

Introducing *Aristolochia ringens* as a Potential New Medicinal Crop

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Executive Summary:

Aristolochia ringens is a new crop on the horticultural market. It is native to South America and can currently only be grown in warm, humid environments. The flowers are fragrant and provide an interesting texture to the landscape in front of the large dark green leaves of the plant. While the plant is grown ornamentally in the landscape as a vine, the main historical use is medicinal. The roots have been used to help manage insomnia, gastrointestinal disturbances, arthritis, oedema, and snake bites, and the leaves can be used as a salve to help heal rashes. Research has been started on the potential anticancer properties of the roots as well. The crop scheduling for this plant still needs to be determined in order to take full advantage of the medicinal value this crop holds. Vegetative propagation seems to be the best way to grow the crop for the market as of now. Domesticated cultivars of *A. ringens* need to be produced as the current production schedule for the crop takes about a year and has unrealistic environmental conditions necessary.

I. Introduction

A. Study Species

The study species is a new crop to the horticultural market: *Aristolochia ringens*, or Gaping Dutchman’s pipe vine.

B. Taxonomic Classification and Geographic Distribution in the Wild

The new crop *Aristolochia ringens* is being introduced to the market. Also known as Dutchman’s pipe vine or Gaping Dutchman’s pipe vine, this plant is in the Aristolochiaceae family. Previously, this species was known as *Howardia ringens* (Aigbe et al., 2019).

Aristolochia ringens is native to South America and grows in tropical regions in the Americas and Africa. Specifically, the crop grows in Panama, Bolivia, Columbia, Venezuela, Sierra Leone, and Nigeria (“*Aristolochia ringens* (Dutchman’s pipe)”). The native habitat of *A. ringens* is tropical America but was introduced into Africa for medicinal and ornamental reasons. The plant may be naturalized in parts of tropical Asia, but it is not commonly found.

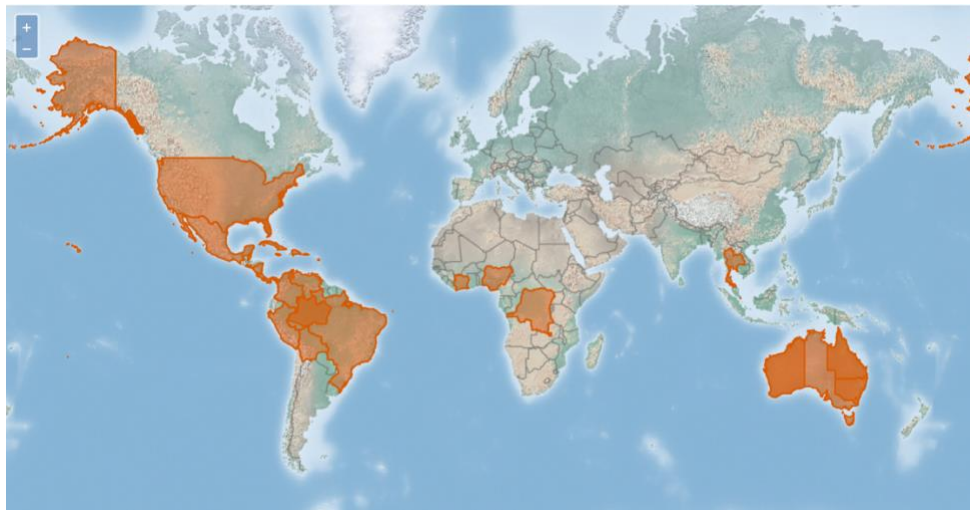


FIGURE 1. *Aristolochia ringens* distribution throughout the world (“*Aristolochia ringens* (Dutchman’s pipe)”).

Because the crop has specific growing conditions, it does not have a large tendency to become invasive. It grows in warm, tropical climates and cannot grow in many other situations. The crop prefers greater than 60 mm of precipitation a year. This leads to the plant mainly occurring naturally in humid to very humid tropical forests or tropical secondary forests. The risk of invasiveness is still being studied but does have known invasiveness in at least one non-native place due to introduction for ornamental purposes (“*Aristolochia ringens* (Dutchman’s pipe)”). The plant can also handle shade, which presents risks of invasiveness and smothering native flora in an introduced area.

