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ROLE OF GREEN MANURING IN ORGANIC FARMING

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Abstract

Soil health degradation is one of the most important problem faced by the farmers. Due to it the land is becoming barren. The uncontrolled use of chemical fertilizers is deteriorating the soil physical, chemical and biological properties. Therefore, to overcome this problems the concept of organic farming came into existence. The organic farming depends on organic manures like farm yard manure, compost, green manuring etc. Therefore, green manuring is one of the most important type of manure used in organic farming. Green manures are fertility building crops and may be broadly defined as crops grown for the benefit of the soil. The green manuring crops improve the humus, organic carbon, nitrogen and soil microbial growth. Green manuring can bring a number of advantages to the grower. Green manuring leads to the addition of organic matter to the soil. Green manuring crops increase the biological activity in the soil. These crops improve soil structure. Green manure crops helps in reducing soil erosion. They help to increase the supply of nutrients available to plants. These crops help in reducing leaching losses. It is also reported that green manuring crops help to suppress weeds, reducing pest and disease problems, providing supplementary animal forage. Thus, the present study indicates the type and importance of green manuring on plant growth.

Key words : Organic farming, green manuring, organic matter, humus, organic carbon, soil organic matter.

Introduction

Organic farming is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, growth regulators and livestock feed additives. It rely on crop rotations, green manures, legumes, crop residues, animal manures, off farm organic wastes and aspects of biological pest control to maintain soil productivity and tilth to supply plant nutrients and to control insect, pests, disease and weeds. Green manuring is a part of organic farming. Green manuring is the practice of enriching the soil by ploughing under or soil incorporation of any green manure crops while they are green or soon after they start flowering. "The value of Green Manuring lies in the fact that organic matter is incorporated into the soil". The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility. The decay of this organic matter influences the availability of the soil nutrients. Crops that are grown for green manure are called green manure crops. Green manuring has recently been under practice by our farmers for decades. Estimates suggest that a 40-50 days old green manure crop can supply up to 80-100 kg. N/ha. Even if half of this N is crop utilizable, a green manure crop can be a substitute to 50-60 kg. fertilizer N/ha (Sharma *et al*., 2013). Some of the potential green manuring legumes are dhanicha, sunhemp, cowpea, mung, bean, guar and berseem etc. Dhanicha, sunhemp, mung bean and guar grown during *kharif* season as green manure crops have been reported to contribute 8-21 tones of green matter and 42-95 kg. of N/ha. Similarly, Khesari, cowpea and berseem grown during *rabi* season can contribute 12-29 tons of green matter and 67-68 kg of N/ha (Mishra and Naik, 2004).

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Materials and Methods

Keeping the above facts in mind, the practice of green manuring is performed in different ways according to suitable soil and climatic conditions of a particular area. Broadly the practice of green manuring in India can be classified in two ways.

A) Green leaf manuring

Where the application of green leaves and twigs of trees, shrubs and herbs collected from plants grown in wastelands, field bunds, degraded lands and nearby forest. They are turned down or mixed into the soil 15-30 days

before sowing of the crops depending on the tenderness of the foliage or plant parts is known as green leaf manuring.

B) *In situ* green manuring

In situ green manuring is also called as On–farm green manure or legume green manuring. In this system, the short duration legume crops are grown and buried in the same site when they attain the age of 60-80 days after sowing. This system of on-site nutrient resource generation is most prevalent in northern and southern parts of India, where rice is the major crop in the existing cropping systems. Almost any crop can be used for green manuring, but legumes are preferred because of their ability to fix nitrogen from the air. Green manuring with legumes (peas, clovers, lentils, etc.) is called legume green manuring. These crops should be turned into the soil before setting of seeds. Legume green manuring could be profitably used on lands where, it was not possible to add animal manures.

Results and Discussion

It was observed that as the 6.7 million hectares area is covered under green manure, which accounts for 4.5 per cent of net sown area (142 million ha) of the country. The practice of green manuring is most common in rice growing states like A.P., U.P., Karnataka, Punjab and Orissa which contribute 41, 16, 11, 6 and 5 per cent to the total area under green manuring in India, respectively. Whereas, the share of Gujarat (3%), M.P. (3%), Himachal Pradesh (2%) and Haryana (1.7%) is not very encouraging and concerted efforts are to be made out at all levels to bring more area under green manuring that too in irrigated area, if nutritional need of organic farming is to be made. India has maximum number of organic growers (400551). The benefits obtained from green manure crops are directly related to the amount of biomass and nutrients added in soil. Biomass production of green manure crops varies due to various factors such as species of the legumes, environmental conditions, soil fertility and crop management practices and age of green manure crops. *Sesbania aculata* and *Crotolaria juncea* have higher rate of biomass production and both can produce dry matter to the extent of 16 to 19t/ha within a short period of 45-60 days and on an average about 5t/ha dry matter can easily be produced, which is sufficient for meeting out nutritional demand of a crop either in *kharif* or *rabi* season. Beside these, some weeds particularly *Eichhornia crassipes* have maximum rate of biomass production and one can get about 70q/ha dry matter with in a period of 46-60 days and could be used for *ex-situ* green manuring. Weeds like *Parthenium hysterophorus* and *Trianthema partulacastrum* are abundantly found in different habitat with better nutrient content and dry matter production cab be used to cater the need of the organic farming in our country (tables 3 and 4).

