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## *Loranthus ligustrinus* – A causal factor for *Khasi* mandarin (*Citrus reticulata* Balnco.) decline in Arunachal Pradesh

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**ABSTRACT :** A survey was conducted in the East Siang district of Arunachal Pradesh, India during the period 2013-2014 for the identification of *Loranthus* species infesting the *Khasi* mandarin orchards in this region. Study on its habit, mode of seed dispersion, host plants, its life cycle and its management in different sites of East Siang district was conducted. It is identified that the *Loranthus* species as *Helixanthera ligustrina* (*Loranthus ligustrinus*) which flowers during the month of April - May and the seed dispersal is mainly done by two birds viz., Plain flowerpecker and Fire breasted flowerpecker in June-July period. The study also revealed that it is one of the main problems causing *Khasi* mandarin decline by lowering down its yield and productivity and finally killed the plant after 4-5 years of infestation. This parasitic weed is slowly spreading to other nearby orchards and needs emergency attention for the citrus grower.

**KEY WORDS :** *Helixanthera ligustrina*, *Khasi* mandarin, Host plants, Flowerpecker

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Citrus is an important fruit crop of the people of Arunachal Pradesh, a hill state in the north east part of India. The North Eastern Himalayan (NEH) region is endowed with favourable agro-climatic conditions for the growth of different citrus species and considered as the centre of origin of several citrus species (Gogoi *et al.*, 2004). Among the different citrus species, *Khasi* mandarin is the premier fruit crop grown in all subtropical belt of Arunachal Pradesh. In the North East region of India (Assam, Arunachal Pradesh, Manipur, Tripura and Meghalaya), a type of mandarin

called *Khasi* mandarin occupied an important place among the other varieties of mandarin orange. It is loose-skinned oranges, belonging to species *Citrus reticulata* Blanco are commonly designated as mandarins. Although *Khasi* mandarins are popularly grown in N-E states, there are certain important growing belt viz., in Assam (Tinsukia, NC Hills, Karbi Anglong), Tripura (Jampui hill), Meghalaya (East and West Khasi, Ri-Bhoi, Garo Hills, Jaintia Hills), Manipur (Tamenglong) and Arunachal Pradesh (East Siang and West Siang) are the main producing zone of this fruit crop. According to different

region in Manipur, Mizoram and Arunachal Pradesh, it is locally called as *Komla*, in Tripura as *Kamla* and Meghalaya known as *Soh*. Cultivation of *Khasi* mandarin is a source of livelihood to many people in the rural areas by the Adi tribe of Arunachal Pradesh. Very poor productivity in this region is mainly attributed to unscientific cultivation of crop, injudiciously use of land resources, lacking of quality planting materials, citrus decline, citrus stem borer and loranthus stem parasite weed (Hazarika and Singh, 2013). The *Khasi* mandarin growing belt of Arunachal Pradesh is heavily infested with loranthus weed especially in the Renging village which is under the East Siang district which is considered for its best quality of its fruit. Keeping in this view, the present survey was carried out to identify the *Loranthus* species found in East Siang region, its biology of life cycle and its dispersion factor to the host plant so that proper steps can be taken up for effective control of this probelematic weed.

## RESEARCH METHODS

The study was carried out at five important citrus growing regions of East Siang district viz., Bodak village, Renging village, Panging village, Oyan village and Boying village (Fig. A). These villages are inhabited by the 'Adi' tribal community. The average altitude of the sites are about 155 m MSL and represent a typical subtropical zone with short cool, dry and windy winter, a hot summer and a heavy monsoon season. Study site represents a subtropical, hot and humid climate; in the lower valleys, summer temperatures in June, July, and August typically rise to about 30°C, while winter temperatures in December, January and February usually drops to 13°C. Annual rainfall in the state averages about 130 inches (3,300 mm), falling mostly between April and September in the centre of the state. During the survey, the weeds is collected for its taxomomical analysis and its seed disperson were are evaluated for studying it weed biology so that it control method can be adopted.

