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Review Article

Weed organic soil amendments for sustainable development

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ABSTRACT

For developing countries the use of organic manure on crop will not only improve the soil properties but will also cut down on the foreign exchange need for the purchase of mineral fertilizers. The amount of organic manures needed for agronomic crops will depend on the nitrogen requirement of the crop as well as nitrogen content of soil. Organic matter plays a vital role in the productivity and conditioning of soil. It serves as a source of food for soil bacteria and fungi which are responsible for converting complex organic materials into simple substances readily used by plants. Undecomposed organic matter opens out heavy clay soils and improves their physical properties such as aeration and percolation. When applied to light soils particularly in semi-arid conditions, it makes them still more porous and produces harmful results. The addition or organic matter also improves the working quality or friability of soil. In association with colloidal clay and calcium, it helps the aggregation of soil particles to produce 'crumb' structure. But its diffused distribution, decomposed organic matter imparts a dark colour to the soil, which helps absorption of heat with beneficial effects on seed germination and plant growth in cold countries or harmful overheating of young seedlings in hot climates. Organic materials are a scattered resource and have to be collected. The production of organic manures involves labour for collection of materials and processing with appropriate technology to obtain good quality compost with minimum nutrient losses, transportation to fields and incorporation into soil. The farmers do not make serious efforts in preparation and conservation of organic manures and recycling of crops and animal residue. Standard method such as proper moisture (50-60%) and turning of organic mass during composting or FYM preparation are not followed resulting in nutrient losses and poor quality organic manures.

Key words: Organic Manure, weed manure, chemical fertilizer, Soil conditioner and Green Manure

INTRODUCTION

India is a primarily an agricultural oriented country where about 70 percent of the population is engaged in agricultural persuits "Agricultural is not merely an occupation. It is way of life, which for centuries has shaped the thoughts and outlooks of many millions of people".

Sustainable agriculture, which is characterized by farming profitably while minimizing damage to the environment, is not easy to practice. "Conventional" agriculture in the India is commonly considered to involve practices that have potential to damage the environment.

Our most precious and vital resource, both physical and spiritual, is that most common matter under foot which is scarsely even noticed "dirt" is, in fact, the mother-love of all terrestrial life and purifying medium wherein wastes are decomposed and recycled, and productivity is generated.

Agriculture plays a predominant role in the economic development of a country. The importance of agriculture in the economic development of a country cannot be under emphasised because to a large extent the development of the country depend upon the development of agriculture.

It is the primary sector of an economy that provides the basic things which are necessary for the existence of human beings. It also provides some raw materials for industries. As the agriculture is the biggest industry in the country, the development of other industries as well as of the development of the country is not possible without the development of the agriculture sector. Agriculture is the major sector in almost all the developing countries of the world. In these countries the main occupation of the people is agriculture but unfortunately agricultural sector is still underdeveloped.

The productivity level of food grain production also increased steadily from 1950 to 1996. Analysis of a 5 years average productivity of all food grains indicates that from just 582 kg/ha during 1950-55, productivity increased to 1499 kg/ha in 1995-96. Higher production and productivity were achieved mainly due to increase in irrigated area, wide adoption of high yielding varieties, enhanced use of fertilizers and plant protection chemicals (Balasubramaniyan and Palaniappan 2001).

As the availability of land is decreasing day by day, application of chemical fertilizers and pesticides has become necessary to meet food grains requirement. The effect of prolonged usage of chemicals on soil has resulted many disorders in human as well as living organisms and pollution of the environment. The development of an alternative source is of vital importance today in view of the increasing cost of chemical fertilizers. Utilization of eco-friendly green manure, compost, Neem cake and all other organic manures can minimise the problems at a large extent.

The production process in the ecosystem involves trapping the solar radiations and converting it to organic matter in the body of primary producers. A greater part of this gross production is consumed by the producers themselves in the respiration. Some part may be decomposed or lost as litter. The remaining part is left as the biomass.Biomass is the amount of organic material present in a community or population at a given time and is represented in gms/cm^2 or tonnes/ha. It is generally expressed in terms of dry weight.

