RESEARCH ARTICLE

Sesbania - A Green Manure for Soil Productivity and Crop Enhancement

Ganesh D. Bhatt

DOI: 10.18811/ijpen.v9i01.11

Abstract

In order to determine how growing the green manure crop Dhaincha (*Sesbania sesban*) in acidic soil conditions affected the soil characteristics, nutrient availability and rice productivity. Another a field study was conducted in the crop cafeteria at School of Agriculture, Galgotias University in Greater Noida, Uttar Pradesh from July 2018 to July 2022. As per the study, the green manure added patch considerably showed the change in the soil physical qualities and availability of nutrients. In comparison to plots where *Sesbania sesban* was not grown-up as a green manure. The crop introduction of *Sesbania sesban* increased the paddy output. The field investigation, which was carried out along the University crop cafeteria in 2018, discovered that the soil's pH was 8.75, which is slowly and steadily improving to 8.0. The amount of soil organic carbon was low, when recorded i.e., 0.27 in 2018, 0.35% in 2019, 0.39% in 2020, and 0.45% in 2021 and 0.47% in 2022 respectively. The application of vermicompost, cow dung manure, gypsum and *Sesbania* (*Sesbania sesban*) as part of an approved scientific method improved soil quality. This also led to an increase in the production of agricultural crops.

Keywords: *Sesbania*, Soil Productivity, Crop Enhancement, NCR, Green Manure.

International Journal of Plant and Environment (2023); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

Intensive agricultural practices have been adopted for many years to fulfill the growing food demand due to the rising human population (FAO, 2017). These agricultural techniques were later viewed as unsustainable ones that raised costs for both the environment and the economy (Gupta *et al.,* 2021; John and Babu, 2021). Intensive agriculture has forced farmers to do some unsustainable practices such as monoculture, the use of high amounts of chemical fertilizers and pesticides, and continuous tillage, weeding, and cultivation (FAO, 2011). In terms of environmental protection, these practices have shown a number of detrimental effects, including harm to soil structure, decreased soil fertility, salinity and deterioration of soil organic matter, all of which had an impact on soil health and productivity (Lal, 2015; Bala et al., 1990). The ability of the soil to contain water, surface and groundwater pollution, lack of nutrients in the soil, and soil erosion (Nelson and Sommers, 1982) are other deteriorating effects which results due to unsustainable farming practices. One of the most crucial elements of soil is organic matter, which is crucial for enhancing the soil's chemical, physical, and biological qualities (Brady, 1974). The amendment of organic matter into the soil is necessary to ensure the sustainability and availability of organic matter and other nutrients of the soil (Carter, 2002). Green manure is one of the basic sources of the organic amendment into the soils (Angers, 1992; Bradbury, 1990). This paper tries to give brief information about green manure and the effect of green manure application on soil properties based on several previous studies.

Material And Methods

Study Area

The study area is at Gautam Buddha Nagar, beside Buddha International Circuit, located at longitude 77°32′ 31″ east and latitude 28°21′ 58″ north. The study area is also a part of India's largest physiographic region-The Indo-Gangetic plains.

College of Agriculture Sciences, Teerthanker Mahaveer University, Delhi Road, Moradabad, Uttar Pradesh, India

***Corresponding author:** Ganesh D. Bhatt, School of Agriculture Galgotias University, Greater Noida, Uttar Pradesh, India, Email: ganeshdattbhatt@gmail.com

How to cite this article: Bhatt, G.D. (2023). Sesbania - A Green Manure for Soil Productivity and Crop Enhancement. International Journal of Plant and Environment. 9(1), 69-72.

Conflict of interest: None

Submitted: 15/01/2023 **Accepted:** 13/02/2023 **Published:** 30/03/2023

Climate

The weather is generally hot during the summer months i.e., March to June, with the lowest of 28°C and highs of 48°C. From July to September, it is monsoon season, which begins in late June and lasts until mid-September, with about 797.3 mm of rain. The temperature ranges from 25°C on rainy days to 32°C on clear days; on average, it is around 29°C. The month of July begins with extreme heat and humidity. From October to February period is considered the winter season. The harsh winters in Noida are brought on by cold waves that originate in the Himalayan region. At the height of winter, lows of 3 to 4°C are common. The city is engulfed in a thick fog during the winter, which makes it harder to see on the streets.

