Abstract: Forty five plumbago rosea accessions collected from different parts of Kerala state were evaluated for variability in morphological and yield related characters and plumbagin content. Highly significant variation was evident for all the characters studied except leaf size indicating wide variability in the accessions. Accessions PR 25 and PR 31 appear to be promising with respect to root yield and high plumbagin content. Character association revealed significant and positive correlation of all the characters except leaf size with yield. Hence, selection of high yielding types could easily be done based on visual characters expressing more vegetative growth but with reduced leaf size.

INTRODUCTION

Plumbago rosea Linn. Commonly known as rose coloured leadwort or chethikoduveli belongs to the family plumbaginaceae. Plumbago zeylanica Linn. and plumbago auriculata Lam. are two other species reported from India. Known as Citraka in Sanskrit, the roots of plumbago rosea and plumbago zeylanica are an esteemed remedy for leucoderma and other skin diseases, in kerala and is considered to be therapeutically more active where as the with flowered Plumbago zeylanica is used in northern parts of India. The synonyms of fire like agni attributed to this drug indicate the burning action of the root, causing and blisters on the skin. This necessitates the drug to be used only after adequate cuing and purification (Sivarajan and Balachandran, 1994). Plumbago rosea is a perennial shrub found growing throughout tropical India often as a cultivated plant or as a garden escape. The root bark contains an orange yellow crystalline pigment named plumbagin, a hydroxy naphthaquinone. Plumbagin is used in the treatment of early cases of chronic skin diseases like leucoderma and baldness, as an abortifacient and in lowering blood pressure. It has got anti-rheumatic, anticancerous and antimicrobial properties. It is also used as a preservative for non alcoholic beverages. Chromosomal aberrations caused by high concentrations of plumbagin were also reported (Santhakumari et al., 1980)

The enormous uses make it a highly demanded drug in the ayurvedic system of medicine and in preparation of medicated soaps. Commercial cultivation is promoted to meet the demand. Albeit, its uses were known even form the time of charaka, no systematic efforts were taken so far for the improvement of the crop. Being not found in fruit and exclusively vegetatively propagated, any desirable variability located could be easily maintained. The present study is an effort to collect and evaluate the variability of Plumbago rosea to isolate elite types with high plumbagin content.
MATERIALS AND METHODS

The experiment was conducted during 1996-98 using 45 accessions of Plumbago rosea collected from different parts of Kerala state. The experiment was laid out in a randomized block design with two replications. Two nodded rooted cuttings were planted in mounds at a spacing of 50 cm. The accessions were categorized based on the pigmentation of aerial parts. Morphological characters like plant height, number of branches, plant spread number of leaves, leaf length and leaf breadth were recorded at 12 months after planting. Post harvest observations like root weight, shoot weight, number of roots, root length, and root girth were recorded at harvesting, 18 months after planting. The data were statistically analysed using analysis of variance technique and simple correlations were worked out following Panas and Sukhatme (1967). To estimate the plumbagin content 25 g of dried and powdered root sample was extracted with acetone followed by fractionation with ethyl acetate. The ethyl acetate fractions were column chromatographed using silica gel column and eluted with 3:1, 2:1, and 1:1 hexane:ethyl acetate and orange red band representing plumbagin was collected and evaporated to dryness. The residue was weighed and expressed as plumbagin content in per cent.

RESULTS AND DISCUSSION

The pigmentation of the aerial portions of the 45 accessions was critically observed. Red pigmentation was observed in the middle and apical leaves, petiole, mid rib, nodal region and top portion of the shoot. Maximum types (34) exhibited red pigmentation in the petiolar region followed by that in the mid (29) and apical leaves (26). Red pigmentation in the nodal region was least observed (4). Majority of the accessions had green stem (37) and only eight types had red pigmentation but they also produced red flowers typical of plumbago rosea as described by Iyer and Kolammal (1960). It is concluded that red pigmentation of the aerial parts alone cannot be taken as a criterion of grouping accessions under P. rosea but the red colour of the flowers should also be taken into account.

