

## SUMMARY AND CONCLUSION

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(Capsicum annuum)  
 Chilli (Capsicum annuum) is a important crop and India is the largest producer of chillies in the world (Patil 1980). Chilli is a multipurpose crop. Green chillies are used for vegetable preparation. It is used by pharmaceutical industries. It is a good source of Vitamin 'A' and 'C'.

Capsicum annuum L belongs to the family Solanaceae. There are about 30 cultivated and more wild species <sup>and</sup> in <sup>of</sup> genus Capsicum, (Hosmani 1982). According to Heiser (1969) there are some twenty wild species of Capsicum, most of them are South American. It is native of Tropical America and West Indies.

The knowledge regarding the physiology of chilli under saline conditions is meagre. For a better yield of chillies under saline conditions it is necessary to investigate certain salt tolerant varieties to tackle the major problem. Hence it is necessary to study the salt tolerance in chillies.

Bernstein and Pearson (1954) and Luninet al. (1963) reported that Capsicum annuum L. is a salt sensitive crop. Fernandes et al. (1977) have studied influence of NaCl in the irrigation water on yield of sweet pepper (Capsicum annuum L.) and observed that yield decreases under saline conditions, Fernandez et al., (1981) have reported that chilli (Capsicum annuum var.) Lamuyo is a moderate salt tolerant. Recently Van der beek and Ltifi (1991) reported about the salt tolerance in pepper varieties (Capsicum annuum L.) in Tunisia. Besides this there is not much work done in salt tolerance of chilli.

Keeping this view in mind we have developed some new hybrid varieties of Capsicum annuum by carrying out a breeding programme

in our experimental fields. In the present investigation two most promising hybrid varieties PC1xDB and L x DB are selected (Pant c1x Deonur Baidge and Lavangi x Deonur Baidge) and an attempt is made to study their physiology under saline conditions. The response of the selected varieties of chillies to salinity is undertaken in <sup>the present</sup> our investigation.

The effect of salinity on growth, development, mineral metabolism, photosynthetic pigments, carbohydrates, polyphenols, proline <sup>and</sup> nitrogen were also ~~estimated~~ studied.

Our observations can help to know the salt tolerance mechanism in the 2 newly developed Capsicum annum hybrid varieties PC1xDB and L x DB under stress conditions. [Pant c1x Deonur Baidge and Lavangi x Deonur Baidge]

For the investigation the techniques and methods extensively used are flame photometry, spectrophotometry, atomic absorption spectrophotometry.

Some of the significant findings of the present investigation can be listed as follows:

#### Growth :

1. In the two Capsicum annum hybrid varieties PC1xDB and LxDB we have observed following results. The height of the plant in PC1xDB decreases as the concentration of NaCl salinity increases. At low levels of salinity the plant height was affected slightly while in L x DB the height of the plant increased upto moderate salinity level i.e. at lower levels of salinity (0.1 M). Further there was decrease in the plant height at higher levels of salinity. Similar results about decrease in root length at higher concentration is observed in both the

hybrid varieties, except there was increase in root length at low levels of salinity in PC1xDB hybrid varieties.

From the present observations it can clearly<sup>be</sup> indicated that the PC1xDB hybrid variety is more salt sensitive than L x DB hybrid variety which appears to be more tolerant to salt.

2. The biomass production is severely affected by salinity in both the hybrid varieties of Capsicum annuum PC1xDB and L x DB. The dry weight production in PC1xDB and L x DB in roots, stem and leaves show a decrease. As the salinity level increased the dry weight decreased except in the leaves of L x DB which showed a slight increase in dry weight at low concentrations. X

These results suggest that there is not much difference in dry weight of both the hybrid varieties under saline conditions.

3. There is a gradual decrease in the leaf area as the concentrations of NaCl increased in PC1xDB hybrid variety whereas in L x DB there is a increase in leaf area at lower levels of salinity but at higher level there is decrease in leaf area.

From these results it is clear that the leaf area of PC1xDB plants is more affected than the L x DB plants where there is stimulation in leaf area at lower levels of salinity.

### Chlorophyll

The chlorophyll content in both the hybrid varieties PC1xDB and L x DB showed a stimulation at 0.05M salinity level. It is observed that the chlorophyll content decreases as the level of salinity increases.

There is increase in chlorophyll a:b ratio in PC1xDB hybrid variety while in L x DB there is decrease in chlorophyll a:b ratio.

These results make it clear that the photosynthetic pigments are affected under saline conditions at higher levels in both the hybrid varieties of Capsicum annuum.

