

RESEARCH ARTICLE

Morphological characterization and ethnomedicinal importance of an underutilized legume plant *Canavalia gladiata* (Jacq.) D.C. from north eastern Terai region of Uttar Pradesh.

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Abstract: *Canavalia gladiata* is an underutilized legume plant with various ethnomedicinal and therapeutic properties. The present paper deals with morphological characterization and ethnobiology of *C. gladiata* which reveals the utilization of plant and its relationship with its environment. The phenological events such as germination, vegetative growth, floral bud initiation and fruiting were carefully recorded. The species is rich in different types of secondary metabolites and bioactive metabolites reflecting its efficacy in adaptive and defensive strategies. The finding of present work is likely to provide a database for sustainable cultivation of plant and to bioprospect as food, fooder, medicine and an industrial crop.

Keywords: *Canavalia gladiata*, Ethnobiology, Ethnomedicine, Phenology, Secondary metabolites.

Introduction

Canavalia gladiata (Jacq.) D.C. is a species of family Fabaceae and subfamily Papilionoideae (Pandey 2018). Troszynska *et al.* (2002) reported that regular consumption of legume reduces the risk of cardiovascular diseases, coronary heart diseases and also helps in prevention of cancer, type II diabetes, obesity and osteoporosis. Primarily the seeds of sword bean was mostly consumed by some tribal groups of India but now it is also been utilized by urban people as a vegetable (Rajaram and Janardhanan 1992, Siddhuraju and Becker 2001, Jaardhanan *et al.* 2003). Investigation of phytochemicals in *C. gladiata* have indicated the presence of alkaloids, tannins, flavonoids, cardiac glycosides and reducing sugars (Pasumarthi *et al.* 2011). *In vitro* evaluation of phytochemical constituents showed the biological activity viz., antioxidant, antimicrobial, anti-inflammatory, anti-diabetic activities etc. Siddhuraju and Becker (2001) published that the sword bean has profitable characters like high biomass production, drought

resistant, pest and disease resistant, high fertility index and high seed production i.e. 800-1000 kg seeds per hectare of crop land. The protein content in the mature seed of sword bean is comparatively higher than that in any other legumes. However, other than protein, the starch, fat and mineral profile also indicated sword bean to be good supplement to cereal based diet (Ekanayake 1999). While studying the distribution of the species, the authors felt the necessity to undertake the morphological characterization and its ethnobotanical importance. The findings of the present work are likely to prove useful in cultivation of the species for its sustainable uses such as food, fooder and medicine to develop plant as industrial crop.

Materials and methods

The plant and plant parts were collected from the Maharajganj district of Uttar Pradesh and identified by using standard taxonomic methods, and finally processed for herbarium preservation. The mature seed pods were collected from plant and those seeds were grown and planted in the Botanical Garden of DDU Gorakhpur University,

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Gorakhpur. Certain characteristics of plant species including its ethnobotany were recorded during field study and rest from literature survey.

Results and discussion

Various findings having applicability with morphology and ethnobiology of *Canavalia gladiata* (Jacq.)D.C. are presented as follows:

Nomenclature

Botanical name: *Canavalia gladiata* (Jacq.)D.C. Prodr. 2: 404. 1825; Manilal & Sivar., Fl. Calicut 76. 1982; Mohanan, Fl. Quilon Dist. 140. 1984; Ansari, Fl. Kasaragod Div. 118. 1985; Antony, Syst. Stud. Fl. Kottayam Dist. 119. 1989; Vajr., Fl. Palghat Dist. 148. 1990; Sanjappa, Legumes Ind. 107. 1992; M. Mohanan & Henry, Fl. Thiruvanthapuram 136. 1994; Sudhir & Agarwal, Journ. Econ. Tax. Bot. 18: 276. 1994.

Systematic position

Kingdom	Plantae
Division	Tracheophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	<i>Canavalia</i>
Species	<i>gladiata</i>
(Jacq.)D.C.	