Normally, all GM crops which are used for *in-situ* or *ex-situ* green manuring contain all the plant nutrients essential for completing the life cycle of any plant. Among the different GM crops, *dhaincha* and Sunhemp have higher accumulation of major and micro nutrients on account of more biomass production and better nutrient composition compared to food legumes which are inferior due to low contents of nutrients coupled with less dry matter production. Water hyacinth has great biomass production and nutrient accumulation and it could contribute 198 kg N, 63.0 kg P_2O_5, 125.3 kg K_2O when about 70 q/ha dry matter is added in the soil. It could be a good source of plant nutrients through *ex-situ* green manuring.

Techniques of green manuring in the field

The maximum benefit from the green manure crop cannot be obtained without knowing the:

1) Right time of growing.

2) Right time of incorporating in the soil.

3) Time required for decomposition

(a) Time of sowing of the green manure crop : Time of sowing of the green manure crop varies according to local conditions and resources available. Normally, green manure crop is sown immediately after monsoon rains. But, if irrigation facility is available, green manure crop can be grown as catch crop after harvesting of rabi crop during April and May. Sunnhemp and dhaincha are suitable for growing in April-May and can be buried in June-July before planting of main *kharif* crop. In rainfed areas intercropping of dhaincha with paddy in row ratio of 4:1 can be done. Also sunnhemp and cowpea can be intercropped in widely spaced crop such as cotton, maize and sugarcane.

Green manures and undersowing : Undersowing involves growing a green manure at the same time as that of main crop. Sometimes they are sown with the crop or slightly later when the crops are already growing. This reduces competition between the green manure and the crop. No extra time is spent preparing the land and sowing the green manure.

(b) Stage of burying of green manure crop : Burial of green manure crop at specific time provides maximum nitrogen and organic matter. This specific stage is when plant is immature and has started flowering, as the basic aim of green manuring is to provide maximum

Table 1 : Representing the plant species used as green leaf manuring.

S. no.	Common name	Botanical name
1.	Subabul	*Leucaena leucocephala*
2.	Glyricidia	*Glyricidia maculate*
3.	Karanj	*Pongamia pinnata*
4.	Madar	*Calotropis gigantean*
5.	Neem	*Azadiracta indica*
6.	Mahua	*Madhuca indica*
7.	Wild dhaincha	*Sesbania speciosa*
8.	Tarwar	*Cassia auriculata*
9.	Ipomoea	*Ipomoea* sps.
10.	Water hyacinth	*Eicchornea* spp.

Table 2 : Representing the nutrient content in weeds on dry weight basis.

S. no.	Weeds	Nutrient content (%)		
		N	P	K
1.	*Amaranthus viridis*	3.16	0.06	4.51
2.	*Cassia occidentalis*	3.08	1.56	2.31
3.	*Chenopodium album*	2.59	0.37	4.34
4.	*Digitaria sanguinallis*	2.00	3.36	3.48
5.	*Echinocloa crussgalli*	2.98	0.40	2.96
6.	*Portulaca quadrifida*	2.40	0.09	5.57
7.	*Solanum xanthocarpum*	2.56	1.63	2.12
8.	*Trianthema partulacastrum*	2.34	0.30	1.15
9.	*Parthenium hysterophorus*	2.66	0.88	1.29
10.	*Eichhornia crassipes*	2.83	0.90	1.79

compared to matured plants. Delay of even 15- 20 days reduce nitrogen content and increase C:N ratio, fibre, hemicelluloses, cellulose, lignin making it difficult for soil microorganisms to act and decompose (Yadav *et al*., 2013).

Method and depth of burial of green manure crop : Before a crop is sown the green manure is dug back into the soil. Green manures should not be ploughed in as this buries the plants and the nutrients too deep. They should be turned in just under the soil surface. Here, it decomposes and the nutrients held inside green manure plants are released. Immature crop can decompose at any depth, but mature crop should be buried at less depth. If the weather is dry green manure crop should be buried at more depth compared to moist season. If moisture in soil is less water should be supplied externally. Green manure crop should be buried at higher depth in sandy soil and in heavy soils at less depth for proper decomposition.

(c) Time interval between burial of green manure crop and the sowing of the next crop : The time interval should be such that it allow complete decomposition of the turned in green manure crop before planting of the next crop. Time interval depends on the following factors: 1) weather conditions, 2) nature of buried green material. Crop should be sown after 35- 45 days of burial of green manure crop as green manure crop takes about 4-6 weeks for complete decomposition. If the green manure crop is succulent, then there is no harm in transplanting the paddy immediately after turning in the green manure crop. However, in case of woody,

Table 3 : Representing the biomass production and nutrient accumulated by green manure crops.

