

Green Manure for Soil Improvement



May Phyoe Way
Land Use Division

Gliricidia sepium



- Fast growing, tropical, leguminous tree, Nitrogen fixing tree
- Grow up to 10 m height
- Used for timber, firewood, Hedges, medicinal purpose, charcoal, live fences, plantation shade, poles, soil stabilization , green manure
- Can adapt pH 4.5 to 6.2
- Fertile sandy soils, heavy clay, calcareous limestone and alkaline soil

Gliricidia sepium

Morphological and biochemical features of *Gliricidia*

1. The leaves contain nutrient: **Nitrogen (N) (2.4%), Phosphorus (P) (0.1%), Potassium (K) (1.8%), Calcium (Ca) and magnesium (Mg)**
2. It grows fast and is tolerant to pruning
3. The foliage can be used as green manure
4. It can thrive in dry, moist, acidic soils or even poor degraded, infertile soils under rainfed conditions.
5. *Gliricidia* is a root nodulating, N fixing and multipurpose legume

Sesbania rostrata And *Sesbania aculeata*



It is a green manure crop, which has **nodules both on the stem and root.**

It thrives well under **waterlogged and alkali soil** condition. The normal seed rate is 30 to 40 kg/ha

To get early, uniform germination and vigorous seedlings, seeds have to be scarified with concentrated Sulfuric acid for 15 minutes and then washed thoroughly with fresh water and sown immediately.

A **green matter yield of 15 to 20 t/ha** which is equivalent to **150-180 kg N/ha** and obtained within a period of 8 to 10 weeks.

Azola



- ❖ rapid reproduction
- ❖ can produce 8 to 10 ton/ha
- ❖ can use as **Bio fertilizer**
- ❖ can absorb chromium, nickel, copper, zinc and lead (Bioremediation)
- ❖ can fix CO₂ and Nitrogen to form carbohydrate and ammonia respectively
- ❖ release plant growth regulator and vitamins which are required to enhance growth of paddy crops

Pungam (*Derris indica* Syn. *Pongamia glabra*)

1. Leguminous, moderate sized ever green tree

2. It grows in **coastal forests**, on river banks and on tank bunds mostly along streams, wastelands and road sides

3. Established by means of planting **two to three months old seedlings, 4 to 5 m Apart**

4. Lopping may be taken once or twice a year

5. A tree yields approximately 100 to 150 kg of green material per lopping.



https://agritech.tnau.ac.in/agriculture/agri_greenmanuring_agronomygreenleafmanures.html

Ipil ipil (*Leucarna glauca*)

1. Introduced shrub & spread by massive campaign in India during 1950s

2. Under favourable conditions of soil and climate, it takes up a tree habit

3. **Quick growing** tree are often used for shade and green leaf manure in tea, coffee and cocoa plantations.



https://agritech.tnau.ac.in/agriculture/agri_greenmanuring_agronomygreenleafmanures.html

4. It can be planted on alternate field bunds of wetland, **1 to 2 m apart**, or as a thick hedge by close planting in three to four rows at 0.5 m spacing or along field border as tall shrubs giving support to the fence line or along farm roads on both sides for the production of green leaf
5. For green leaf purposes, the shrub **could be kept low by pruning or lopping** at convenient heights
6. The shrub is pruned two to three times a year and it withstands repeated lopping and the height is restricted to 2 - 3 m
7. Gliricidia do not affect the growth of cultivated crops with their shade effect.
8. Gliricida can be propagated by planting stem cuttings or seedlings
9. Each plant gives 5 to 10 kg of green leaves annually

https://agritech.tnau.ac.in/agriculture/agri_greenmanuring_agronomygreenleafmanures.html

Ipomoea cornea

- 1.Quick growing, profusely branching and highly drought resistant weed
- 2.It gives abundant green leafy material in short time
- 3.It is multiplied by means of mature stem cuttings
- 4.Two to three lopping can be taken in a year
- 5.Each plant will give about 5 to 7 kg of green matter per lopping.



https://agritech.tnau.ac.in/agriculture/agri_greenmanuring_agronomygreenleafmanures.html

Neem (*Azadirachta indica*)

1. Profusely branching, large ever green tree and gives plenty of foliage

2. It comes up in all types of soil

3. The trees are grown along field borders, rivers banks, roads, waste lands and also in garden lands and homestead gardens.