Geographical distribution

C. gladiata is native to Asia and distributed throughout the world viz., Africa, Asia, Australia, Latin America, North America and South America. Sword bean is cultivated all throughout India in very limited scale where as tribal community of Indian states like Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya in North East, the Kadar, Mannan and Muthuvan tribal state of Kerala, South India respectively are reported to be readily cultivating and utilizing this plant species.

Habit and Habitat

C. gladiata is a perennial climber but oftentimes cultivated as an annual plant (Purseglove 1986). It is grown near the high structured houses, trees and on wall (Moteetee,

2016; India Biodiversity Portal, 2019, PROTA, 2019).

Plant Morphology

Plants of *C. gladiata* are fast growing vine with winding stem (Knoblauch *et al.* 2001). The stem height varies from 4.5 to 10 m. Leaves are trifoliate. Leaflets are large pubescent. The sword bean show a peculiar inflorescence being inverted, the standard being at bottom and keel on the top. The size of flowers ranges from 3.5 to 4 cm long white or pinkish in colour (Herklots, 1972).

Carpology

Fruit- The fruit of *C. gladiata* is simple dry fruit called pod. The mature pod is large and its size varies from 25-30 cm in length and shape is sword like hence also called as sword bean. Each pod contains 10 seeds.

Seed- The seed of *C. gladiata* is elliptical in shape and measure around 3 cm. The mature seed is divided into three parts: the seed coat, the cotyledon and the embryo. The external structures of the seed are the testa (i.e., seed coat), hilum, micropyle, and raphe.

Phenology

Various phenological events in both vegetative and reproductive phase were recorded throughout the year. Different stages of germination as shown in Fig 1 (a)-(f)

- **Vegetative phase-** *Canavalia* species are perennial climbing plants with twining stem. Seeds are shown in month of May (Baby and Radhamany 2019).
- **Reproductive phase-** The plant species show annual phenology pattern. The flowering start after 2 to 4 months of planting. The inflorescence are axillary raceme and single inflorescence produced from the nodal region and the flowers were papilionaceous (Fig 1 (g)). Plants showed peak flowering in August to October. The fruits attained maturity after two

Table 1: Traditional and Ethnobiological uses of *C. gladiata*

Part Used	Ethnomedicinal Uses	References
Fruit	Constipation and other ailments	Ekanayake et al. (1999)
Fruit	Treatment of furuncle	Ekanayake et al. (2007), Micheletto et al. (2016)
Fruit	Treatment of sinus infection	Ekanayake et al. (2007), Micheletto et al. (2016)
Fruit	Treatment of vomiting	Duranti (2006), Li et al. (2007)
Fruit	Used as remedy for coughing	XIA et al. (2017)
Fruit	Cure hernia	XIA et al. (2017)
Fruit	Cure dysentery	XIA et al. (2017)
Fruit	Lower soiling and pain around kidneys	Kumarasamy et al. (2020)
Fruit	Treatment of athlete's foot and acne	Lim (2011)
Fruit	Treatment of ozena	Lim (2011)
Fruit	Treatment of haemorrhoids	Lim (2011)
Fruit	Treatment of pyorrhea	Lim (2011)
Fruit	Treatment of otitis media	Lim (2011)
Fruit	Treatment of boils	Lim (2011)
Fruit	Treatment of cancers	Lim (2011)
Fruit	Treatment of inflammatory diseases	Lim (2011)
Fruit	Treatment of atopic dermatitis	Lim (2011)
Leaves	Improvement and treatment of hiccups	Lee (1994), Kim et al. (2013)
Leaves	Treatment of rhinitis	Lee (1994), Kim et al. (2013)
Leaves	Treatment of pertussis	Lee (1994), Kim et al. (2013)
Leaves	Curing low back pains	Lee (1994), Kim et al. (2013)
Leaves	Treatment of Persistent skin rashes	Ekanayake et al. (2000)
Leaves	Treatment of gonorrhoea	Lim (2011)
Leaves	Tonic for eyes	Lim (2011)
Root	Cure enlargement of liver	Sabjan et al. (2014)

to three month later fruiting start from October and mature by December (Baby and Radhamany, 2019)

- **Seed Germination-** The seed germination is epigeal. The different stages of seed germination is given in Fig 1 (a) to (g). The emerging cotyledons become green and called cotyledon leaves. The first developing leaves are simple then it became trifoliolate. It took 3-5 days for germination (India Biodiversity Portal, 2019).