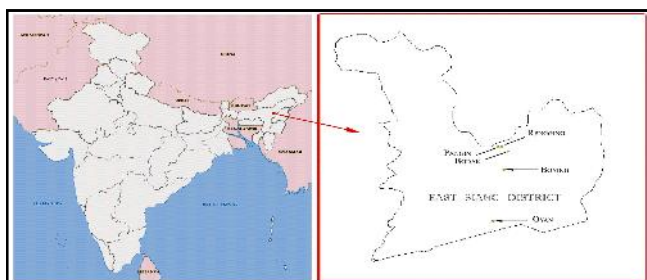
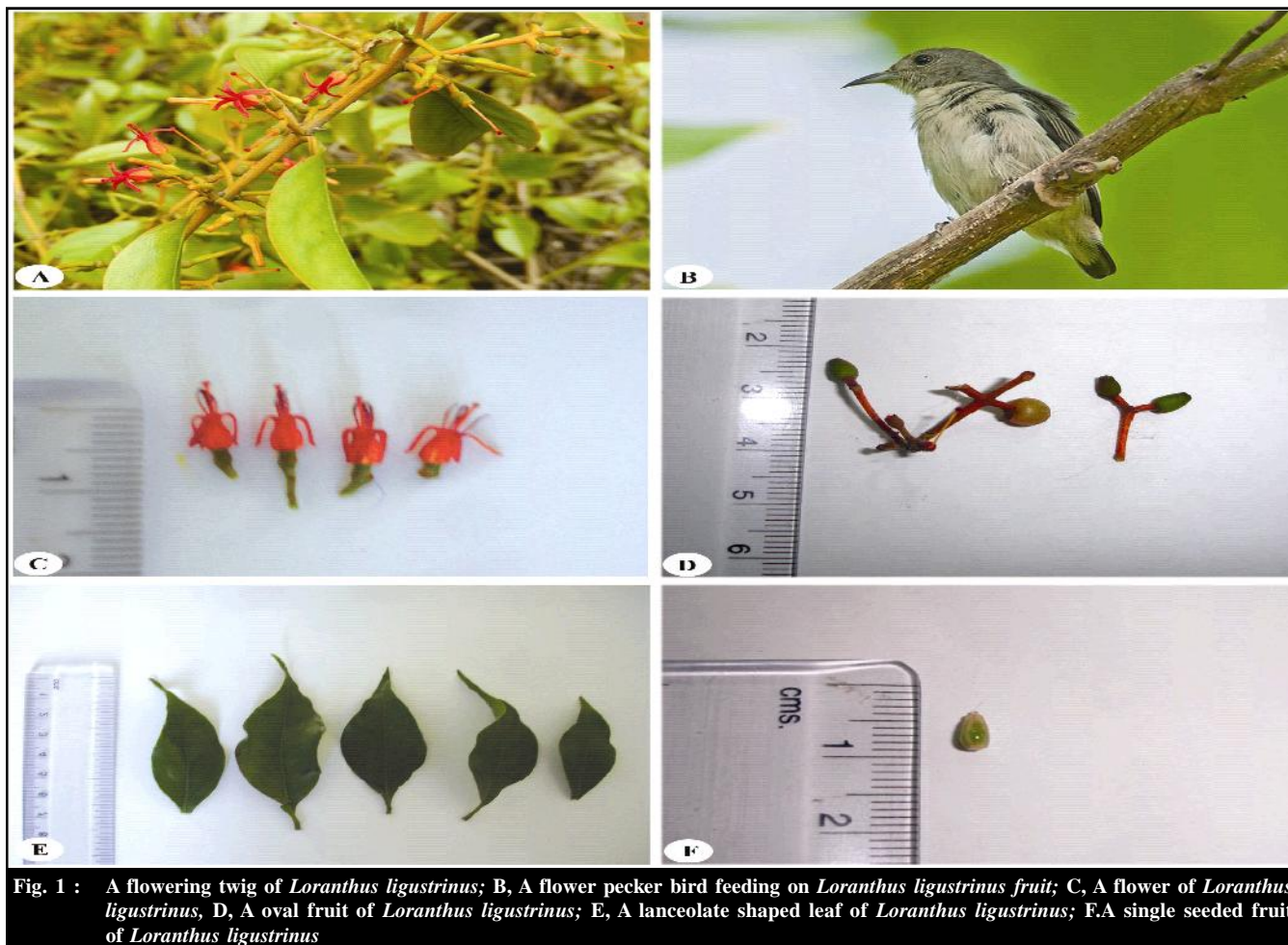