Grassland has been paid relatively less attention from the point of view of study or their conservation. They are one of the most important ecosystems of the world. Their primary role lies in providing a natural source of food for grazing animals. The legumes in grassland help for maintaining nitrogen content of the soils and the grass cover is a protection against soil erosion. They are also the systems, which can be easily converted to an agrosystem. The grass land vegetation also consists of different types of weeds as composites, legumes and some other dominant groups as weeds of different families. The quality of vegetation in any ecosystem is one of the best indications of the environmental conditions there. Weed biomass form a free crop of great potential value. The weed biomass is an open treasure for plants which can be used as a nutrient source. The production is the weight or biomass or organic matter accumulated by an organism or community over a given period of time. The productivity of the weed plants depends upon the type of plants, ecological condition, and age of the plant. Normally the terrestrial weeds are available only in monsoon and their productivity studies get restricted to the few months in the rainy season. This free crop can be conserved by drying and storing it for use in the other months of the year. This weed biomass can be used for the preparation of compost, green manure, for biogas production, as forage, medicinal plants, for hatching and weaving materials. It can also be used for producing paper pulp, extracting leaf protein and as green leafy vegetables in our daily diet.

The biochemical composition of this free crop provides us a good quality of compost manure and some edible weed act as a very good source of β-carotene, Vitamin C and proteins.

Agricultural land on the major part of country suffers from erosion. Apart from reducing the yields through the loss of nutrients erosion destroys the soil resources itself every year. The problem of conserving soil and moisture is also of very great importance in the extensive regions of low and uncertain rainfall. Wind erosion also has been responsible for destroying the valuable top soil in many areas. In addition to the erosion of the cultivated fields, neglected pastures and wastelands, considerable roadside erosion also takes place owing to defective highway engineering. Severe erosion occurs in the sub-humid area per humid areas due to high rainfall and proper and improper management of land and water.

With its increasing demand for higher food production to feed increasing population, there is

increased demand for chemical fertilizers, which are based on non-renewable fossil fuel, improved seeds, and agrochemicals.A group of micro organisms have the capacity to enrich the soil fertility either as free living or in association with host plant. It is impossible to grow healthy vigorous plants without humus. Humus has been described as "vegetable mould manufactured from mixed plant wastes by living organisms". The rotting is done by mainly fungi and continued by bacteria. The speed of rotting depends on the nature of the material and their moisture content, the conservation of heat, the degree of aeration, and the soil pH. Soil contains N.P.K. as macro-elements and other micro-elements or trace elements. It is alive with billions of micro-organisms per gram. An effective and profitable response from manures and fertilizers depends upon a continuous and assured supply of adequate soil moisture. Hence irrigation and assured rainfall increases the agricultural production. Plant growth and development primarily governed by the environmental conditions of the soil and climate. The success or failure of farming is intimately related to weather conditions. Weather conditions such as temperature, wind speed, sunshine, atmospheric pressure, cloud type and amount, humidity, rainfall precipitation etc. all affect the crop. organic materials as soil amendments and sources of plant nutrients.

WEEDS AS GREEN MANURE

Certain leguminous and other low C:N ratio weed plants can be used as green manure before they set seeds (Bharati Jadhav and Suryawanshi, 1998). Crotons (*Croton sparsiflorus*) growing on bunds and abandoned fields are used in South India for green manuring rice fields and camelthorn (*Alhagi camelorum*) and pluche a (*Pluchea lanceolata*) in sandy soils of North India. The possibility of converting weeds into compost and ash manure is an important area of research on utilization of weeds particularly in view of current shortage of fertilizers and high N and K_2O content of many weeds (Bharati Jadhav and Suryawanshi, 1998).

Green manuring is the practice of growing a crop and ploughing it or turning into the soil in green to benefit a companion or succeeding crop. 'Green leaf manure' refers to turning under of green leaves and tender green twigs collected from shrubs and trees grown on the bunds, wastelands and nearby forest areas. Leguminous as well as non leguminous plants or crops used as green manure practiced to enrich soil nitrogen. When organic matter is decomposed, the nitrogen bound in the organic matter is released first as ammonia. The ammonia may be absorbed by the plant or converted to nitrate. Apart from enrichment of soil nitrogen, green manuring enriches the phosphorus, calcium, sulphur and other mineral content of soil.

