ATTRA Sustainable Agriculture
NCAT A program of the National Center for Appropriate Technology • 800-346-9140 • ATTRA.NCAT.ORG

Butterfly Pea: A Cover Crop for Hot and Humid Areas

From 2017 to 2021, NCAT's Subtropical Soil Health Initiative tested butterfly pea as a cover crop in the subtropical Rio Grande Valley of south Texas. This tipsheet was developed in part from the findings of those field trials.

Introduction

Butterfly peas *(Clitoria ternatea)* are known for their showy flowers, but their twining, delicate-stemmed growth habit also makes them a great cover crop candidate. They have pinnate leaves with five to seven delicate leaflets. Their seed pods are relatively flat and narrow, with papery shells that shatter easily and can eject seeds with some force. The butterfly pea is a perennial vine that is intolerant of freezing weather, so it needs to be protected in the subtropics or treated as an annual.

Butterfly pea setting seed in the Lower Rio Grande Valley. Photo: Jennifer Slavik

Butterfly peas originated in Africa but have spread through cultivation through much of both the tropical and subtropical regions. There are several synonyms for *Clitoria ternatea,* such as *Clitoria albiflora, C. bracteata, C. mearnsii, C. tanganicensis,* and *C. zanzibarensis,* but the literature has mostly settled on the first term. There has been little in the way of cultivar development but, luckily, butterfly pea is already naturally widely adapted (Staples, 1992).

As far as secondary uses, butterfly pea has reportedly been used in Ayurvedic traditional medicine for many years (Mukherjee et al., 2008). In southeastern Asia, the flowers are used as a natural food coloring, especially for rice. This practice is believed to increase the phytochemical content of the rice and enrich the diet with antioxidants (Yusof, 2015). The flowers can also be batter-fried, as in tempura. Another use for the flowers is making blue-colored drinks that change color with the addition of lime juice. Also, the butterfly pea is a stately ornamental vine that can be used as a screen. Aside from being a good cover crop, it's also a fodder crop for goats and an excellent pioneer species for disturbed land.

Soil Nutrients

In addition to supplemental phosphorous, butterfly pea responds well to additional zinc, but it responds much better to manganese and boron (Dayal et al., 2015). In an arid Saudi Arabian soil, *Clitoria* in combination with *Leuceana* ameliorated sodium and improved electroconductivity parameters. The organic matter in this combined system resulted in an increase in nitrogen, potassium, calcium, and magnesium in the research plot (Elfeel et al., 2013).

Butterfly pea benefits from Rhizobium inoculation by the cowpea group of inoculants. It can also, to a limited degree, be colonized by soybean inoculants, as well as those isolated from Sesbania (Oblisami, 1974; Evans and Rotar, 1987). Butterfly peas can fix approximately 280 to

Butterfly pea grown without any irrigation in drought conditions at Yahweh Farms in Harlingen, Texas. Photo: Diana Padilla

300 pounds per acre of nitrogen, which is very significant. However, after several years, nitrogen-scavenging weeds can overwhelm the field.

Organic Matter

Depending upon environment, *Clitoria* can yield up to 15 tons per acre of dry matter each year, if it is managed properly and there are ideal conditions. In drier places, expect less than six tons per acre total production. Over the course of a season, about 700 pounds of seed can be produced on an acre. Due to the indeterminate nature of the crop, flowers and pods can be in many different stages of development at any given time, so harvest will not be uniform (Reid and Sinclair, 1980). One study found that an intercropped field of *Clitoria* and *Leucaena* created more organic matter than either crop planted alone (Elfeel et al., 2013).

Soil Moisture

Butterfly pea roots are tolerant of short-term flooding but cannot survive with "wet feet" for too long. They appreciate summer rainfall at a rate of about 18 inches and a mean annual rainfall of about 54 inches. In more arid environments, they would benefit from extra irrigation and mulching. Once established, they are quite drought-tolerant. In northeastern Queensland in Australia, *Clitoria* persisted for 14 years in dryland conditions, while being heavily grazed (Hall, 1985). Of the cover crops we tested in south Texas, this was one of the most drought-resistant. Not only did several of the accessions make it through the blistering heat of six weeks with no rain and +100ºF days, but they also flowered and set fruit.