4. Trees are established by planting seedlings at a spacing of 5 to 6 m

5. One or two lopping in a year are taken in favourable seasons, each lopping weighing about 150 to 200 kg of green matter.

https://agritech.tnau.ac.in/agriculture/agri_greenmanuring_agronomygreen/leafmanures.html

Advantages of Green Manuring

- Adding organic matter to the soil
- Increasing biological activity
- Improving soil structure
- Reduction of erosion
- Increasing the supply of nutrients available to plants
(particularly by adding nitrogen to the system by fixation)
- Reducing leaching losses
- Suppressing weeds
- Reducing pest and disease problems
- Providing supplementary animal forage

Disadvantages

- Direct costs of seed and extra cultivations
- Lost opportunities for cash cropping
- Extra work at busy times of the year
- Exacerbated pest and disease problems (due to the 'green bridge' effect)
- Potential for the green manures to become weeds in their own right

N₂-fixing capacities of different species of grain, forage, and green manure legumes grown in lowland rice areas of the Philippines

Legume	Growth duration	N fixation	
		Ndfa %	Kg N/ha
<i>Aeschynomene afraspera</i>	56	68–76	105–145
<i>Cajanus cajan</i>	190–195	71-72	117-167
<i>Clitoria ternatea</i>	190-195	78-79	200-240
<i>Clotaria juncea</i>	190-195	72-81	199-213

(modified from Ladha and Kundu, 1997).

N fixation

Legume	Growth duration	Ndfa %	Kg/ha
<i>Desmanthus virgatus</i>	190–195	78–80	196–226
<i>Glycine max cv Clark</i>	70–84	69	149
<i>G. max cv UPSY2</i>	70–84	74	176
<i>Indigofera tinctoria</i>	225	70	79

(modified from Ladha and Kundu, 1997).

Nitrogen Fixation

Legume	Growth duration	Ndfa %	Kg/ha
<i>Macroptilium atropurpureus</i>	190–195	69–74	91–132
<i>Sesbania cannabina</i>	45–55	93	119–188
<i>S. rostrata</i>	45–65	68–94	70–458
<i>Vigna radiata</i>	125	64	37
<i>V. radiata cv Pagasa 1</i>	70–84	45	61

(modified from Ladha and Kundu, 1997).

N fixation

Legume	Growth duration	N fixation	
		Ndfa %	Kg/ha
<i>V. radiata</i> cv Pagasa 2	70–84	61	90
<i>V. unguiculata</i> cv IT82D-889	70–84	48	60
<i>V. unguiculata</i> cv Pelungthay	70–84	56	78

(modified from Ladha and Kundu, 1997).

A detailed botanical illustration of the Sunn Hemp plant. The main drawing shows a branch with several large, ovate leaves and a terminal raceme of flowers. A separate, enlarged view of a seed pod is shown in the upper left corner. The text 'SUNN HEMP' is overlaid in a black box with yellow lettering, and the scientific name 'Crotalaria juncea' is written in a white box with black lettering below it.

SUNN HEMP

Crotalaria juncea

History



In 1958

The National Resources Conservation Service (NRCS) and University of Hawaii Purchased seeds of Crotalaria from farmer who was growing it as a cover crop on the island of Kauai.

