SUMMARY AND CONCLUSION

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Turmeric (Curcuma longa L.) is an important spice crop grown on commercial scale in India. Turmeric is a best known spice as well as the condiment which belongs to the family - Zingiberaceae and the order Scitamineae. It is an indespensible constituent of curry powder and is used as colouring matter in pharmacy, confectionary and food industries (Pruthi 1976 and purseglove et al., 1981).

It is mostly cultivated in Maharashtra which contributes about 8,200 hectares (Anonynmous, 1987) which is 7.8 % of country's total. It is mainly grown in Sangli district.

Very little physiological work has been done on turmeric. So it is necessary to study the physiology of turmeric and effect of salinity on turmeric and to find our whether the plant withstands the saline condition.

Keeping this view in mind we were selected two varieties of turmeric-sugamdhum and Erode and an attempt made to study their physiology under saline conditions.

The effect of salinity on growth, development and mineral metabolism, Nitrogen and Carbohydrate metabolism, Titratable acidity and Chlorophyll, Proline , Polyphenol and Curcumin content has been studied.

Present observation can help to know the physiology and salt tolerance mechanism in two varieties of turmeric.

Some of the significant findings of the present investigation are listed as below :-

1. The height of the plant in Sugamdhum and Erode varity of Curcuma longa decreases at all the levels of NaCl salinity. No. of leaves in both the varieties are decreased with increasing salinity level. The leaf length is also decreased. Similarly leaf breadth of both the varieties decreases with increasing NaCl salinity level. Root length is also decreased in both the varieties.

2. The biomass production is severely affected by NaCl salinity in Sugamdhum and Erode varieties of Curcuma longa. Erode variety is more affected than the Sugamdhum variety at all the levels of salinity. In both the varieties fresh weight and dry weight of the plants decreases with increasing concentration of NaCl salinity.

3. Leaf area of Sugamdhum and Erode varieties of Curcuma longa decreases with increasing NaCl salinity levels. Productivity is severely affected by increasing salinity levels. Length of the rhizome and girth of the rhizome are also reduced with increasing salinity levels.

4. In the Curcuma longa varieties - Sugamdhum and Erode total chlorophyll content of the leaves decreases with increasing salinity levels. In both the varieties chlorophyll a : b ratio decreases due to NaCl salinity. In Sugamdhum variety, except at

0.05 M level it slightly decreases. It is also found that degradation of chlorophylls in the levels of Sugamdhum variety is relatively more than in the leaves of Erode variety, when both the plants were grown under saline conditions. These results indicates that NaCl salinity probable affects photosynthetic activities in both the plants.

5. TAN (Titratable acid number) is greatly affected by various levels of NaCl salinity in both the varieties Sugamdhum and Erode TAN. In the leaves, rhizome and roots of both the varieties TAN is extremely decreased with increasing concentrations of NaCl salinity. These results suggest that inhibition of organic acid synthesis at all levels of NaCl salinity is one of the causative factors for salt sensitive nature of these two varieties.

6. In the leaves of Sugamdhum variety, polyphenols are increased at higher levels are decreased at lower levels of salinity while in Erode leaves polyphenols are decreased at all the level of salinity. In the rhizome of Sugamdhum variety the polyphenol content is decreased while in Erode rhizome it is increased at all the levels of salinity. In both the varieties polyphenols are increased in roots at all the levels of NaCl salinity except at 0.05 M salinity level where it is slightly decreases.

7. An increase in proline content due to salt stress is observed in the Curcuma longa varieties - Sugamdhum and Erode. Proline content is increased in the leaves, rhizome and roots of both the varieties due to salinity. Proline is accumulated more in the

rhizome than in the leaves and roots at all the levels of salinity. These results suggest that there is an enhancement in proline level in all plant parts due to NaCl salinity.

8. Increase and decrease in nitrogen content is observed in various plant parts of Curucma longa - varieties due to salinity. In the leaves of Sugamdhum and Erode varieties nitrogen content is increased due to salinity. It is decreased in the sugamdhum rhizome while increased in the Erode rhizome at all the levels of NaCl salinity. In the roots of Sugamdhum variety it is slightly decreased while in Erode it is increased due to NaCl salinity. Nitrogen is accumulated more in Sugamdhum variety than in the Erode variety.

9. Carbohydrate metabolism is affected by salinity in both the varieties. In the Sugamdhum leaves, reducing sugars, total sugars and starch and total carbohydrates are decreased at all the levels of salinity. In Sugamdhum rhizome, reducing sugars and total sugars are decreased at lower levels and increased at higher levels of NaCl salinity starch and total carbohydrates are decreased at all the salinity levels except at 0.05 M level where starch is slightly increased. In Sugamdhum roots, reducing sugars are increased and total sugars, starch and total carbohydrates are decreased at all the levels of NaCl salinity. In Erode leaves, reducing sugars, total sugars, starch and total carbohydrates are decreased due to NaCl salinity.

In the Erode rhizome, reducing sugar and total sugars are in

creased at all levels and increased at higher levels. But total carbohydrates are increased at lower levels and decreased at higher levels of NaCl salinity.