Aristolochia ringens is an evergreen vine that can reach 2 to 10 meters tall. The vine produces long fragrant flowers that are 12 cm long all throughout the vine leaves. The flowers are a mixture of reds and purples and yellows, which pair nicely with the dark green foliage. The seeds are stored in a capsule fruit, which starts green and turns brown when it is mature. The capsule then splits open to release the seeds into its environment. The vine features a woody stem, which allows the plant to support itself growing up fence wires or posts.

II. Crop Species

A. History and Potential Uses

Aristolochia ringens was previously known as *Howardia ringens*. There are no known cultivars of the crop on the market. *Aristolochia ringens* and other plants in the genus are used as medicinal and ornamental crops, but no known cultivars are sold. As an ornamental crop, the plant is used as a vine which can be seen in Figure 3 below. The flowers on the crop are very unique, which can be seen in both figures 2 and 3 below.



FIGURE 2. Closeup of *Aristolochia ringens* flower (“*Aristolochia ringens* (Dutchman’s pipe)”).



FIGURE 3. *Aristolochia ringens* plant including flowers and leaves (“*Aristolochia ringens*”).

There is no known horticultural distribution chain in any of the literature. Seeds for the crop can be bought online, but the grower is not listed on any of the websites. The plant occurs naturally, so seeds must be taken from local plants to cultivate or the plant spreads in the wild.

All seeds for studies done have been obtained from the wild and confirmed by professors of botany or horticulture at nearby universities (Aigbe et al., 2019).

A possible distribution chain would include a grower to produce the seeds for the crop. The seeds would then be shipped to another grower who would be able to produce small crops and cuttings to vegetatively grow the plant. Brokers could be used to find the plant for the smaller retail markets as the crop is not widely produced. Retail markets would then sell the crops to local consumers to plant in their gardens. If the distribution chain was used for medicinal values, the seeds would be shipped to a grower who would likely produce the crops for use and ship them to a pharmaceutical company or sell the crops at a local farmer's market for consumers.

One major reason that the crop was introduced into Africa was as an ornamental plant. After being introduced, the crop is used traditionally as a medicinal plant; therefore, it can be considered edible. However, studies have been done on the toxicity of the plant when ingested in large amounts. The root extract showed significant weight loss in female rats, enlargement of male rats' stomachs, and stress in the rats' kidneys and liver (Aigbe et al., 2019). Acute exposure to the roots seemed to be safe and thus far, no human has had any adverse effects when eating *A. ringens* for medicinal purposes. The roots are eaten to help manage insomnia, gastrointestinal disturbances, arthritis, oedema, and snake bites (Aigbe et al., 2019). Roots of the plant are sold at local markets as seen in Figure 1. The roots of the crop have also seen levels of anticancer activity. In studies done, tumor growth has been inhibited by 29.45% to 50.50% (Akindele et al., 2015). The leaves are not eaten but can be used to relieve rashes on the skin. With that being said, the toxicology levels of the plant are still being studied.



FIGURE 4. *Aristolochia ringens* root as it is sold on the market for medicinal purposes (Aigbe et al., 2019).

The *Aristolochia* genus has some specific growing requirements when it comes to germination. The plant is mainly seed propagated, although vegetative propagation could also be used. For seed germination, the seeds need to be soaked in warm water for 48 hours before sowing. The seeds need to be surface sown and then covered lightly with vermiculite, compost, or another similar material. The seeds should also be placed in a polyethylene bag to allow the seeds to germinate in darkness. Germination can take one to three months, or even longer if the growing requirements are not quite right (“*Aristolochia ringens* seeds (Gaping Dutchman's pipe seeds)”). The experiment that I am conducting with my seeds is planting half of them in darkness to germinate and half of them in light. Some of the articles that I have been reading say to cover them when seeding and then transplanting them away from direct sunlight. After germination, if my seeds germinate in time, I am going to grow the seeds germinating in the dark in the short-day light greenhouse, and the seeds germinating in light in the regular greenhouse. This will help to understand if *A. ringens* prefers light or dark growing conditions.