In 1982

Release sunn hemp cultivar
'Tropic Sun'

ref; Rotar and Joy 1983

Morphology

❖ Annual, erect shrubby herbaceous legume ,

Height of 1-4 m

❖ **strongly tap rooted** and has several lateral roots

❖ stems are up to 2 cm in diameter, cylindrical and ribbed

❖ The leaves are spirally arranged along the stems, hairy, simple,

❖ oblong-lanceolate or elliptical in shape

❖ Inflorescence is a terminal open raceme, up to 25 cm long, showy, deep-yellow papilionaceous

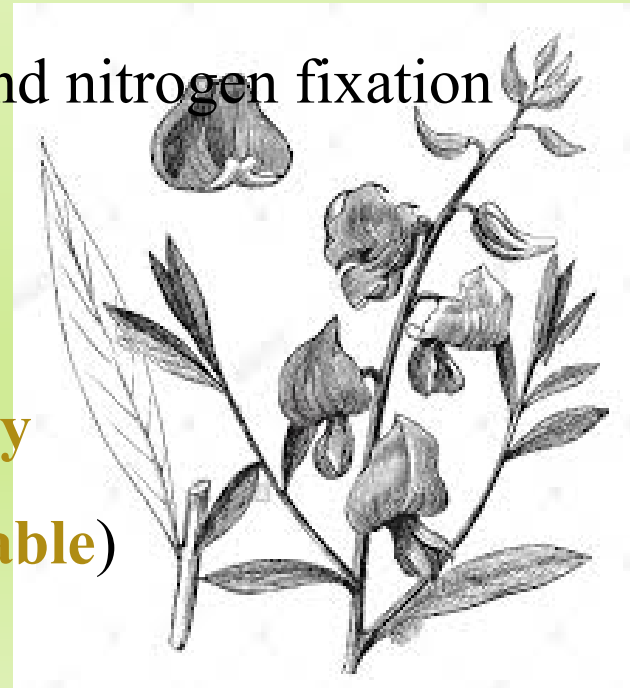
❖ The fruit is cylindrical, many seeded, hairy pod, light brown when mature, 3-6 cm long, and 1-2 cm in diameter

(FAO,2017;Duke,1983)



General Information

- Widely cultivated in tropic and subtropics
- can withstand light frost (not less than -2 C) without injury but growth and N fixation are reduced (Cook et al.,2005)
- **Drought resistant species** (average annual rainfall is as low as 200 mm)
- Temperature is ranging from 15 C to 27.5 C
- Irrigation is necessary for maximum growth and nitrogen fixation (minimum of 25 mm of water/week)
- can produce **wide range of soil**
- **does not withstand waterlogging and salinity**
- pH range is **5-8.4 where phosphorus is available**)



Uses

- Fiber (ropes, strings, twines, floor mat and fishing nets)
- Foliage (as a protein source)
- Fodder
- Green manure



Noted

***The Agricultural Research Services Poisonous Plant Laboratory and the University of Hawaii determined that seeds of this cultivar were **not toxic** to livestock

*** Raw seeds are **toxic** and can not be fed to cattle without prior boiling

(FAO,2017: Orwa et al.,2009: Cook et al.,2005)



Green Manure

“The use of *Crotalaria juncea* as green manure and fiber had led the agriculture Scientists to advocate its cultivation in areas deficient in manurial constituents and in such localities where other crops may not successfully grown.”

(Singh and Singh, 1963; Singh, 1963; Panse et. al 1965; Sutaria and Patel, 1975 and Agarwal et. al,1993)

“Sunn hemp definitely play an important role in cropping system restore and maintain. The soil health and fertility for sustainable agriculture.”

(Conway and Barbier, 1990)

Advantages



- Easy decompose
- short life cycle
- no need special preparation of soil
- Suppress weeds
- Slow down erosion
- Reduce root-knot nematode population

(Rotar and Joy 1983)



Nutrient Content

Different nutrients in different parts of Sunn hemp

Plant part	N %	P %	K%	Ca%
Leaf	4.52	0.35	1.3	2.4
Raw Ribbion	1.7	0.26	1.74	0.37
Wood	0.96	0.1	0.85	0.22

Source Dempsey, 1975

N content in plants

leave 3.96%

stem tissue 0.88%

whole plant tissue 2.5%

(Marshall 2002)

Cultivation

- 40 -60 lb/ac for cover cropping (Rotar and Joy 1983) (old)



Seed
rate

-10 lb/ac or less may be adequate (recent)

- 30 to 50 lb/ac (row planting)

-88 to 213 lb/ac (fiber)

49to 63 days old sunn hemp crop as green manure was found to give significant response in rice and wheat



Harvest
ing

(Sharma et al. 2000)

In case of sugercane, best result was obtained when sunn hemp was burried At **56 to 77 days** after sowing.