S. no.	Crop	Dry matter in 45-60 DAS (q/ha)	Nutrient accumulation						
			Major nutrients (kg)			Total micro nutrients (g)			
			N	P_2O_5	K_2O	Zn	Fe	Cu	Mn
1.	*Sesbania rostrata*	50.00	131.0	18.5	62.5	200	9840	180	1050
2.	*Sesbania speciosa*	30.00	119.4	07.2	39.0	150	1440	132	330
3.	*Gliricidia maculata*	35.00	125.6	125.6	46.8	108	1980	68	540
4.	*Eichhornia crassipes*	70.00	198.1	63.0	125.3	350	3290	133	2940
5.	*Crotolaria juncea*	52.50	150.2	47.3	93.9	262	2467	100	2205
6.	*Trianthema spp.*	25.00	58.5	07.5	28.7	75	4980	47	500
7.	*P. hysterophorus*	40.00	106.4	35.2	51.6	280	1880	76	640

succulent green matter at burying. During early period of crop growth N content, protein, water soluble constituents are maximum, whereas fibre, hemicelluloses, cellulose, lignin and C:N ratio are less. Therefore, tissues of immature plants usually decompose more rapidly as then sufficient time should be allowed for it's decomposition. Green manure crop was intercropped in between the rows of the main crops like paddy, cotton, sugarcane etc. Then, it is buried in the succulent stage for it's rapid decomposition.

Table 4 : Representing the content of green manure crop and weeds on dry basis.

S. no.	Plant	Botanical name	Nutrient content (%) on air dry basis		
			N	P	K
	Green manure crop				
1.	Sunnhemp	*Crotolaria juncea*	2.30	0.50	1.80
2.	Dhaincha	*Sesbania aculata*	3.50	0.60	1.20
3.	Sesbania	*Sesbania speciosa*	2.71	0.53	2.21
4.	Cowpea	*Vigna sinensis*	1.70	0.28	1.25
5.	Mungbean	*Vigna radiate*	2.21	0.26	1.26
	Green leaf manure				
6.	Gliricidia	*Gliricidia sepium*	2.76	0.28	4.60
7.	Pongamia	*Pongamia pinnata*	3.31	0.44	2.39
8.	Neem	*Azadiracta indica*	2.83	0.28	0.35
9.	Gulmohar	*Delonix regia*	2.76	0.46	0.50
10.	Peltophorum	*Peltophorum ferrugenum*	2.63	0.37	0.50
	Weeds				
11.	Parthenium	*Parthenium hysterophorus*	2.68	0.68	1.45
12.	Water hyacinth	*Eichhornia crassipes*	3.01	0.90	0.15
13.	Trianthema	*Trianthema partulacastrum*	0.64	0.43	1.30
14.	Ipomoea	*Ipomoea*	2.01	0.33	0.40
15.	Calotropis	*Calotropis gigantean*	2.06	0.54	0.31
16.	Cassia	*Cassia fistula*	1.60	0.24	0.20

At Navsari (Gujarat), incorporation of either of the three green manure crops *S. rostrata*, *S. aculeate* or *C. juncea* was comparable with that of 100 kg nitrogen/ha for grain yield of 5 ton /ha during summer (Hiremath and Patel, 1998). Green leaf manuring with gliciridia, ipomea or pongamia considerably reduced fertilizer needs of summer rice at Bhubaneshwar (Mishra *et al*., 1998.). Also in Estonia, Maiksteniene and Arlauskiene (2004) reported that the yield of spring wheat was 2.12 mg/ha on unfertilised soil, whereas red clover and hybrid lucerne, as a preceding crop gave a wheat yield of 3.46 mg/ha and 3.57 mg/ha, respectively. Green manuring in the absence of fertilizer nitrogen, decreased the mustard yield. But the combined application of green manure with 100 kg N ha^{-1} (otherwise optimum rate) further improved the yield potential of mustard, illustrating the benefit that any amount of fertilizer N cannot achieve. Green manuring to mustard substantially improved the yield (920 kg ha^{-1}) of the succeeding crop of rice.

The physico-chemical properties of soils are affected significantly due to addition of organic matter in the form of green manures. It improves soil texture, structure, infiltration rate, bulk density and water holding capacity of soil. It is evident from that incorporation of subabool, sunnhemp and crop residues were equally effective in increasing infiltration rate of soil while the water use efficiency of sorghum was increased significantly with the green leaf manuring of sunnhemp, subabool and fertilizer application over crop residues.

Conclusion

Therefore, it can be concluded that green manures improve soil structure, letting more air into the soil and improving drainage. Organic matter help sandy soil hold more water and not drain so quickly as a result of increased aggregate stability and porosity. Also organic matter reduces rate of runoff and soil erosion. Change in chemical property of soil could be clearly observed. Leguminous green manure crop in soil increases nitrogen level by fixation. Increase in Fe and Mn concentration can be seen under submerged condition. Different green manures and grain-legumes are used to increase the nitrogen content and texture of the soil. Among the green manures *Sesbania aculata* accumulated the largest amount of biomass and nitrogen contribution and among the grain legumes, cowpea ranks first both in terms of grain yield and biomass addition.

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