow similar trend in case of highest and lowest Ca levels. Highest Ca levels in both plants are from mature leaves while low levels are from stem of both seedlings. However, in remaining group no such trend is observed. Though Ca is thought to be immobile element mangroves show efficient uptake of calcuim. In the present study Lumnitzera seedlings seem to efficient in Ca uptake, but if may be due to its accumlative nature. In none of the seedlings mauture leaves show lowest levels except A. ilicifolius.

On per seedling basis the high level of Ca is found in Ceriops and Rhizophora but the percentage contribution either to ash or total elements is less than salt accumulating type, especially L. racemosa. In salt excluding mangroves per seedling values indicate that Ca is second highest cation, however, in Lumnitzera it is the highest element, close to Na. Except Acanthus where it is les than Mg, Ca is third highest element in remaining plants, leading to conclussion that though it is immobile, divalent element it plays an important role in ion regulation.

Magnesium

Highest value for Mg is in the leaves, either mature or young, except Sonneratia where it is in stem, may be indicating its slow translocation and therefore its accumulation. But exactly contrasting observations are recorded for remaining seedlings where low levels are in stem and accumulation in leaves owing to its translocation.

On the per seedling basis Mg stands fourth in the descending order of mineral elements in Aegiceras and Avicennia, however, in Acanthus it is third. There is very less difference in the values for third and fourth position elements, except Lumnitzera. Closeness of the values for the third and fourth rank element (descending order) indicates that uptake and/or distribution of these two elements is interlinked. Thus for the regulation of third order element the fourth order one namely Mg is directly or indirectly responsible it can be vice versa.

Microelement - Iron

In present study Fe values are high as compared to earlier reports. The values range between 0.218 (roots of A. corniculatum) to 2.90 (roots of S. alba). Highest values are recorded either for the stem or root. For salt excreting type stem shows maximum value whereas, rest of the two groups have highest value for root except C. tagal. Where stem and root have more or less same level. It is very likely that at seedling stage translocation of Fe is slow or the stem and roots can accumulate it for some time.

On the per seedling basis, Fe values can be considered at three levels as upto 5, 5-10 and above 10 % of ash. Only salt excreting group shows higher K level than Fe. In R. mucronata Fe and K values are very close, while in C. tagal Fe is in more quantity than K. However, in accumulating type Lumnitzera shows values near to each other while Sonneratia has slightly higher level of Fe. Thus, Fe seems to compete with K though the valancies of both the elements are different. Thus for mangroves Fe can be identified as a macroelement.

Chlorides

Succlence in halphytes is supposed to be due to Cl ions which has been supported in the present study by higher levels of Cl in leaves of Sonneratia and Lumnitzera, representing accumulating type. Further the chlorides in young leaves of L. racemosa are higher than mature ones. In other species seedlings do not show much difference in young and mature leaves, with respect to chlorides. Similarly, there in no major difference in chloride levels of different organs of seedlings except salt accumulating type of species.

It is interesting to note that the weight of the seedling ash is contributed by Cl which can be as high as 49.24 % (L. racemosa). In comparison with other elements its percentage goes very high except in A. ilicifolius and S. alba. Thus it can be said that there may not be any other anion/element, the level of which could be more than Cl except excluding type where there is a large gap in the ash per seedling and the total of the elements, possibly indicating other anion/element having higher levels than Cl.

COMPARATIVE STRATEGY OF DIFFERENT ELEMENTS

In short it can be stated that in case of salt accumlating type leaves and roots show higher ash than stem whereas for excluding type roots have highest ash percentage. This trend indicates that more ash in the leaves of excreting type is because of higher minerals which are translocated to the leaves possibly for excretion. In case of succlent species there is no such distinction.

ECOLOGICAL MODEL

The behaviour of the species in the community can be explanied with the help of suitable ecological model. In ecology population dynamics, single species behaviour etc. are depicated with the help of model. In the present study also attempt has been made to explain the behaviour of species falling in different groups. A verbal model with its mathametical expression is proposed and tested for the behaviour of species with respect to ion regulation. This model considers four parameters upon which the behaviour is thought to depend. These are, life form, catogery in classification, (excreting, accumulating, and excluding), reproduction mode, and percentage difference in highest and lowest values for the element under investigation. Based on this index values are obtained it is found that the mangrove seedlings studied can be broadly grouped under three catogeries which aer similar to their classification however, there is some deviation at certain points e.g. Acanthus shows the behaviour which is transitional between two grooups. Thus the model helps to justify placement of Acanthus into salt accumlating type of mangroves though it is having salt glands in the leaves. But it is more apropriate to classify it as a transitional species with respect to ion regulation.

CONCLUSIONS

1. There is small difference between highest and lowest values for water content in salt excreting type of mangroves.

2. Accumulating type shows considerable difference between water levels of stem and leaves.

3. Lowest and higest moisture percentage values have almost same difference for Ceriops and Rhizophora.

4. At seedling stage biomass production by the species depends much upon what type of species it is.

5. Considering sodium there seems some kind of check or barrier between roots and other organs, especially, in Rhizophora.

6. Uptake of higher amount of sodium at seedling stage, may be due to its requirement, or due to lack of check at seedling stage.

7. Salt secreting mangrove A. ilicifolius accumulates Na.

8. Mangrove seedling absorbs large amount of Mg.

9. There is a possibility of presence of separate mechanism for K which is independent of Na. But K mechanism at this stage remains unclear.

10. From the point of view of metabolic process the relative amount of Na and K is more important.

11. The study indicates that the seedlings have different preference for different elements, especially, K and Ca.

12. Though Ca is immobile, divalent element at least at seedling stage, it plays an important rule in ion regulation.

13. There is a indication of presence of interlink for uptake and or distribution of third and fourth rank elements (values in descending order) due to their closeness in values.

14. More or less equal preference is given to both the elements.

15. Though Fe is suppose to be microelement its level in mangrove seedlings is pretty high, even more than some of the major elements.

16. For mangroves Fe can be identified as a macroelement.

17. Major weight of the seedling ash is contributed by Cl which can be as high as 49.24% .

18. Acanthus is more appropriatly classified as a transitional species with respect to ion regulation.