(Singh and Singh, 1936 and Srivastava and Pandit, 1968)



- ❖ ‘Percentage of organic matter, nitrogen and other essential elements increase with the age of the plant and attained maximum at **60-75 days** after sowing. (Singh and Singh (1936) , Kanwar and Hardyal (1959)
- ❖ “Use of Sunn hemp as green manure of organic mulch would be the most Beneficial at **the early to mid blooming stage** “(Marshall 2002)

Noted

*****Plowing after 60-75 days low contents of sucrose and total carbohydrate in fact reduce the manurial value**

-*Larger quantity of cellulose after 75 days**

How to harvest

1. After harvesting the fiber crop, top 30 cm from top can be incorporate in to the soil and rest portion is used as fiber.

(S.K.Sarkar and A.K.Ghorol)

2. Cutting Sunn hemp stems 1 ft above soil level 100 days after planting and allowing the plants to grow for an additional 70 days resulted in the highest quality of green manure harvested as compared to uncut or cutting at a higher stem height.

(Abdual-Baki et al.2001)

3. Harvest of top 18 inches of new growth by clipping Sunn hemp 16 to 32 inches height above soil line produced an organic fertilizer of 4 % N (3 ton/ac of dried Sunn hemp contain 240 lb of N.) (Seaman et al. (2004)

❖ The amount of nutrient added through leaves and top at harvesting (for fibre) is almost 80 percent in comparison to the whole plant green manuring (Dempsey, 1972).

❖ Thus, harvesting at 50% flowering stage with subsequent incorporation of leaves and top portions are more profitable than whole plant green manuring because about 3-5 q/ha fibre can be obtained.

(Tandon et al., 1959; Gupta 1968; Singh, 1963; Srivastaba and Pandit, 1968)

How to use as green manure

- incorporating with soil by plowing
- bring it from elsewhere and incorporating it at the appropriate time
- residue are dried, grind up and store as organic fertilizer



Yields

- 3 ton/ac of air dry organic matter at 60 days of growth at 40 kg seed/ha
- 134 -147 lb N/ac (Rotar and Joy 1983)

- 2.4 ton/ac of dry biomass
- 112 lb N/ac (summer)
- 67-71 lb N/ac (winter) (Reeves et al.1996)

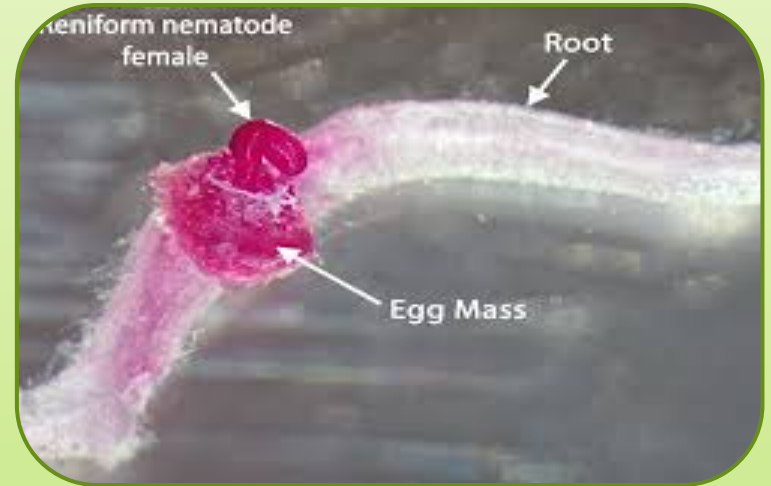
- 4.8-10 tons/ac organic matter
 - 44-66 lb N/ac, 13-18 lb P₂O₅ and 35-58 lb K₂O
- (Demsey, 1972; Panse et al.,1965 and Bhattacharya et.al.,2003)

The whole plant sunn hemp residue harvested early blooming stage contain N-P₂O₅-K₂O in amount of 123-42-80 lb/ac , which gives a ratio of 3:2:1 .