Sunnhemp, (*Crotolaria juncea* L. and *Sesbania sesban* L Merr. (Shevari) Could be utilized profitably if a part of protein is extracted from them and the fibre left after protein extraction is buried into the soil. The yield of wheat per kilogram of N supplied through fibre was greater than the yield obtained when the whole plant was used as green manure (Bharati Jadhav *et. al.* 1979, 1982).

Rice was grown under submerged conditions in soil amended with 10 g wheat straw/kg soil with 100mg 15N/kg as urea and *Sesbania aculeata.* Percentage N derived from labelled material was higher from urea than *S. aculeata.* There was also a higher recovery of labelled N and a lower amount of unaccounted 15 N after rice harvest with N from urea compared with N from *S. aculeata.* (Patil and Sarkar, 1991).

The use of *Sesbania rostrata* and *Aeschynomene afraspera* as green manure crops in low input, low land rice farming systems is a viable alternative to mineral N fertilizer application (Becker and Ottow, 1991). The catch crops *Lupinus luteus* L*., Sinapis alba* L*.,* and *Trifolium pratense* L., grown without fertilizers, were used for green manure. In the first cycle catch crops increased oats, fibre flax, starch content of potato tubers, grain quality of cereals and seed quality of fibre flax. Catch crops increased humus, N, P and K contents and biological activity in the soil. (Kulbida and Artyushenko 1991).

Methods of growing green manure in situ: The common methods are:

1. Summer sown catch crops: The quick growing green manure crops like sunhemp, dhaincha, pilipesam etc. are grown in May to June and buried in the field, in the months of July to August before the planting of the main crop of the kharif season. This method is most common with paddy in Andhra Pradesh, Karnataka, Tamilnadu, Kerala, Orissa and West Bengal.

2. Inter row sown crops: The quick growing green manure crops are sown along with the main crop between the lines of the crops. Such green manure crops dhaincha inter-cropped with paddy, sunhemp, cowpea or horse gram sown in between the rows of irrigated American cotton and maize. This method is followed in Punjab, Uttar Pradesh, Karnataka, Gujrat and part of Madhya Pradesh.

3. Crops taken on base fallow: In wheat tracts or with vegetables, green manure crops like sunnhemp, guar, cowpea and dhaincha are sown and buried during the kharif season. Instead of leaving field fallow or alternative krarif crop being raised. With this method, the cultivators loose one kharif season crop. This method is popular in Punjab, Uttar Pradesh, Rajasthan, Bihar and Madhya Pradesh.

4. Green manure as a main crop: This practice is adopted only on very poor sandy soils as a preliminary to more profitable rotations or in the programme of reclaiming saline and alkaline soils. Under these conditions, dhaincha is raised as a main green manure crop.

According to an ideal green manure crop should possess the following characteristics

1. It should be a legume with good nodular growth habit indicative of rapid nitrogen fixation under even unfavourable soil conditions.
2. It should have little water requirement for its own growth and should be capable of making a good stand on poor and exalted soils.
3. It should have a deep root system which can open the sub soil and tap lower regions for plant nutrients.
4. The plant should be of a leafy habit capable of producing heavy tender growth early in its life cycle.
5. It should contain large quantities of non-fibrous tissues of rapid decomposability containing fair percentage of moisture and nitrogen.

As it is expected that ideal green manure crops should possess the above properties. The weeds fulfill all above conditions along with it, they have several advantages as:

1. It is not necessary to purchase costly seeds.
2. It is available free of cost and grow on all types of soil in all seasons.
3. It is not necessary to sacrifice the season for their cultivation.
4. It adds organic matter to the soil. This stimulates the activity of the soil microorganisms.
5. Weed green manures improve the structure of soil.
6. It facilitates the penetration of rain water, thus decreasing run off and erosion.
7. The green manure crops hold plant nutrients that would otherwise will be lost by leaching.
8. However they are more abundant and available everywhere in every mansoon, specially in irrigated areas.

