



E-ISSN: 2278-4136

P-ISSN: 2349-8234

JPP 2019; 8(2): 2124-2127

Received: 21-01-2019

Accepted: 25-02-2019

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## Garari (*Cleistanthus collinus*): Multipurpose hedge crop for organic farming through agroforestry intervention

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**Abstract**

Organic farming is gaining importance with time in farming communities since the effects of synthetic pesticides are turning out to be harmful to health. Garari is a small, deciduous and fast-growing tree having short rotation (4-5 yrs.) with good coppicing ability and it can thrive in infertile soil. Its bark, leaves and fruits contain phytochemical compounds like Lactone glycoside which are having pesticidal property making it a potent bio-pesticide, alternative to synthetic pesticides. Looking to the potential utilization of the Garari, the present paper is exploring the potential of Garari (*Cleistanthus collinus*) a multipurpose tree suitable for organic farming. The information has been collected from the secondary sources and the review of research has been done. It is learnt from the review of research that the spraying of extracts from different plant parts is more effective than spreading the bulky mass of leaves in paddy fields. Its extract is effective against rice caseworm, hoppers, leaf rollers, cotton bollworm, *spodoptera etc.* It is revealed from the study that the Garari (*Cleistanthus collinus*) can be also used as timber, fuel wood and wasteland reclamation agent. Wood of garadi is tough, durable and resistant to termite attack, decay and marine borer. Larvicides and wood preservatives are also prepared from Garari (*Cleistanthus collinus*). It will highly suitable species for marine uses. Easy boundary plantation and management makes it convenient to farmers. Despite having all these useful characters it is not yet exploited fully in agroforestry for organic farming. Its use is ecofriendly, addressing economic, ecological, and social aspect leading to sustainability. Though organic farming is considered as costly approach, agroforestry can reduce the cost without hampering efficiency and effectiveness, so further research needed in this direction.

**Keywords:** garari (*Cleistanthus collinus*), agroforestry, organic farming, bio-pesticide, rice caseworm

**Introduction**

Due to toxicity of the synthetic insecticides, emerging environmental issues, have brought about increasing attention to safe, eco-friendly and yet effective alternative methods of control. Natural substances of plant origin constitute an important part of these alternative approaches. India with huge natural resources of herbs and other medicinal plants, the possibility of developing herbal pesticides could be a solution to control pest related problems.

Insect and disease killers derived from plant extracts are called *botanical pesticides* or *botanicals*. They are easily decomposed by a variety of microbes common in most soils. Botanical pesticides are good alternatives to chemical pesticides. Botanical pesticides are eco-friendly, economic, target-specific and biodegradable. These are safer to the user and the environment because they break down into harmless compounds within hours or days in the presence of sunlight.

*Cleistanthus collinus* (Garari) is a toxic small deciduous tree belonging to the family Euphorbiaceae and it grows in the dry forests of southern and central parts of India. It is commonly called as "Garari" in Hindi, "Oduvan" in Tamil, "Vadise" in Telugu and "Nilapala" in Malayalam. Many parts of the plant are reported as toxic and the aqueous extract of crushed leaves of this plant are used as cattle and fish poisons, abortifacient, suicidal and homicidal agents. The alcoholic extract of the leaves, roots and fruits of *C. collinus* are used to treat gastrointestinal disorders and it possesses anticancer activity (Chhalliyil *et al.*, 1996) [4]. Further, the plant also possesses insecticidal properties against the red flour beetle, *Tribolium castaneum* and is used as insecticide in the rice field. (Harwansh *et al.*, 2010) [9] The leaf extracts of this plant exhibited insecticidal properties such as antifeedant and insect growth regulatory against the larvae of *Spodoptera litura*. It contains cleistanthus A and Cleistanthus B, diphyllin glycosides were reported to exhibit cytotoxicity on several cancer cell lines. (Chhalliyil *et al.*, 1996) [4].

Agroforestry is introduction of perennial shrub or tree component in agriculture. Garari

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(*Cleistanthus collinus*) meets the all suitability of trees as required for agroforestry. Garari (*Cleistanthus collinus*) is fast growing multipurpose tree having high coppicing ability which facilitates its cultivation and easy management on boundary at close spacing. It gives lump of foliage after every cut. It also serves as fuel wood, timber and live fencing. Its wood have high calorific value 4595 Kcal/kg which is comparable to other fuel wood. Its timber is resistant to insect, marine borer and termites. Therefore, advocating and promoting the use of naturally durable Garari (*Cleistanthus collinus*) wood should be of prime importance not only to the timber industry but also for environmental protection. Looking to the potential utilization of the Garari (*Cleistanthus collinus*), the present paper is exploring the potential of Garari (*Cleistanthus collinus*) a multipurpose tree suitable for organic farming through agroforestry intervention.

## Methodology

The information has been collected from the secondary sources and the review of research has been done, various published research papers, thesis, abstracts and reviews were searched from Google scholars, Research Gate, PUBMED, Krishikosh and Shodhganga. Also authors and other specialists, farmer were contacted to clarify certain aspects and traditional information. Review of research work has been done and lethal dose, LD<sub>50</sub> and LD<sub>100</sub> were compiled into table from different papers for particular time duration and for particular pest on crops.