Soil

Its alluvial soil is a result of the Ganga River's sediment build-up. Although it is a sandy loam that produces grain well, its high pH value makes it susceptible to salt water situations.

Sampling of Salt-Affected Soils

There are two approaches to sample salt-affected soils: surface and underground soil data collection. The same methods are used for soil fertility analysis and to collect surface

samples. These samples are used to assess the soil's gypsum requirements. Understanding the characteristics of shallower soil is crucial for reclamation efforts. In order to obtain samples, these soils are dug up to a depth of one meter. If the soil is uniformly salt-affected the samples taken from one to two locations from every 0.4 hectares. Soil samples are collected separately for soil depths of 0–15 cm, 15–30 cm, 30–60 cm, and 60–100 cm soil depths. The soil samples were collected through an auger. The vertical side of the pit is marked at 15, 30, 60, and 100 cm below the surface when a pit is dug in the absence of horizons, and around 1 kg of material is gathered at each mark. Soil from every layer, cutting uniform slices of soil separately. Like when soil is sampled typically for fertilizer recommendations, one additional surface soil sample are taken in addition to the samples specified above.

As with the standard soil sample method the samples in bags with labels that include extra information on the depth of the samples, the sheet that is included with the sample contains details about the soil type, hardness, permeability, relief from salinity, seasonal rainfall, irrigation, the frequency of waterlogging, the water table, the history of soil management, the crop species and conditions of plant cover, and the depth of the hardpan etc. Before shipping soil samples to the testing facility site for analysis, we have sample bags and labels are correctly identified.

Results and Discussion

Soil parameter includes pH, humidity, K (potassium), P (phosphorus) and N (nitrogen) etc. Measurement of these parameters is necessary, which gives us an idea to choose the appropriate fertilizers for the deficient component of the soil and improves crop yield. From July 2018 to July 2022, a field study was conducted in the crop cafeteria at School of Agriculture Galgotias University, Greater Noida, Uttar Pradesh, India, to examine the effects of growing the green manure crop Dhaincha (*Sesbania sesban*) in acidic soil conditions on soil characteristics, nutrient availability, rice productivity, and other factors. The study found that the green manure-performed patch significantly increased the soil's physical characteristics and nutrient availability alteration.

The introduction of *Sesbania sesban* as a green manure crop enhanced paddy output in contrast to plots where it wasn't planted. The research analyzes the chemical, physical and biological properties of the soil quality assessment, before and after the reclamation, to find out the feasible way to indulge saline soils. The soil pH in 2018 was 8.75 which after three years of crop nurturing and reclamation efforts reduced to pH 8.0. The soil organic carbon was too low in the year 2018 and it was reported 0.27, 0.35, 0.39, 0.45 % and 0.47 in the year 2018, 2019, 2020, 2021 and 2022, respectively which is positive sign for reclamation (Singh *et al.,* 2022) (Table 1).

The use of green manure (*Sesbania sesban*), cow dung manure, vermicompost, neem cake, gypsum, and other components of the approved scientific procedure allowed us to improve the soil's attributes and start improving the soil's size, structure, patterns of association, and crop productivity (Fig. 3).

Taxonomic Description

The common *Sesban* is a small, frequently multiple-stemmed tree growing between 4 and 8 meters tall. It has linear-oblong, pinnately compound leaves 2–18 cm long and 6-27 pairs of leaflets (26x5 mm). With purple or brown striations on the petals, the raceme's two to twenty pea-shaped yellow blooms are yellow in colour. Sub-cylindrical pods with 10-50 seeds that are straight or slightly curved can be up to 30 cm long and 5 mm wide (Fig. 1 and Fig. 2).In India, common *Sesban* has a long history of use, primarily as a source of cut-and-carry forage and green manure. Because it increases crop yields and supplies fuelwood, improved fallows are planted or helped develop as volunteers in southern and eastern Africa maize fields. Rich compost is being created on the agricultural field from the gathered leaves. For cattle and sheep, its leaves are a good source of protein.