Fig. A : Site of study (East Siang District, Arunachal Pradesh, India)

## RESEARCH FINDINGS AND DISCUSSION

During the investigation, it was observed that the *Loranthus* species found infesting *Khasi* mandarin orchards in East Siang is *Helixanthera ligustrina* syn. *Loranthus ligustrinus*. Taxonomical identification of this species was done by the scientists of Botanical survey of India, Regional Centre, Itanagar, Arunachal Pradesh. Similar report was also made describing its distribution in Arunachal Pradesh for the host plant of *Ficus* species however, there are no reports of *Loranthus* species infesting the *Khasi* mandarin orchards in Arunachal Pradesh (Bora, 2003). It is a semi-stem plant parasite having thick leathery leaves arranged oppositely, elliptic-ovate or elliptic lanceolate nearly acute or obtuse or spear shape. The leaves are light green in colour as compared to host plant since chlorophyll content of the leaves after the extraction using 80 per cent acetone was found to be 48.28 mg/g (Sadasivam and Manickam, 1997). Flowering starts by March month and continues till the third week of May month. Flowers are hermaphrodite and reddish in colour with four petals, four stamens and one pistil, short racemes and borne in cluster with two flowers in opposite side. The tiny flowers are borne in cluster of 7-23 flowers/cluster in the leaf axillaries. The corolla curves downward exposing only the stamens and pistil after anthesis. Pistils are yellow in colour but stigma is red in colour, slender in nature which remained intake even after anther dehiscence. Fruiting starts by the end of April month and usually it gets ripened by June -July months. Unripe fruit are green in colour and turned to yellow when it matures. Fruits are small berry type with single seeded /fruit (Fig. 1). The seed is very small in size (Table 1). Similar report was also made describing its distribution in Arunachal Pradesh, Assam, Tripura, Tropical Himalayas and Bangladesh (Bora, 2003).

The north-eastern region of India being the natural home of citrus, a wide genetic diversity of citrus germplasm found in this region (Bose *et al.*, 2001). There are many reports of loranthus infestation in many citrus orchards in the world. *Loranthus yadariki* for *Citrus aurantium* (lime) and *Citrus grandis* (pomelo) are reported (Harinder *et al.*, 2006); *Loranthus micranthus* for citrus species (Omeje *et al.*, 2014). However, in our study it was observed that infestation is found in some particular citrus species viz., in sour orange, *Khasi* mandarin (Mandarin variety) and Valencia and Mosambi (Sweet orange variety), grape fruit (*Citrus paradise*), pomelo (*Citrus grandis*). Interestingly, it was also



**Fig. 1 :** A flowering twig of *Loranthus ligustrinus*; B, A flower pecker bird feeding on *Loranthus ligustrinus* fruit; C, A flower of *Loranthus ligustrinus*, D, A oval fruit of *Loranthus ligustrinus*; E, A lanceolate shaped leaf of *Loranthus ligustrinus*; F, A single seeded fruit of *Loranthus ligustrinus*

observed that the citrus species like lime (*Citrus aurantium*), wild orange (*Citrus indica*) and lemon (*Citrus limonia*) growing near the infested orchards were not affected by this weed. Other than the citrus species infestation of this weed was also observed on some non-citrus species plants like *Ficus hispida* (Hairy fig), *Albizia lucida* (Potka seris), *Morus laevigata* (Mulberry), *Melia azadirachta* (Indian lilac), *Duabanga grandiflora* (Duabanga), *Gymnocladus burmanicus* (Coffee tree) etc.