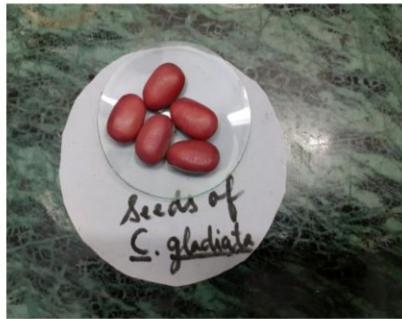
Environmental Requirements

Sword bean is cultivated in tropical climate

at temperature 15° - 30°C with evenly distributed annual rainfall of 80-180 cm/year. *C. gladiata* can tolerate salinity, water logging, and drought but cannot tolerate the frost. It can also well thrive in nutrient depleted and acidic soil with pH 4.5 to 7.0 (Ekanayake *et al.* 1999, Kooi 2016, PROTA 2019, Useful Tropical Plants 2019).

Ethnomedicinal Use

The plant of *C. gladiata* showed wide range of applications in traditional medicine. The traditional and ethnobiological use of *C. gladiata* is given in Table 1. It is used as pacifiers, viliated kapha, pitta, burning sensation, over precipitation, anorexia, wounds, ulcers, kidney stones and



(a) Fresh dry seed.



(b) Sprouting seeds after 72hrs.



(c) Emergence of radical.



(d) Penetrance of radical in soil.



(e) Emergence of leaves



(f) Establishment of plant showing trifoliate leaf



(g) Plant showing inflorescence and flower.

Figure 1 (a-g): Showing stages of germination of seed of *Canavalia gladiata*.

jaundice. It's root paste (20 grams) given along with rice gravel for 2 to 3 days to cure enlargement of liver (Sabjan *et al.* 2014). It is used in treatment of furuncle, sinus infection and suppurative diseases (Ekanayake *et al.* 2007 and Micheletto *et al.* 2016). The fruit of sword bean is utilized in treatment of vomiting, it's fruit is also used as remedy for coughing, hernia and dysentery (Duranti 2006, Li *et al.* 2007, XIA *et al.* 2017), lower sores and pain around kidneys

(Kumarasamy *et al.* 2020). Leaves of sword bean has been utilized in the treatment of hiccups, rhinitis, sinusitis, pertussis, low back pain (Lee 1994, Kim *et al.* 2013). In Korea, traditionally the extract of sword bean is being used in soap for the treatment of athlete's foot and acne. In Malaysia, the leaves of sword bean is used by Malays people for treating gonorrhoea besides these the leaves are also squeezed into the eyes along with other extract which act as magic tonic for eyes. Japanese used for

treating atopic dermatitis, boils, cancers, haemorrhoids, , inflammatory diseases, otitis media, ozena and pyorrhea (Lim 2011). Investigation of phytochemicals in *C. gladiata* have indicated the presence of alkaloids, tannins, flavonoids, cardiac glycosides and reducing sugars (Pasumarthi *et al.* 2011). The ethnomedicinal uses showed the intimacy with the people, environment and health of the society (Pandey and Srivastava 1990, 1991, 1993, Pandey 1994 and Kumar *et al.* 2021).

Conclusion

The present study is on morphological characterization and medicinal uses of an underutilized legume plant *Canavalia gladiata*. Sword bean has high amount of protein contents and numerous of phytochemicals viz. phenol, tannin, phytic acid, tannic acid, flavanoids etc. to be active constituent. The different parts of plant are utilized as traditional medicine around the world for treatment of different ailments. The ethnobiology, therapeutics uses bioactives and than conservation will provide a new way for poverty eradication. The plant has not received much attention in the area under survey hence, underutilized. This study will be helpful to attract the attention of people to cultivate this plant which could be utilized as food and feed and its bioprospection for upliftment of livelihood of the society.

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