(Marshall 2002)

Nematode suppression

- ❖ poor host or nonhost to many plant parasitic nematodes
- ❖ produce allelopathic (toxic) compounds against several key nematode pests
- ❖ Sunn hemp leaf leachate essentially stopped movement of the reniform nematode.
- ❖ Leaf extract of sunn hemp was lethal to burrowing nematode (*Radopholus similis*) at dilutions of 1: 5 within 24 hours. (Jasy and Koshy 1994)



Nematode suppression

❖ Sunn hemp enhance natural enemies of plant parasitic nematodes, such as fungi that trap nematode or feed on their eggs

(Wang et al. 2001)

❖ Sunn hemp amendments have been demonstrated to enhance free- living nematode In the soil that are involved in nutrient cycling .

(Wand et al.2003b)

Incidence of Pest and Disease

- major diseases of sunn hemp is Fusarium wilt and anthracnose caused by *Collectotrichum curvatum* (Purseglove 1974)
-

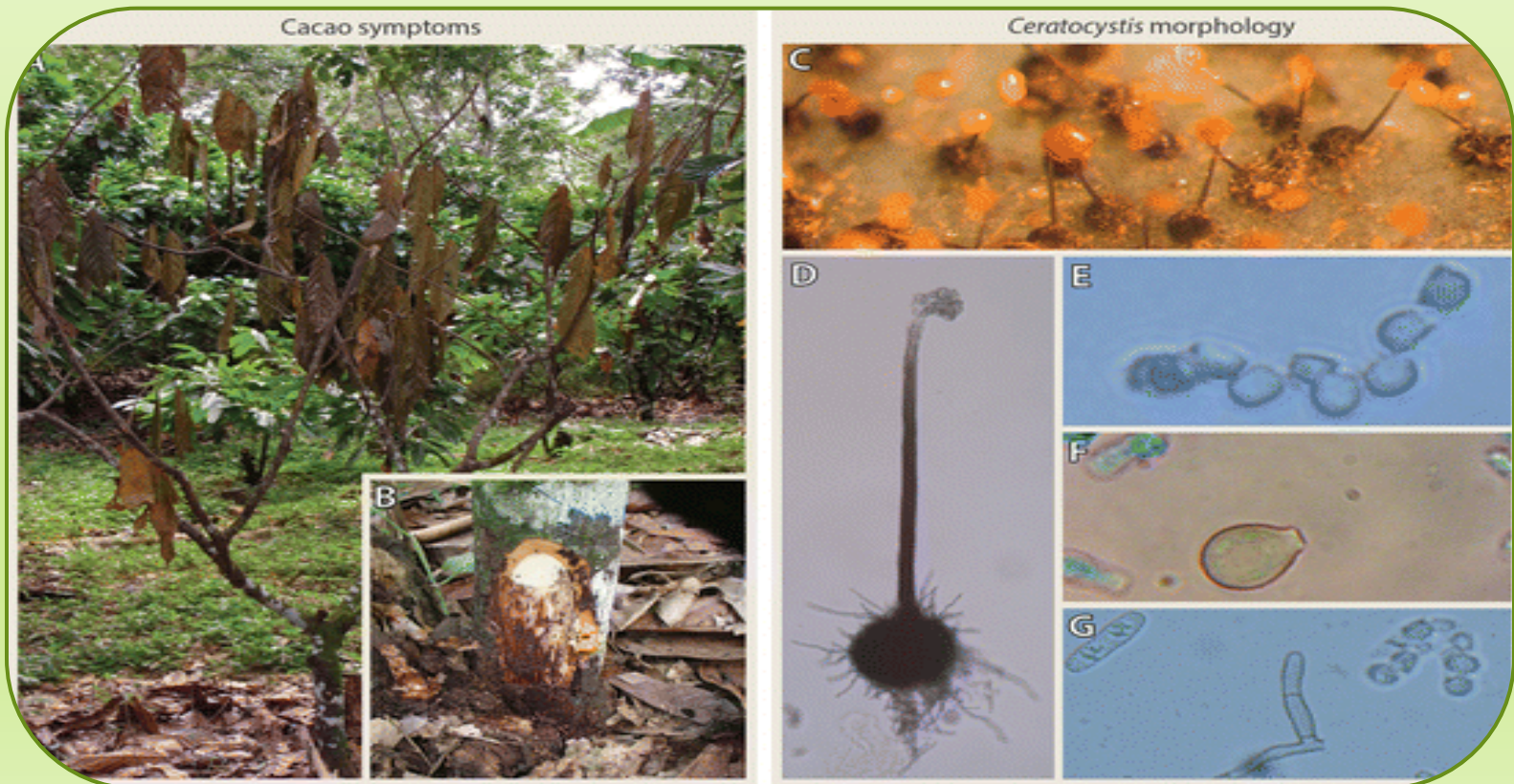


Incidence of Pest and Disease

- In Brazil

only disease reported on the crop is *Ceratocystis fimbriata*

(National Research Council 1979)



Incidence of Pest and Disease

- Pests are larvae of the sunn hemp moth *Utetheisa pulchella*, stem borer and pod borer

(Purseglove 1974)



Challenges of Sunn hemp cultivation

- Inadequate facilities
- Overlapping of season
- Non availability of adequate seeds and high cost of seeds
- Market for fiber



www.shutterstock.com • 1475161811