The *Loranthus* species are widely recognized as damaging agents to the host plants including citrus species and intense multiple infection may be quite damaging or even fatal to the host. *Loranthus* infested on the crown of the host causes its ultimately death (Docters, 1954). In East Siang district, it is locally called 'Tache-grenik' or 'Coltak' by the local people; a name given to the bird which is responsible for dispersal of this weed. It is a semi-parasitic plant that derives some or all of its

nutritional requirements from the host plants through a special organ, 'haustoria' which penetrate the conductive system of their host and extract water and nutrient from them. *Loranthus* once it established, steals minerals and water, as well as block sunlight by covering the encroached place (Baloch and Ghani, 1980). This parasitic weed is found in a dense cluster easily spottable on the branches of trees, bearing smooth broad, leathery, greenish yellowish leaves with tubular red flowers. The seeds are disseminated by birds from one plant to another after feeding on the fruits. Seeds dropped along with the faeces on young branches of the host plant germinate and penetrate the tissue. The parasitic stem creeps along the branches of host plant and attached itself with a peg like-haustoria or knot like structures (Fig. 1). Such structures were observed at the point of attachment as a bulged stem or knotty outgrowths on the stem of the host. The sharing of the nutrient and water along with the parasitic plant renders, the host plant lesser growth

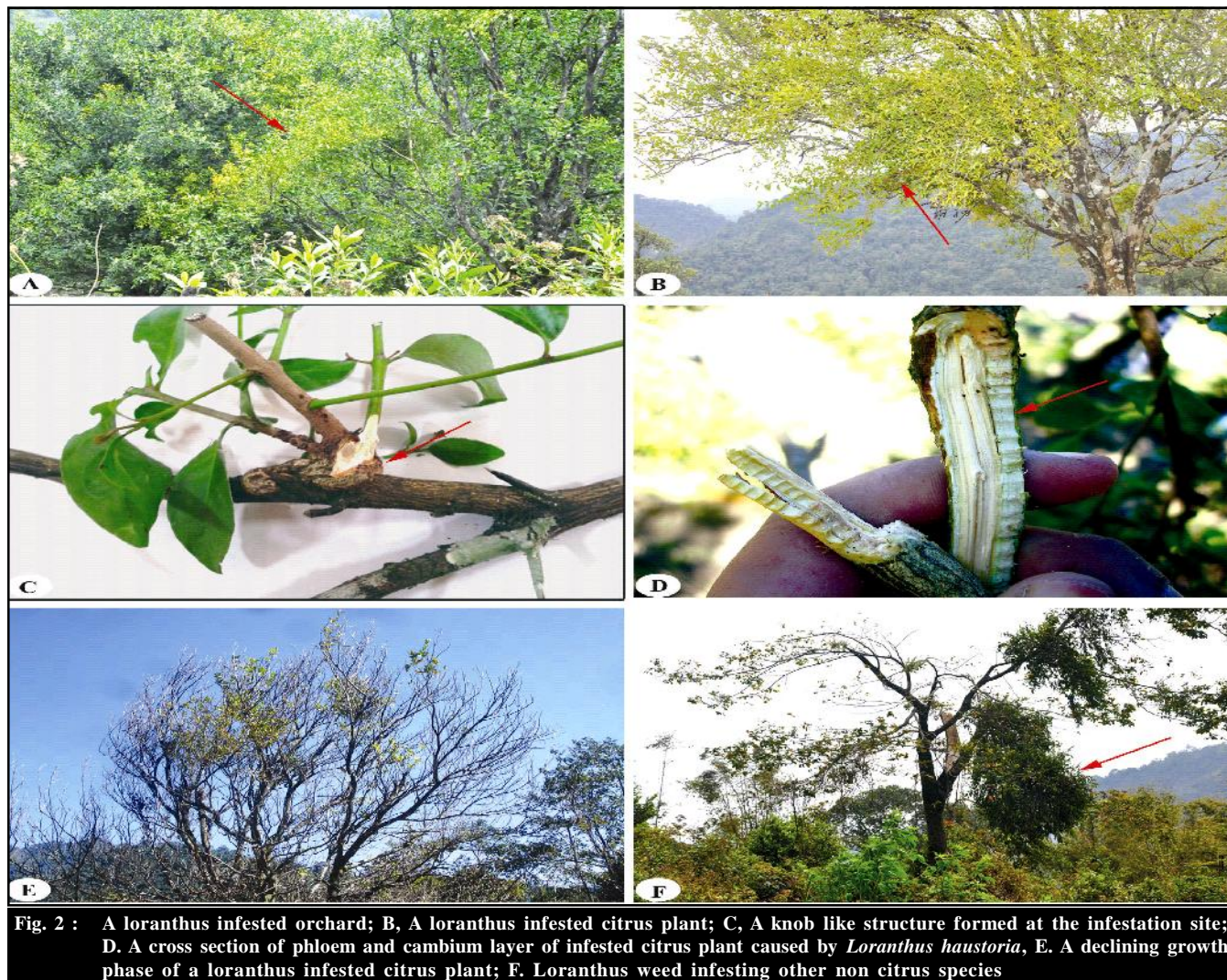


Fig. 2 : A loranthus infested orchard; B, A loranthus infested citrus plant; C, A knob like structure formed at the infestation site; D, A cross section of phloem and cambium layer of infested citrus plant caused by *Loranthus haustoria*, E, A declining growth phase of a loranthus infested citrus plant; F, Loranthus weed infesting other non citrus species

eventually became unproductive. Once, loranthus infestation starts, the citrus plant show decline in growth and fruit yield and after 4-5 years, the plant show decline symptoms and finally dies (Fig. 2).

In our study it was observed that the main dispersing agents of this weed were two small birds namely, Plain flowerpecker (*Dicaeum concolor*) and Fire-breasted flowerpecker (*Dicaeum ignipectus*). Similarly it was also reported by Singh *et al.* (2013). In Ghana, loranthus in citrus orchard is spread both by birds and pruning knife from the infected tree to the healthy trees (Asare *et al.*, 2013). The seeds of this parasitic weed loranthus get stuck to the beaks of birds feeding upon its fruits and then transferred to the fresh tree branches (Gupta, 2010). In Australia birds of the genus *Dicaeum* have tongues that are specifically modified to sip nectar from mistletoe