III. Production Information

A. Anticipated Cultural Requirements

The lifecycle of *Aristolochia ringens* is a perennial in the warmer climates that it is grown in. It would not be worth it to grow in greenhouse settings in cool climates and sell as an annual as the crop is a vining evergreen. The characteristics of the plant make it an herbaceous perennial in warmer climates (“*Aristolochia ringens* (Dutchman’s pipe)”). The crop should be hardy down to the USDA Hardiness Zone 11, which encompasses tropical climate zones. Therefore, on an ornamental scale, the crop should only be grown in tropical America and Africa. However, for the medicinal value, the crop could be grown in greenhouses throughout the world. The root is the main portion that would be used for medicines, but the leaves could also be made into balms to help with rashes. Essentially all parts of the plant could be harvested in the greenhouse: the roots to eat, the leaves for balms, and the remainder of the plant could be composted.

Aristolochia ringens could be grown from seed. The seeds should be planted in a germination mix soil and covered lightly with perlite. The temperature during the summer should be around 25 degrees Celsius, and the temperature in the winter should be around 12-15 degrees Celsius (“*Aristolochia ringens*”). The seeds should only be germinated in the summertime. *A. ringens* is likely to like a longer period of light during growth, as they are grown near the equator, although no studies have been done on this. I am trying to determine if *Aristolochia ringens* prefers long or short days once my seeds germinate. Before sowing, the seeds should be soaked for 48 hours to break the dormancy and allow for higher germination rates (“*Aristolochia ringens* seeds (Gaping Dutchman's pipe seeds)”). No pinching or cooling is needed, and the seeds are large so they should be started in a 72 flat.

B. Market Niche

The product would ideally be on the market year-round for its medicinal purposes. There is no specific holiday that the crop would benefit from being sold on. The crop would be programmable to be forced year-round depending on the growing conditions of the area. Tropical America and Africa would be able to produce the crop all year, and it should be able to be forced in a greenhouse in any part of the world if the conditions are correct.

The main potential crop limitation is the germination time. The germination time of the crop is thought to be 3-4 months long. I planted my seeds for *A. ringens* 6 weeks ago and there is no sign of germination yet. Once the crops are established, it would be easier to keep them growing, but getting the actual seedling itself to establish seems like a large limitation. Another limitation is the very specific growing conditions of the crop. As mentioned above in the paper, the seeds need to be soaked for 48 hours and then covered lightly after planting. The seeds should also be placed in a polyethylene bag to allow the seeds to germinate in darkness. It does not seem worth it to grow the crop on a large scale in greenhouses if the seeds require these specific germination requirements.

The main crop that *Aristolochia ringens* would have to compete with is other plants in the *Aristolochia* genus. Many of the plants in the genus have the same medicinal values as *A. ringens*, and they all have the same general type of flower, just with varying sizes and colors (Murugan et al., 2006). *Aristolochia tagala*, for example, can be vegetatively propagated and has regenerative roots, which might make it easier to grow in greenhouse production (Remya et al., 2013). There is not any information currently about whether *A. ringens* could potentially be vegetatively propagated, so the market might stick to what they already know instead of trying to grow *A. ringens*. Table 1 below discusses the various parts of the plants that each of the species

uses, some of which could be easier to harvest than the roots from *A. ringens* as they all have the same compound. Aristolochic acid is an alkaloid found in the family, which is an anti-neoplastic, anti-inflammatory and bactericidal agent (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2002).

Aristolochia species	Part used
<i>Aristolochia fangchi</i>	Root
<i>Aristolochia manshuriensis</i>	Stem
<i>Aristolochia contorta</i>	Fruit
<i>Aristolochia debilis</i>	Fruit
<i>Aristolochia contorta</i>	Herb
<i>Aristolochia debilis</i>	Herb
<i>Aristolochia debilis</i>	Root

TABLE 1. Various *Aristolochia* species and the part of the plant that is used (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2002).