Project Implementation

Pakokku Township

- Farmers 42 numbers
- Village 42 numbers
- Plant population 280000
- Growth duration 45-65 days

2016-2018

Yesagyoo Township

- Farmers 42 numbers
- Village 42 numbers
- Plant population 230000
- Growth duration 45-65 days

2016-2018

Result and Discussion

Sr.	Township	Total green manure (t/ac)		Nutrients/ac			
		Min	Max	Green manure	N (kg)	P (kg)	K (kg)
1.	Pokakku	7.84	36.60	17.70			
2.	Yesagyo	8.49	25.82	16.01			

Organic matter (dry) = Green manure * 24%

Nitrogen = Organic Matter (dry) * 2.66%

Phosphorus = Organic Matter (dry) * 0.40%

Potash = Organic Matter (dry) * 1.91%

Result and Discussion

Sr.	Township	Total green manure (t/ac)		Nutrients/ac			
		Min	Max	Green manure	N (kg)	P (kg)	K (kg)
1.	Pokakku	7.84	36.60	17.70	113	17	81
2.	Yesagyoy	8.49	25.82	16.01	102	15	73

Organic matter (dry) = Green manure * 24%

Nitrogen = Organic Matter (dry) * 2.66%

Phosphorus = Organic Matter (dry) * 0.40%

Potash = Organic Matter (dry) * 1.91%

သာစည်မြို့နယ်

စိုက်ဧက ၅ ဧက

မျိုးစေ့နှုန်း ၁၈ ပေါင်/ဧက

ရိတ်သိမ်းရက် ၅၅ ရက်သား

အထွက်နှုန်း ၇ တန်/ဧက





ပြင်ဦးလွင်မြို့နယ်



သစ်စိမ်းစေ့ခြောက် ခံမြေကွက်
တောင်သူအပည့် - ဦးစိန်လေး
မျိုးအပည့် - ဝိုက်ထိပ်လှိုင်
စိုက်ရက် - ၁၇.၅.၂၀၂၀



ပုသိမ်မြို့နယ်

မျိုးစေ့နှုန်း

၁၄ပေါင်/ဧက

ရိတ်သိမ်းရက်

၄၅-၅၀ ရက်သား

အထွက်နှုန်း

၅-၇ တန်/ဧက

တစ်ဧကကုန်ကျစရိတ်

၄၀၀၀၀ကျပ်





Challenges?

Research?