Carbohydrates  
Carbohydrate analysis revealed that the higher salt concentrations 0.15M and 0.2M cause decrease in carbohydrates level in leaves, stem and roots of the plant. However, there is continuous accumulation of sugars at 0.05M salinity level in both hybrid varieties PC1xDB and L x DB. It is suggested that salinity at lower levels favours carbohydrate metabolism in these plants.

#### Polyphenols

PC1xDB hybrid variety is rich in polyphenols as compared to L x DB hybrid variety.

The Polyphenol content of leaves of PC1xDB showed a increase while in L x DB there was a decrease as the level of salinity increases. The Polyphenol content in stem and roots of both the hybrid varieties is increased at lower levels while it decreased at higher levels.

It suggests that the secondary metabolism is affected more in L x DB hybrid variety than PC1xDB hybrid variety X

#### TAN.

There is decrease in the titratable acid number (TAN) as the level of salinity increases in both the Capsicum annuum hybrid

varieties i.e PC1xDB and L x DB. All the values of TAN are less than control at all the levels of NaCl salinity.

This result indicates that the Titratable acid number is severely affected under saline conditions.

Total Nitrogen There is increase in nitrogen content as the level of salinity increases in leaves, stem and roots of the 2 Capsicum annuum hybrid varieties PC1xDB and L x DB except there is a slight decrease in nitrogen <sup>at</sup> higher levels of salinity in both the hybrid varieties. <sup>There is increase in proteins also at all the levels of salinity.</sup> Our result suggest that there is increase in nitrogen content <sup>and Proteins</sup> in PC1xDB as well as L x DB hybrid varieties which is a significant finding that may help these hybrid varieties to survive under saline conditions.

#### Nitrate reductase and Nitrite reductase

All the results indicate that there is decrease in Nitrate reductase as well as nitrite reductase at higher levels of salinity. The PC1xDB hybrid variety show decreased Nitrate reductase activity at all the concentration of NaCl salinity increases whereas in LxDB variety there is slight stimulation of NR and NiR at lower levels of salinity and inhibition at higher levels of salinity. So it suggests that the LxDB hybrid variety shows a better Nitrate and Nitrite reductase activity while PC1xDB variety is affected more under saline conditions.

#### Proline

It is observed that proline content increases due to salinity in both the hybrid varieties PC1xDB and L x DB. As compared to control there was increase in proline content at all the levels of salinity. Proline accumulation was higher in leaves than in

roots and stem. Thus it appears that it is a significant feature towards salinity tolerance in both the hybrid varieties.

#### Mineral nutrition

Na<sup>+</sup> : It is clear from the observations that sodium content of both the hybrid varieties. PC1xDB and L x DB increases with increasing levels of NaCl salinity in root, stem and leaves over control. Na<sup>+</sup> was stored more in the leaves than in roots and stem, which indicates that Na<sup>+</sup> accumulation is favoured under saline conditions which may be the reason for the salt sensitive nature of the plant.

K<sup>+</sup> : There is increase in K<sup>+</sup> content in leaves at lower levels of salinity and decrease at higher levels in PC1xDB hybrid variety while in L x DB there is increase in K<sup>+</sup> content at higher levels of salinity and decrease at low levels.

There was decrease in total K<sup>+</sup> content in roots and stem of both the hybrid varieties as the level of salinity increases. From the above observation it can be said that there is lesser accumulation of K<sup>+</sup> at higher level in roots, stem and leaves in both the hybrid varieties.

Ca<sup>2+</sup> : Increase in Ca<sup>2+</sup> content is observed in both the hybrid varieties PC1xDB and L x DB at various levels of salinity.

There is increase in Ca<sup>2+</sup> content in leaves of PC1xDB hybrid variety as the level of salinity increased, while in the leaves of L x DB hybrid variety the Ca<sup>2+</sup> content decreased as the level of salinity increases.

In stem the  $\text{Ca}^{2+}$  content increases as the level of salinity increases in both hybrid varieties whereas in roots of PC1xDB there was increase in  $\text{Ca}^{2+}$  content as the level of salinity increases except at 0.2M salinity level whereas it decreased slightly, while in L x DB there is decrease in  $\text{Ca}^{2+}$  content as the level of salinity increases.

From these observation it indicates that  $\text{Ca}^{2+}$  accumulation is more in PC1xDB hybrid variety than in L x DB hybrid variety.

Mg<sup>2+</sup> :  $\text{Mg}^{2+}$  content increased at lower levels of salinity in leaves of PC1xDB hybrid variety whereas there is decrease at higher levels. In L x DB hybrid variety the leaves showed a linear increase and decrease of  $\text{Mg}^{2+}$  content at all the levels except at 0.1M level of salinity where it increases the maximum.