Problems

In Australia, powdery mildew has been observed on *Clitoria* (Liberato and Shivas, 2012), but we observed no incidence of disease in south Texas. Few pests bother *Clitoria* because it contains an insecticidal defensive chemical known as a cyclotide (Poth et al., 2011). These *Clitoria* cyclotides have led to the creation of a commercial product that's touted as an eco-friendly pesticide (European patent number 1275025605) and is used in cotton and macadamia in Australia (Oguis et al., 2020; Mensah et al., 2015). It's been found to retard the growth of the very destructive *Helicoverpa armigera* caterpillar by means of membrane tissue permeabilization (Gilding, et al., 2015). Moreover, these insecticidal traits vary from accession to accession and are thus amenable to selective breeding (Oguis et al., 2020). In addition to being toxic to the caterpillars, butterfly pea also has an oviposition deterrent effect on the adult moths (Brévault et al., 2019). I can't recall seeing any pest pressure on *Clitoria* at our test sites in either south Texas or Prairie View, Texas.

Weeds

Butterfly pea hasn't been used extensively as a cover crop, but the potential is definitely there for wet subtropical regions. It's been used on coconut plantations as a cover crop and, in Malaysia, it was used for this purpose in conjunction with rubber trees. In these areas, it's perennial but needs to be replanted after five years due to weed buildup (Staples, 1992). Because it's also used in some places as a medicinal crop and cultivated as such, there are details on how beneficial weed management can be for *Clitoria* (Mohammed, 2013). Its use as a cover crop must be very intentional and well planned to get the best effects. In our tests in south Texas, the vines scrambled on and above weeds, using them as supports, but the butterfly pea was not planted at a high enough density to achieve weed suppression.

Cost of Implementation

Due to butterfly pea's highly ornamental nature, seed is readily available, but it may not be specifically adapted for cover crop usage or may not be available in quantities necessary for cover crop needs. If this is the case, propagation will be important. *Clitoria* is self-pollinated, like many legumes, and readily sets prodigious amounts of viable seed from one plant. Producers who wish to use it as a cover crop will need to grow seed on their own until bulk supplies become available. The recommended planting rate is about six pounds per acre to achieve the desired density, which works out to be about 70,000 seeds.

For more information, see the ATTRA publication *Cover Crop Options for Hot and Humid Areas.*

References

Brévault, T., D. Badiane, R. Goebel, A. Renou, I. Téréta, and P. Clouvel. Repenser la gestion des ravageurs du cotonnier en Afrique de l'Ouest. 2019. Cahiers Agricultures. Vol. 28. p. 25.

Dayal, D., A. Kumar, M.L. Swami, D. Machiwal, S. Manglassery, S.C. Vyas, and H. Kunpara. 2015. Chapter 18: Management Practices for Improved Forage Production of Butterfly Pea *(Clitoria ternatea).* p. 215-224. In: Improving Productivity of Drylands by Sustainable Resource Utilization & Management, Edition: 2016. Devi Dayal, Deepesh Machiwal, Shamsudheen Mangalassery, and R.S. Tripathi (eds.) New India Publishing Agency, New Delhi, India.

Elfeel, A.A., A.A. Bakhashwain, and R.A. Abohassan. 2013. Interspecific interactions and productivity of *Leucaena leicocephala* and *Clitoria ternatea* under arid land mixed cropping. The Journal of Animal & Plant Sciences. Vol. 23, No. 5. p. 1424-1430.

Evans, D.O., and P.P. Rotar. 1987. Sesbania in Agriculture. Westview Press, Boulder, Colorado.

Gilding, E.K., M.A. Jackson, A.G. Poth, S.T. Henriques, P.J. Prentis, T. Mahatmanto, and D.J. Craik. 2015. Gene coevolution and regulation lock cyclic plant defence peptides to their targets. New Phytologist, Vol. 210. p. 717-730.

Hall, T.J. 1985. Adaptation and agronomy of *Clitoria ternatea* in Northern Australia. Tropical Grasslands. Vol. 19. p. 156-163.