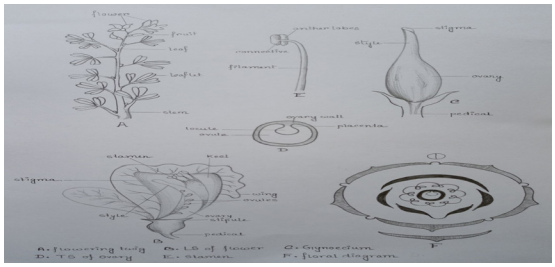

Fig.1: *Taxonomic diagram of Sesbania sesban* with floral formula**.**

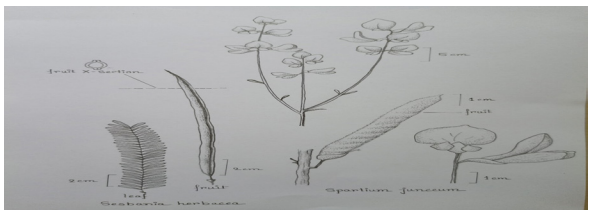

Fig. 2: *Taxonomic diagram of Sesbania sesban.*

Table 1: Showed year wise comparative assessment of soil.

S. No.	Parameters	Desirable Range	Year (2018)	Year (2019)	Year (2020)	Year (2021)	Year (2022)
1.	pH	6.5-8.5	8.75	8.40	8.30	8.00	7.75
2.	Soil Organic Carbon	0.35 (low) ≥ 0.80 %	0.27	0.35	0.39	0.45	0.47
3.	Phosphate	28 kg/ha ≥ 40.0 kg/ha (Medium)	36.20	28.00	34.00	18.00	17.25
4.	Electrical Conductivity (EC)	1.35 milimole/cm ≤ 1	0.94	1.35	0.98	0.67	0.65
5.	Potassium	101 kg/ha ≥ 250 (Medium)	87.58	101.00	122	193.00	192.00
6.	Available Sulphur	10.1 ≥ 15 ppm	14.00	15.60	14.80	15.00	14.25
7.	Available Zinc	0.61 ≥ 1.2 ppm	0.20	0.22	0.45	0.38	0.37

Fig. 3: A. Land preparation for rice cultivation. B. Removal of woody roots of *Sesbania*. C. Land leaching in rice filed. D. Inter mixing of *Sesbania* crops with soil. E. Rice crops after inter mixing of *Sesbania*. F. The fully groom of wheat field after soil treatment using *Sesbania*. G. *Sesbania* crops in fully mature stage. H. Dry *Sesbania* crops along with grasses. I. Removal of dry *sesbania* in the field.

Use of *Sesbania* in Rice Field

Sesbania generates both nitrogen and organic matter, both of which are beneficial to the soil and subsequent crop growth. When alternative nutrient sources cannot be reliably delivered due to poor infrastructure and transportation, growing green manures might occasionally offer a more affordable and consistent source of nitrogen.

Management of *Sesbania* in Rice Field

During the long day season, *Sesbania* generates up to 80-100 kg N/ha in around 40 days, and during the short day season, it can do so in 50-60 days.

Planting of *Sesbania*

Sesbania is produced either before or after the rice crop when the area is vacant. *Sesbania* can be planted with little to no-tillage, but more extensive soil preparation achieves a greater crop establishment. Due to its great photoperiod sensitivity, *Sesbania* blooms roughly 35 days during the long day season and 125 days during the short day season. Around 25°C, the optimum temperature for growth and development, *Sesbania* flourishes.

Seed Rate

Prior to the commencement of the rainy season, *Sesbania* seeds can be dispersed at a rate of 30 kg/ha in areas with low weed densities. It is possible to drop the sowing rate to 16 kg/ha with adequate field preparation and irrigation for each 1000 seeds-seed typically weighing between 14 and 18 grams. Seeds can be immersed in 100°C water for three seconds to hasten emergence and germination by up to 65%. Some farmers just pound the seed sacks to scarify the seeds, which causes the seed coat to partially tear.

Irrigation

Although standing water surrounding the crop is not necessary, irrigation water should be utilized when necessary, such as when the soil is cracking and *Sesbania* leaves are shedding.