There is decrease in  $\text{Mg}^{2+}$  content in stem of both the hybrid varieties PC1xDB and L x DB as the level of salinity increases whereas in roots there was an increase in  $\text{Mg}^{2+}$  content of both the hybrid varieties as the concentration of salinity increases except in PC1xDB where it decreases at 0.15M salinity level.

These observations reveal that the  $\text{Mg}^{2+}$  content is accumulated more by the roots of both the varieties where it is stores and there is slow translocation of  $\text{Mg}^{2+}$  to stem and leaves which may be one of the factor for the failure of the hybrid varieties under saline conditions.

### Phosphorus

Increase in phosphorus content was observed in leaves of PC1xDB hybrid variety at lower levels of salinity and decrease at higher levels, whereas in L x DB there is increase in phosphorus content



as the level of salinity increases. There is decrease in phosphorus content in roots and stem of both the hybrid varieties PC1xDB and L x DB as the level of salinity increases.

These observations(results) indicate that there is more accumulation of  $P^{5+}$  in L x DB hybrid variety while in PC1xDB hybrid variety it was less. Thus this may be the reason for the more tolerant nature of L x DB hybrid variety under saline conditions.

### Chlorides

The chlorides increased under saline conditions in both the hybrid varieties PC1xDB and L x DB.

Chloride content of root, stem and leaves of both the varieties increased as the level of salinity increases. There is higher accumulation of chlorides in leaves of both the varieties than the roots and stem.

Higher concentrations of chlorides in the leaves may be the reason for the reduced growth and dev. of both the hybrid varieties.

### Iron

The iron content in the leaves and stem of 2 hybrid varieties of Capsicum annuum PC1xDB and L x DB is less than control at all the levels of salinity, whereas it is obvious that NaCl salinity on iron content in two hybrid varieties is different. In PC1xDB hybrid variety lower levels of salinity increases iron content in leaves over control while in L x DB there is a linear decrease in iron content as level of salinity increases.

Due to NaCl salinity, the stem of PC1xDB and L x DB hybrid varieties show decrease in iron content over control. However

this decrease in iron content in stem is not uniform with level of salinity.

Copper There is increase in  $\text{Cu}^{2+}$  content in leaves at lower levels of salinity and decrease at high level in PC1xDB hybrid variety while in L x DB hybrid variety there is increase in  $\text{Cu}^{2+}$  as the level of salinity increases.

In stem of PC1xDB hybrid variety there was increase <sup>in</sup>  $\text{Cu}^{2+}$  as the level of salinity increases while in L x DB hybrid variety increase in  $\text{Cu}^{2+}$  at lower levels and decrease at higher concentrations of NaCl salinity. In the roots there was increase in  $\text{Cu}^{2+}$  at lower levels and decrease at higher levels in PC1xDB hybrid variety while in L x DB hybrid variety  $\text{Cu}^{2+}$  content increases as the level of salinity increases. It there by indicates the stimulatory effect of NaCl salinity on copper uptake.

#### Zn<sup>2+</sup>

$\text{Zn}^{2+}$  content increases in roots stem and leaves at lower levels of salinity while at higher levels in both the hybrid varieties of Capsicum annuum PC1xDB and L x DB there was decrease in  $\text{Zn}^{2+}$  at higher levels which indicates that  $\text{Zn}^{2+}$  accumulation is higher at lower levels of salinity in both the hybrid varieties.

#### Mn<sup>2+</sup>

The average  $\text{Mn}^{2+}$  content (roots + stem + leaves) decreases in PC1xDB hybrid variety while in L x DB hybrid variety there was inhibition of  $\text{Mn}^{2+}$  at higher levels of salinity.

All these results indicated that deviated metabolism of  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$  and  $\text{Fe}^{3+}$  was responsible for salt sensitive nature of both the hybrid varieties PC1xDB and L x DB.

From the foregoing discussion it can be concluded that NaCl salinity affects the leaf area, organic metabolism, uptake, and accumulation of inorganic constituents in PC1xDB and L x DB hybrid varieties. It means both the hybrid varieties of Capsicum annuum under study do not withstand saline conditions. However, when both the hybrid varieties are compared L x DB shows less affected leaf area, chlorophyll, nitrogen metabolism, organic acid content, accumulation of Proline and uptake, translocation and accumulation of various mineral elements at various concentrations of NaCl salinity. It may be said that amongst PC1xDB and L x DB, latter is found better.