In the Erode roots, reducing sugars and total sugars increase and starch decreases at lower levels and increases at higher levels of salinity. But total carbohydrates are decreased at all the levels except at 0.1 M level where it increases.

10. As the level of salinity increases, sodium content increases in the leaves & roots of Sugamdhum and Erode varieties. In the Erode rhizome sodium content increases and in Sugandhum rhizome it decreases at all the levels of NaCl salinity Sodium accumulation is more in the leaves than in the rhizome and root at all the levels of salinity.

11. In Sugamdhum leaves Chloride are increased at all the levels of NaCl salinity except at 0.05M level where it is decreased. In the rhizome and roots also chlorides are increased. In the Erode variety chloride content is increased in the leaves, rhizome and roots due to NaCl salinity. The concentration of Cl^- in all parts of the plant is considerably higher than Na^+. This clearly indicates that there is differential uptake and distribution of these two elements. Further more sensitivity of Curcuma longa varieties may be due to rapid accumulation of Cl^- in the leaves.

12. Potassium content is more than control in the leaves of Sugamdhum and Erode varieties under saline conditions. In the

Erode rhizome potassium is increased while in Sugamdhum rhizome it is decreased at all the levels of salinity. In the roots of Erode it is increased and in Sugamdhum roots it is decreased due to NaCl salinity. Potassium is accumulated more in the leaves than in the rhizome and roots. Erode variety shows efficient uptake of K^+ under saline conditions.

13. There is an increase in calcium content in the leaves, rhizome and roots of both the varieties under saline conditions. Calcium content of all the plant parts was more than control under all the levels of NaCl salinity which reflects ability of the plant to uptake more calcium under saline conditions. This is regarded as salt tolerant nature of the plant (Strogonov, 1964). Eventhough Ca uptake is increased under saline conditions in both the varieties, productivity is decreased under saline conditions which can not be explained.

14. In the leaves of Sugamdhum and Erode varieties magnessium content is more than in the rhizome and roots under saline conditions. In the rhizome of both the varieties Mg^{2+} content is decreased at all the levels of NaCl salinity except at 0.2 m where it is increased. In the Erode leaves Mg^{2+} content decreases at higher levels and increases at lower levels of salinity while in Sugamdhum leaves Mg^{2+} content increases with increasing concentration of NaCl.

15. In the leaves, rhizome and roots of Sugamdhum variety phosphorus is decreased with increasing salinity levels. In the

Erode leaves, Phosphorus content is decreased at lower levels and increased at high levels of NaCl salinity. In the rhizome and roots of Erode variety it is increased at all levels of salinity. Decrease in Phosphorus content suggests failure of phosphorus uptake under saline conditions in Sugamdhum variety. Less phosphorus uptake under saline conditions is one of the reasons for decreased productivity.

16. Uptake and distribution of micro elements such as Fe^{3+}, Cu^{2+}, Zn^{2+}, Mn^{2+} are affected by NaCl by salinity. In the Sugamdhum leaves iron content is decreased at lower levels and increased at higher levels of salinity. In the Sugamdhum rhizome and roots it is increased at all the levels of NaCl salinity. In the Erode leaves, rhizome and roots of phosphorus is increased with increasing salinity levels. Phosphorus is more accumulated in the leaves than the rhizome and roots under saline conditions.

Cu^{2+} content is increased in the Erode leaves and roots at all the levels of salinity. In the Erode rhizome it is decreased due to salinity. In Sugamdhum variety Cu^{2+} content is decreased in the leaves due to salinity while it is decreased at lower levels and increased at higher levels of salinity in the rhizome. In the Sugamdhum roots Cu^{2+} content is increased.

Zn^{2+} content is decreased at lower levels and increased at higher levels of salinity in the leaves of Erode variety under NaCl salinity. In the Erode rhizome and roots Zn^{2+} content decreases as the level of salinity increases. In the Sugamdhum leaves Zn^{2+}

content decreases and in the rhizome it is decreased at lower levels and increased at higher levels of salinity and in the roots it is increased at all the levels of NaCl salinity. Mn^{2+} content is decreased in the Erode leaves due to NaCl salinity. Zn^{2+} content decreased at lower levels and increases at higher levels of salinity in the Erode rhizome. In the Erode roots Mn^{2+} content increases at higher levels of salinity. In the Erode roots Mn^{2+} content increases with increasing levels of salinity. In the Sugamdhum leaves and rhizome Mn^{2+} content is decreased at lower levels and increased at higher levels of NaCl salinity. All these results indicated that there is a deviated metabolism of Fe^{3+}, Cu^{2+}, Zn^{2+} and Mn^{2+} and it is responsible for salt sensitive nature of both the varieties.

17. Curcumin content is increased in both the varieties of Curcuma longa. In the rhizomes of Sugamdhum and Erode varieties curcumin content is highly increased at all the levels of NaCl salinity. These results suggest that eventhough the curcumin content increases in the rhizome of turmeric plant, the productivity is strictly affected due to NaCl salinity.