## Result and Discussion

The plant parts of Garari (*Cleistanthus collinus*) and their use is given in brief in (Table 1).

**Table 1:** Plant parts of Garari (*Cleistanthus collinus*) and their uses

Sr. No.	Plant parts	Contents	Semi processed product	Uses	Reference
1.	Dried Leaves	Lactone glycoside the active ingredient	Powder of dried leaves	Bio-pesticide	Raut <i>et al.</i> , 2010 [17]
2	Fresh leaves	-	Fresh leaves juice	Bio-insecticide against red flour beetle	Harwansh <i>et al.</i> , 2010 [9]
3.	Leaves, roots and fruits	anticancer activity	aqueous extract of crushed leaves	treat gastrointestinal disorders	Chhalliyil <i>et al.</i> , 1996 [4]
4.	Leaves, twigs			Green Manuring	Raut <i>et al.</i> , 2010 [17]
5	leaves	cleistanthin A	Leaf extract	Insect repellent	Raut <i>et al.</i> , 2010 [17]
6	leaves			rodenticide	

*Cleistanthus collinus* commonly called as Garari is traditionally used as fish poison and to control various diseases in rice field. Recently its anticancerous properties also discovered now days most of farmers use extract to control various diseases in rice and other crops.

It is observed that each part of the Garari (*Cleistanthus collinus*) plant is useful, dried leaves powder can be used as bio pesticides with some processing (Raut *et al.*, 2010) [17], whereas fresh leaves juice can be used against red flour beetle (Harwansh *et al.*, 2010) [9]. The extract of leaves, roots and fruits can be used for treatment of gastrointestinal disorders and also having anti cancerous activity, while leaves and twigs can be used for green manuring, insect repellent and rodenticide (Harwansh *et al.*, 2010, Raut *et al.*, 2010) [9, 17].

Decoction of the leaves is used for suicidal purpose in many parts of Southern India Traditionally the farmers of Chhattisgarh and Maharashtra used this plant leaves solution as an effective pesticide or insecticide (Ahirwar *et al.*, 2011) [1], when insects attack on rice crop. Many farmer spread crude leaves in rice field to control rice case worm but this method is not effective than application of decoction or aqueous extracts (Ahirwar *et al.*, 2011) [1].

### Aqueous extract (decoction) by local method

The selected plant materials (leaves) were shade dried and crushed to make into a powder. 100 g of the crushed material was boiled with 1 litre of water (10%). Then it was cooled and kept closed with cover plate. On next day, again it was boiled for 15-20 minutes, cooled and kept closed. The decoction so obtained was filter dusting a fine cloth. The obtained decoction was used as a stock solution (10% solution). The stock solution was used for preparation of different concentrations. (Panigrahi *et al.*, 2013) [12]

### Pesticidal properties

Lactone glycoside, the active ingredient present in

*Cleistanthus collinus* Possessing variety of anti-insect properties like antifeedant, insecticidal and insect growth regulatory activity was bio assayed on third, fourth and fifth instar *Spodoptera litura*. Many findings revealed the potential of the active ingredient lactone glycoside and the possibility of developing it into an effective plant based insecticide. Many parts of the plant are reported as toxic and the aqueous extract of crushed leaves of this plant are used as pesticides, insecticides and acaricides.

Farmers also use its extract to control ticks in animal production system. Investigation done by Giri, 2013 revealed that aqueous and alcoholic extract of *Cleistanthus collinus* could achieve 100% mortality of ticks after different hour of application of extract. Aqueous (8%) and alcohol (6%) extract of *Cleistanthus collinus* could achieve 98.63 and 97.36 % tick mortality in 5 and 7 days, respectively. Hence, both aqueous and alcoholic extract can be used as acaricides. It is observed that aqueous extraction of *Cleistanthus collinus* at rate of 400g/leave powder with 5 litres of water has highest potency than alcoholic extract of *Cleistanthus collinus*. Aqueous extract of *Cleistanthus collinus* has almost equal potency as compared to chemical acaricides, (amitraz) in knocking down the ticks from the animal body. As the aqueous extraction had better result and was easy to prepare, its social acceptability would gain acceleration for its use as herbal acaricides and could be safe for environment and for human life.