It is true that all the weeds cannot be recommended to use as green manure. (Suryawansh, 1999). Some leguminous and non leguminous weeds are excellent green manure crops with large quantity of non fibrous tissues and fair percentage of moisture and nitrogen.

ORGANIC MANURES AND NEEM CAKE

Organic agriculture is natural in the Indian context. It is not just a philosophy but is also a means to stabilize our food product through maintenance of soil health and avoiding the use of hazardous chemicals, fertilizers and pesticides which have been disturbing our ecosystem on a large scale. Thus there is an urgent need for enunciating the most suitable organic agricultural practices to varied agro-climatic conditions to set standards for their effective implementation. Organic manures are primarily considered as nitrogen carriers, and are of two kinds bulky or non proteid organics and concentrated or proteid organics. The former refer to farmyard manure, compost, and green manure, and later to oilcakes, fishmeal, dried blood etc. of the proteid organics, oilcakes (Neem cake) are the most commonly used in the country. Effect of oil cake is improved when applied a fresh compared to dry form. It has been shown that Neem cake application reduces the pest incidence. Oil cakes contain high amount of N and small quantities of P and K, they have low C:N ratio which helps in releasing the nutrients quickly. High production of chicken manure resulted in lower utilization of urea N (Lu *et. al.,* 1991). Rice cv Rasi was grown

Table : 1 Analysis of Legume weed manures before sowing of Spinach

Sr. No.	Name of the plant	Type of manure	Fresh manure wt. kg/ha	Dry matter		Nitrogen		Percentage		C/N ratio		
				%	Kg/ha	%	Kg/ha	Phos-phorus	Potas-sium	Ash %	Carbo n%	C/N ratio
1	*Cassia tora*	Green manure	112800	17	19176	1.99	382	0.155	1.072	13.0	7.54	3.79
2	*Crotolaria notonii*	Green manure	112800	19	21432	2.65	568	0.160	1.209	13.5	7.83	2.96
3	*Tephrosia hamiltoni*	Green manure	112800	23	25944	2.98	774	0.193	1.063	14.2	8.24	2.77
4	Mix weed	Green manure	112800	21	23688	2.32	550	0.179	1.053	13.7	7.95	3.43
5	*Cassia tora*	Dry powder	112800	17	19176	1.49	286	0.127	0.999	12.7	7.37	4.95
6	*Crotolaria notonii*	Dry powder	112800	19	21432	1.99	427	0.158	1.009	13.7	7.95	4.00
7	*Tephrosia hamiltoni*	Dry powder	112800	23	25944	2.66	691	0.178	0.951	14.0	8.12	3.06
8	Mix weed	Dry powder	112800	21	23688	2.49	590	0.173	0.990	13.0	7.54	3.03
9	*Cassia tora*	Compost	150475	35	52666	0.83	437	0.070	0.775	44.7	25.93	31.24
10	*Crotolaria notonii*	Compost	196272	31	60844	1.16	705	0.081	0.814	41.0	23.78	20.50
11	*Tephrosia hamiltoni*	Compost	166944	30	50083	1.33	666	0.047	0.785	41.5	24.07	18.10
12	Mix weed	Compost	173712	37	64273	1.0	643	0.063	0.775	42.2	24.48	24.48

Source: (Mogle, 2002)

at Rajendranagar, Andrhra Pradesh in 1988-89 dry season and the 1989 wet season without adding N or with 100 kg N/ha applied as urea as *Sesbania cannabina, Gliricida sepium* (Jacq) Kunth ex. Steud, *Crotolaria juncea* L. or *Ipomoea carnea* Acut. green manures or as 50% urea + 50% green manure mixtures. All N treatments increased grain yield compared with controls. The agronomic efficiency of urea was lower in the wet than in the dry season possibly due to greater losses while the agronomic efficiency of green manures increased in the wet season, when higher temperatures may have increased the rate of mineralization (Kundu *et al.,* 1991).

Sustainable agriculture seeks close harmony with nature. The challenge of sustainable agriculture is that it is information-intensive and requires the farmer to have a deep and detailed understanding of natural processes. Because of its special requirements, farmers practicing sustainable agriculture may need to develop more management skills than even modern "conventional" agriculture requires.

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