Liberato, J., and R. Shivas. 2012. Powdery mildews on Clitoria in Australia. Australasian Plant Disease Notes. Vol. 7, No. 1. p. 111-114.

Mensah, R., D. Leach, A. Young, N. Watts, and P. Glennie. 2015. Development of *Clitoria ternatea* as a biopesticide for cotton pest management: Assessment of product effect on *Helicoverpa* spp. and their natural enemies. Entomologia Experimentalis et Applicata. Vol. 154. p. 131–145.

Mohammed, S.A.A. 2013. Effect of Weed Control on Growth and Seed Production of Butterfly Pea *(Clitoria ternatea)* Under Rainfed Conditions at Zalingei Western Darfur State-Sudan. ARPN Journal of Science and Technology. Vol. 3, No. 5.

Mukherjee, P.K., V. Kumar, N.S. Kumar, and M. Heinrich. 2008. The Ayurvedic medicine *Clitoria ternatea*—from traditional use to scientific assessment. Journal of Ethnopharmacology. Vol. 120. p. 291–301.

Oblisami, G. 1974. Studies on the Rhizobium and nodulation pattern in a forage legume, *Clitoria ternatea.* Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences. Vol. 40. p. 618-623.

Oguis, G.K., E.K. Gilding, Y. Huang, A.G. Poth, M.A. Jackson, and D.J. Craik. 2020. Insecticidal diversity of butterfly pea *(Clitoria ternatea)* accessions. Industrial Crops and Products. Volume 147. p. 112214.

Poth, A.G., M.L. Colgrave, R. Philip, B. Kerenga, N.L. Daly, M.A. Anderson, and D.J. Craik. 2011. Discovery of cyclotides in the Fabaceae plant family provides new insights into the cyclization, evolution and distribution of circular proteins. ACS Chemical Biology. Vol. 6. p. 345-355.

Reid, R., and D.F. Sinclair. 1980. An Evaluation of a Collection of *Clitoria ternatea* for Forage and Grain Production. Genetic Resources Communication. Vol. 1. p. 1-8.

Staples, I.P. 1992. *Clitoria ternatea* L. In: Plant Resources of South-East Asia No. 4. Forages. L. Mannetje, and R.M. Jones (eds). Pudoc Scientific Publishers, Wageningen, the Netherlands. p. 94–96.

Yusof, N.A.B.A. 2015. Investigation on natural blue colorant of *Clitoria ternatea* Fabacaeae (bunga telang): The effects of stabilizers to extracts. Chemical & Natural Resources Engineering, University Malaysia, Pahang.

Notes

Appendix A: Butterfly Pea Agronomic Data

USDA hardiness zone	7-10
Soil pH	6.6-7.5
Soil type	Any
Seeding rate (lb/acre)	6-12
Nitrogen fixed (lb/acre)	281
Dry matter (tons per acre)	3.07
Erosion reduction	Low
Weed supression	Low
Provides hay?	Yes
Provides secondary product?	Yes, potentially medicinal, ornamental
Grazing?	Yes

Soil compaction	Relieves
Seed size	0.06 cm
Salinity	Moderately saline
Beneficial insects	Pollinators
Response to mycorrhizae	Positive
Germination rate	80%
Germination time	14-20 days
Inoculant group	Cow pea or soy
Water use stage	Mature
Water use in max. use stage	Medium

We would like to thank the **Germplasm Resources Information Network (GRIN)** of the USDA Agricultural Research Service for supplying the seeds used for the duration of this project. Without their support, we could not have conducted these trials.

This publication is produced by the National Center for Appropriate Technology through the ATTRA Sustainable Agriculture program, under a cooperative agreement with USDA Rural Development. This publication was also made possible in part by funding from the Conservation Innovation Grants program at USDA's Natural Resources Conservation Service, agreement #69-3A75-17-281. ATTRA.NCAT.ORG.

Butterfly Pea: A Cover Crop for Hot and Humid Areas
By Justin Duncan, NCAT Agriculture Specialist
Published March 2022 ©NCAT
IP626 • Slot 658 • Version 030822