Fresh leaf juice, decoction and alcoholic extract of *Cleistanthus collinus* in different concentrations were studied for their insecticidal activity. Leaf decoction (50%) was found to be most effective, where single application was able to kill all the insects within 12 hr. and control the insects till harvesting especially rice caseworm (*Nymphula depunctalis*) a common paddy pest of Chhattisgarh region of India. Study of Ahirwar, 2011 at Chhattisgarh reveals that leaf extract of Garari (*Cleistanthus collinus*) is an effective natural insecticidal agent. Rice field was treated with different

concentration of leaf juice, decoction and alcoholic extract and 50% concentration of all the extracts was found effective. The harvested rice grains were healthy and sound and rice yield was higher in crops treated with extracts as compared to control and benzene hexachloride treated. Treatment with fresh leaf juice, 50% dilution of this juice was most effective and kill all the insects specially rice caseworm (*Nymphula depunctalis*). Slight brown stain was produced on the surface of leaves while growth of crop was normal. Application of leaf decoction, 50% dilution was found most effective and it produced effect within 12 hour and did not damage the crop

and promoted its growth. Alcoholic extract treatment and its 50% dilution was found moderately effective and developed brown stains on leaves. The growth of crop was affected adversely and even some plants died. Lethal doses and concentration of various extract of Garari (*Cleistanthus collinus*) is presented in table based on studies by various researchers. Studies by various researchers found that Garari (*Cleistanthus collinus*) having low toxicity than chemical pesticides but also effective against many pests thus promoting organic farming (Table 2).

**Table 2:** Lethal doses of extracts of *C. Collinus* on different pest

Application	Pest or crops	LC <sub>50</sub> /LD <sub>50</sub>	LC <sub>100</sub> /LD <sub>100</sub>	Sources
Aqueous extract of <i>C. Collinus</i>	<i>B. microplus</i> (ticks)	7% at 1 hr. 6% at 5 hrs.	8% at 1 hr.	Panigrahi <i>et al.</i> , 2014 [12]
Alcoholic extract of <i>C. collinus</i>	<i>B. microplus</i> (ticks)	4% at 2 hrs.	6% at 1 hr.	Panigrahi <i>et al.</i> , 2014 [12]
Lactone glycoside	5th instar of <i>S. lutura</i>	2.5 ppm	10 ppm	Selvamuthukumaran <i>et al.</i> , 2010 [21]
Aqueous leaf Extract of <i>C. Collinus</i>	Mosquitoes larvae	500 mg/L	NA	Arivoli <i>et al.</i> , 2014 [18]
Extract of <i>C. Collinus</i>	Mouse	12.5±1.15 mg/kg	15.5 mg/kg	Nitu, 2015 [10]
Extract of <i>C. Collinus</i>	Rat	10.5±1.23 mg/kg	13.00 mg/ kg	Nitu, 2015 [10]
Extract of <i>C. Collinus</i>	Rabbit	13.5± 1 mg/kg	17.00 mg/kg	Nitu, 2015 [10]

The table 2 revealed that application of Aqueous extract of *C. Collinus* can with LC<sub>50</sub>/LD<sub>50</sub> 7% for 1 hr. or 6% at 5 hrs and 8% at 1 hr (LC<sub>100</sub>/LD<sub>100</sub>) can be used against *B. microplus* (ticks), whereas Alcoholic extract of *C. collinus* with 4% at 2 hrs (LC<sub>50</sub>/LD<sub>50</sub>) and 6% at 1 hr (LC<sub>100</sub>/LD<sub>100</sub>) can be used against *B. microplus* (ticks) (panigrahi *et al.*, 2014) [12]. Selvamuthukumaran *et al.*, (2010) [21] reported that 5<sup>th</sup> instar of *S. Lutura* with 2.5 ppm (LC<sub>50</sub>/LD<sub>50</sub>) and 10 ppm (LC<sub>100</sub>/LD<sub>100</sub>) can be used for Lactone glycoside. The study also shows that 500 mg/L (LC<sub>50</sub>/LD<sub>50</sub>) of Aqueous leaf Extract of *C. Collinus* can be used for control of Mosquitoes larvae (Arivoli *et al.*, 2014) [18]. The study conducted by Nitu, 2015 [10] revealed that the Extract of *C. Collinus* can be used to control Mouse {12.5±1.15 mg/kg (LC<sub>50</sub>/LD<sub>50</sub>) and 15.5 mg/kg (LC<sub>100</sub>/LD<sub>100</sub>), Rat {10.5±1.23 mg/kg (LC<sub>50</sub>/LD<sub>50</sub>) and 13.00 mg/ kg (LC<sub>100</sub>/LD<sub>100</sub>)} and Rabbit (13.5± 1 mg/kg (LC<sub>50</sub>/LD<sub>50</sub>) and 17.00 mg/kg (LC<sub>100</sub>/LD<sub>100</sub>)} respectively. Further research in this area has the potential to extend the usefulness of Garari (*Cleistanthus collinus*) as a botanical pesticides in crop production systems. Recent advances in the development of botanical pesticides offer opportunities for the worldwide exploitation of botanicals for as replacements for more hazardous and environmentally unacceptable chemical insecticides thus helping in low cost organic farming.

## Conclusion

Despite having all these useful characters it is not yet exploited fully in agroforestry for organic farming. Its use is ecofriendly, addressing economic, ecological, and social aspect leading to sustainability. Though organic farming is considered as costly approach, agroforestry can reduce the cost without hampering efficiency and effectiveness. Further studies and field trials on effects on crops and interaction with crops are necessary to recommend an effective bio-pesticides tree in agroforestry.

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