flowers and digestive canals that pass the viscid seeds in a remarkably short period of time (Watson, 2001).

*Euzophero desephestialis*, *Demarchu spubipennis*, *Anarsia sagmatica*, and *Ceratitella asiatica* insects are found to be specific and potentially effective biocontrol agents for the loranthus weed (Mushtaque and Baloch, 1979). Deepu and Habeeburrahman (2013) reported 1 per cent of 2,4-D around the pest trunk with cotton cloth strip soaked in herbicide, at the point of attachment to the host, after removing the outer skin to about 0.5 cm length. In India *Loranthus pulverulentus* was successfully controlled by injection of copper sulphate ( $\text{CuSO}_4$ ) and feroxone into the host plant (Kadambi, 1954). Under East Siang district, it is mainly control by cutting down the affected branches of host plants before the maturity of fruit (June-

July month) and applying with bordeaux paste to prevent the infection in the wounded part of the plant (Hazarika and Singh, 2013). In the heavily loranthus infested tree, there is high incidence of ants (*Crematogaster* spp.) at the citrus – mistletoe union and which make it difficult for pruning by climbing the tree. So, using standard tree pruner is the best way to control this noxious weed from the beginning of infestation. Similar opinion has been recorded (Asare *et al.*, 2013).

### Conclusion :

In summary, it is concluded the destructive effect of this weed is increasing at an alarming rate in these regions. The infestation of loranthus (*Helixanthera ligustrina*) weed in the orchard belt of East Siang and West Siang district of Arunachal Pradesh is increasing day by day affecting many citrus farmers. The economy of many farmers is mainly depended on this citrus crop which is in the declining phase. That day will not be far where all the citrus orchards of these regions will be destroyed in this state if proper steps and control measures are not taken up timely. Therefore, effective awareness programme among the farmers is necessary in order to provide the knowledge about the weed biology and mode of dispersion and method of controlling of this weed.

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