Data recorded on morphological and yield characters showed significant difference between 45 plumbago accessions for all the characters studied except leaf length and leaf breadth (Tables 1 & 2). Plant height of the accessions ranged from 10.00 to 75.75 cm. Plant height was maxim for PR 42. The number of branches varied from 3.0 to 43.0 and maximum value was recorded for PR 30. Plant spread ranged from 11.0 to 70.5 cm. The maximum spread was observed for PR 11. The number of leaves ranged from 12.0 to 405.0 PR 25 was having the maximum number of leaves. Leaf length and leaf breadth showed no significant variation among the different accessions. Leaf length and leaf breadth were maximum for PR 41 and PR 17 respectively.

The fleshy roots are the officinal part in Plumbago rosea and major thrust in selection was laid on root yield. Root yield of the accessions ranged from 62.5 to 937.4 g plant-1 PR 25 recorded the maximum root weight and this was statistically on par with eight other accessions PR 11, PR 9, PR 8, PR 30, PR 7, PR 13 and PR 20. Shoot weight ranged from 25.0 to 1350 g Plant-1, maximum value being recorded for PR 11. Number of roots ranged from 9.0 to 38.75 and was maximum for PR 30. The longest root was observed in PR 34 (61.5 cm). The
root girth ranged from 2.18 to 5.13 cm and was maximum for PR 22.

Plumbagin, the therapeutic principle in plumbago roots was estimated in 16 selected high yielding accessions. Plumbagin content varied from 0.34% in PR 1 to 1.0% in PR 42. Accessions PR 31 and 25 which are high yielding accessions had low plumbagin content of 0.38% in which case the curing and purification of roots to reduce the burning sensation can be eliminated. CSIR (1959) reported the content of plumbagin to the extent of about 0.9% in the roots of Plumbago rosea and that it varied according to the locality, age of the plant, condition of the soil and the season of the year.

Character association with root yield was worked out (Table 3) Among the different characters, shoot weight showed the highest positive correlation (0.96) with root weight. Characters like number of branches (0.63) number of leaves (0.61), Plant spread (0.59), plant height (0.56), root length (0.53), number of roots (0.52) and root girth (0.41) were also having significant positive correlation with root yield. This may substantiate the high values recorded for these characters by the top yielders. Size of the leaf measured in terms of leaf length and leaf breadth was negatively correlated with yield. Madhavan et al. (1996) found single leaf area to be negatively correlated with yield in rubber and stated that clones with small leaf size have high assimilatory capacity per unit area since photosynthetic apparatus gets diluted when leaf area is large. This will explain the negative relationship between leaf size and positive correlation with leaf number observed in the present study. This also signifies the fact that selection of high yielding types can be easily done based on visual characters expressing more vegetative growth but with minimum leaf size.

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| Character                | Range          | Mean  | CD (5%) |
|--------------------------|----------------|-------|---------|
| Plant height (cm)        | 10.0 - 75.75   | 44.24 | 21.01   |
| No. of leaves            | 12.0 - 405.00  | 134.93| 170.31  |
| No. of branches          | 3.0 – 43.00    | 19.00 | 22.77   |
| Plant spread (cm)        | 11.0 - 70.5    | 36.48 | 30.76   |
| Leaf length (cm)         | 7.0 - 14.0     | 10.41 | 4.24    |
| Leaf breadth             | 4.0 - 8.5      | 6.13  | 2.65    |

| Character                | Range          | Mean  | CD (5%) |
|--------------------------|----------------|-------|---------|
| Root yield (g plant -1)  | 62.5-937.5     | 340.83| 411.30  |
| Shoot weight (g plant -1)| 25.0-1350      | 441.03| 616.80  |
| No. of roots             | 9.0 - 58.75    | 30.44 | 25.52   |
| Character                | Correlation of coefficient |
|-------------------------|----------------------------|
| Plant height (cm)       | 0.56**                     |
| No.of leaves            | 0.61**                     |
| No.of branches          | 0.63**                     |
| Plant spread (cm)       | 0.59**                     |
| Leaf length (cm)        | -0.05                      |
| Leaf breadth            | -0.09                      |
| Shoot weight (g plant -1)| 0.96**                    |
| No. of roots            | 0.52**                     |
| Root length (cm)        | 0.53**                     |
| Root girth (cm)         | 0.41**                     |

**Significant at 1% level

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