Aristolochia ringens is a new crop to market. Sometimes trying out a new crop can be scary because markets are driven by capital, and a new crop does not guarantee capital. *A. ringens* is known to have medicinal value, especially to locals in tropical America and Africa. Other species in the *Aristolochia* genus also have medicinal value and more research done on them. However, *A. ringens* has a beautiful flower that is larger than many others in the genus and with more research, it could be found that *A. ringens* grows faster or better. Putting some time and money into *A. ringens* to discover more of its potential could go a long way for the horticultural market.

IV. Product Information Guide (PIG) & Crop Schedule

Aristolochia ringens is a beautiful plant that has many ornamental and medicinal uses.

However, the crop scheduling of the plant is not easy to be determined. To try and determine the best growing conditions for the plant, I planted 7 seeds covered and 7 seeds uncovered. After waiting about three months, none of the seeds germinated. This made me rethink that seed propagation was the best form of planting. Vegetative propagation has worked for other genera in the species *Aristolochia* (Hedman, 2005). Because *Aristolochia* spp. are woody vines, rooting the vegetative parts of the plant will have the most success.

An anticipated crop schedule for vegetative propagation would be taking the 5-inch cuttings and dipping them in rooting powder. The cutting will then be placed in a sand and perlite soil mixture. The cuttings should be on a 75-degree F heat mat and placed in a mist house with high humidity. The only way that *Aristolochia ringens* could be grown would be in areas close to the equator with high humidity and preferable in a greenhouse as the conditions must be just right for them to take. The plants will grow in the greenhouse for one year until they are large enough and have a dense enough root system to be sold to the general consumers. They should be sold in #1 or #2 pots which would make them a large enough vine to plant in their landscape for ornamental purposes.

The anticipated crop schedule for seed propagation would be to soak the seeds for 48 hours in warm water and then plant them in the germination mix. The seeds should be in a warm greenhouse with high humidity and misted multiple times a day. Germination of the seeds is supposed to take 1-3 months, although I did not see any germination in this time with my seeds. The seeds should be started in a 128 and then transplanted into larger containers as they grow. Eventually, as mentioned above, they would be sold in #1 or #2 pots. After transplanting, the

crop should grow fairly quickly as it is a vine. It would also likely need to be staked for the same reason. There has not been much luck with seed propagation of the crop in the literature, so the crop scheduling is still something that would need more research done.

To be sold on the market from either seed or vegetative propagation, it would take about a year overall before the crop is ready for the market. After a year, then the flowering should occur in the late winter or early spring. Planting the crop in week 1 in the greenhouse should allow for flowering in about week 12 of the following year for ornamental purposes. For medicinal purposes, the vines would be able to start being harvested after a year and continue harvesting as the plant grows back. To go from planting to flowering would take about 64 weeks.

Information about whether the crop prefers long-day or short-day light patterns is not currently available. My study was going to be on which photoperiod length the crop preferred, but the seeds never germinated for either condition. A way that I could have gotten the seeds to germinate faster would be if they were in a warmer greenhouse. Minnesota does not have good growing conditions for *Aristolochia ringens* even in a greenhouse during the winter months. The seeds also might have been misted too much throughout the day as the soil was always quite wet and did not have time to dry out even a little bit.

Shipping should not be a problem for this crop as they would be grown in containers. The only problem with shipping would be that the plant itself cannot be shipped to colder regions. This plant is grown only in warm, humid areas and will not do well in dry or cold regions. Once the roots are harvested, they will need to be dried and prepped but then can last up to two years and be shipped anywhere.

The production of *Aristolochia ringens* is just at the beginning of our understanding. No specific time frames have been determined in any of the existing literature, and both of my

anticipated crop productions have been based off my understanding of the crop through the research I have done. Micropropagation of the plants in water and using bioreactors is one-way other genera in the species are starting to be propagated. Currently, it does not seem sustainable to market *Aristolochia ringens* on a large scale. More information about seed and vegetative propagation needs to be found. Genetic engineering to create more domesticated cultivars would also help with the greenhouse production. Breeding the crop to be able to withstand cooler temperatures would help a lot with the production and widen the area that the crop can ornamentally be grown in landscapes. Cold hardiness is the main area that needs to be domesticated in the crop in order for it to do well on the market.

V. **Acknowledgments**

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