Incorporation

After 45 to 60 days, before it gets woody, *Sesbania* can be used in a variety of ways, such as by slicing the crop for easier plowing. *Sesbania* can be overturned more quickly and successfully, for example, by using a wooden plank carried by an animal and then being plowed in the direction of the crop that has become lodged. When tillage is being done in deep mud, a hydro-tiller can successfully include bulky biomass.

The biomass is cut into little pieces by the short, triangular teeth of the high-speed cage wheel before being buried in the puddled soil. The field must be buried in water for at least 48 hours prior to using a hydro-tiller to incorporate the biomass. A tractor with four wheels and a rototiller is the most efficient method for mass production.

Seed Production

Growing *Sesbania* is possible when the day length is less than 11 hours. *Sesbania* blooms at these times in 30 to 35 days and yields seed in 30 days. Because they are frequently contaminated by pod borers, seeds gathered during the wet season are frequently of lower quality. Seeds can also be produced on marginal lands, dikes, or paddy bunds to cut expenses.

Conclusion

Sesbania sesban is one of the most crucial bio fertilizer matters. The source of nitrogen and all other nutrients is soil organic matter. *Sesbania* sesban plants fundamentally increase the amount of organic matter in the soil while improving its physical, chemical, and biological qualities. A number of earlier research found that adding various *Sesbania sesban* crops considerably enhanced the soil's chemical, physical, and biological qualities. In addition, green manure also potentially contributes to disease, pests, weed control, and increased soil erosion. *Sesbania sesban* is very important for environmental sustainability by reducing chemical fertilizers and pesticides, improving soil properties, controlling soil erosion, and preventing the leaching of nitrate and other chemical inputs into surface and groundwater.

Acknowledgement

The authors gratefully acknowledged the inspiration received from the Dean, School of Agriculture, Galgotias University and Visionary Chancellor Shri Suneel Galgotia Ji and Mr. Dhurv Galgotias, CEO for his continuous guidance and motivation.

Authors Contribution

The author's contributions are to conceive, design, and perform the experiment in the University crop cafeteria. The author also analyzed the research data, wrote the research paper and updated the research paper as per the peer reviewers' suggestions.

References

Angers, D.A. (1992). Changes in soil aggregation and organic carbon under corn and alfalfa. Soil Science Society of America Journal, 56:1244-1249.

Bala N., Sharma P.K. & Lakshminarayana, K. (1990). Nodulation and nitrogen fixation by salinity-tolerant rhizobia in symbiosis with tree legumes. Agriculture, Ecosystems and Environment, 33(1),33-46.

Bradbury, M. (1990). The effect of water stress on growth and dry matter distribution in juvenile Sesbania sesban and Acacia nilotica. Journal of Arid Environments, 18(3), 325-333.

Brady, N.C. (1974). The Nature and Properties of Soils. New York: Macmillan Publishing Co.

Carter, M. (2002). Soil quality for sustainable land management: Organic matter and aggregation-Interactions that maintain soil functions. Agronomy Journal, 94: 38-47.

FAO (2011). The state of the world's land and water resources for food and agriculture (SOLAW) - Managing systems at risk. Food and Agriculture Organization of the United Nations, Rome and Earth scan, London.

FAO (2017). The future of food and agriculture - Trends and challenges, Rome.

Gupta, N., Shanal P., Jain A. & Patel N. (2021). Sustainable Agriculture in India 2021 - What we know and how to scale up. New Delhi: Council on Energy, Environment and Water.

John, D.A. & Babu G.R. (2021). Lessons from the Aftermaths of Green Revolution on Food System and Health. Frontier in Sustainable Food System. 5:644559. doi: 10.3389/fsufs.2021.644559.

Lal, R. (2015). Restoring Soil Quality to Mitigate Soil Degradation. Sustainability 7(5): 5875-5895.

Nelson, D.W. & Sommers, L.E. (1982). Total carbon, organic carbon and organic matter. In A.L. Page, R.H. Miller and D.R. Keeney) Methods of soil analysis. Part -2, Chemical and Microbiological Properties, pp: 539-579.

Singh, M., Bharti, A., Bhatt, G.D., & Jain, P.K. (2022) Salt Affected Soil and its Management in the University Crop Cafeteria, Gautam Buddha Nagar, Uttar Pradesh, India. International Journal of Plant and Environment. 8(1): 90-92.