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Study of characterization of green manures and their effect on the chemical properties of soil in entisol

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Abstract

The laboratory experiment was carried out for 120 days in ambient condition to study mineralization of nitrogen from various sources of green manures, added on the basis of carbon content. Among the various sources of green manures the highest amount of total N, P and Fe contents were observed in the Cow pea while the lowest amount of total N, P, K, S, Mn, Zn and Cu contents were recorded in *Subabul*. The lowest C:N ratio (11.97) was recorded in *Glyricida*. However, the highest C:N ratio (20.89) was noticed in *Sunnhemp*. The soils properties viz., pH, EC, calcium carbonate, Ex. Ca, Ex. Mg and all the DTPA extractable micronutrients were significantly not affected due to the incorporation of all the sources of organic manures. However, the addition of all the sources of organic manures significantly improved the organic carbon, available nitrogen and potassium content as compared with control treatment.

Keywords: Green manures, micronutrients, C:N ratio

Introduction

Green manuring is an ageold practice of agriculture where crops are incorporated into soil primarily as a soil amendment and as a source of plant nutrients for other crops, which lost importance as the use of mineral fertilizers became widespread. legumes are used as green manures, they fix atmospheric nitrogen and add a lot of organic matter to the soil. Organic matter when they decompose adds macro and micro-nutrients as well as improves the soil organic carbon content. The most effective means of improving natural supply of N and organic matter to the soil is the cultivation of suitable legumes and the in-situ incorporation at an appropriate stage of growth. The suitability of organic material as a sources of N depends to a great extent on its mineralization of N in relation to crop demand. The mineralization of N from crop residues varies with N content and C:N ratio of residue (Pathak and Sarkar 1994)^[9]. At present, the level of organic carbon has declined down to 0.2 – 1.0%. Soil fertility is closely linked to soil organic matter. In poor soils, it is the organic matter that determines the improvement of physical properties, water retention and biological activity, as well as the storage and slow release of plant nutrients. The humans need to produce crop yields to cope up with ever increasing population. In this context, soil organic carbon plays an important role in ensuring good health of the soil. Higher soil organic carbon content will result in higher fertilizer use efficiency. Therefore, maintenance of soil fertility is very important to increase food production on long term basis for future generations. Use of green manure cover crops for soil fertility recoupment is among the most promising technologies to reverse the problems of land impoverishment for the poor rural people. When legumes are used as green manures, they fix atmospheric nitrogen and add a lot of organic matter to the soil. Organic matter when they decompose adds macro and micro-nutrients as well as improves the soil organic carbon content.

Material and Methods

The laboratory experiment was conducted at wire house, Soil Science and Agricultural Chemistry Section, RCSI College of Agriculture, Kolhapur during December 2018- March 2019 under ambient condition.

Soil: Soil samples from 0-15 cm depth were collected randomly before conduct of the experiment to study the physico-chemical properties of soil. Physical and chemical properties of the soil viz., sand, silt, clay, textural class, pH, EC, calcium carbonate, organic carbon, available nitrogen, available phosphorus, available potassium, exchangeable calcium, exchangeable magnesium, available sulphur, DTPA extractable micronutrients (Fe, Mn, Zn, Cu) were determined.

Incubation Study: The green manures collected were added on the basis of carbon content @ 1.5 g C Kg⁻¹ soil. The 10 kg capacity plastic pots were field with 2 mm sieved, 5 kg entisol soil. Carbon was added through chopped green manures on oven dry weight basis by considering moisture content on fresh weight basis. Chopped green manures and MPKV's decomposing culture @ 2.5 g per 5 kg soil were mixed in soil

Results and Discussion

Characterization of Green Manures and their C:N Ratio

The green manure crop viz., Dhaincha, Sunnhemp, Cowpea were collected from field which is harvested at 45 day old and Subabul, Glyricidia and Neem leaves were collected from field sources.

The N concentration in green manure crop residue ranged from 2.01% in sunnhemp to 3.16% in cowpea. Variation in P and K concentration among green manure residue was high ranging from 0.15% in subabul to 0.75% in cowpea and 0.16% in subabul to 4.60% in glyricidia, respectively. The concentration of carbon in the crop residue differed considerably ranging from 33.0% in glyricidia to 52.3% in

neem leaves. Concentration of Sulphur was variable ranging from 0.26% in subabul to 0.46% in dhaincha. Concentration of different micronutrients viz., Fe, Mn, Zn and Cu in various crop residues show wide variation. The iron content varied from 0.52 g kg⁻¹ in subabul to 1.04 g kg⁻¹ in cowpea, similarly Mn ranged from 0.098 g kg⁻¹ in subabul to 0.38 g kg⁻¹ in glyricidia as well as Zn ranged from 0.094 g kg⁻¹ in subabul to 0.30 g kg⁻¹ in cowpea and Cu ranged from 0.055 g kg⁻¹ in sunnhemp to 0.10 g kg⁻¹ in dhaincha.

There was wide variation in C:N ratio of green manure crop residue. The C:N ratio of green manure crop residue varied inversely to their N concentration. The C:N ratio of green manure crop residue differed considerably ranging from 11.97 in glyricidia to 20.89 in sunnhemp. Constatnides and Fowners, (1994) [7] reported the similar results that the green manure crop residue had wider C:N ratio due to their low N concentration

From data in relation to different parameters following decreasing trend was observed:

N concentration: cowpea >dhaincha>subabul> neem leaves >glyricidia>sunnhemp.

Pconcentration: cowpea >sunnhemp>dhiancha>glyricidia> neem leaves >subabul.

S concentration: dhaincha> cowpea >sunnhemp> neem leaves >glyricidia>subabul.

C concentration: neem leaves >dhaincha> cowpea >sunnhemp>subabul>glyricidia.

C:N ratio :sunnhemp> neem leaves >dhaincha> cowpea >subabul>glyricidia.

Table 1: Chemical composition of green manuring crops

Green manures	Total N (%)	Total P (%)	Total K (%)	Total S (%)	Total C (%)	C:N Ratio	Micronutrients (mg kg ⁻¹)			
							Fe	Mn	Zn	Cu
Subabul	2.85	0.15	0.16	0.26	36.0	12.6	522.7	98.1	94.8	62.02
Glyricidia	2.77	0.28	4.60	0.30	33.0	11.97	902.5	387.8	220.7	99.37
Dhaincha	2.86	0.33	2.07	0.46	43.80	15.03	835.7	231.7	122.9	98.6
Sunnhemp	2.01	0.50	2.0	0.38	42.00	20.89	944.1	226.3	121.6	55.87
Neem leaves	2.83	0.28	1.3	0.32	52.3	18.72	754.3	151.1	122.9	56.02
Cowpea	3.16	0.75	2.10	0.40	42.60	13.48	1041.2	194.5	303.3	75.27

Effect of Green Manures on Chemical Properties of Soil

The data on chemical properties and available nutrient status after end of incubation study influenced by different treatments of green manure sources presented in Table 4.10 and Table 4.11.

The soil properties viz., pH, EC, calcium carbonate percent (CaCO₃%), exchangeable Ca and Mg and micronutrients viz., Fe, Mn, Zn, Cu after the end of incubation study did not differ significantly due to the different treatments of green manure sources. The soil chemical properties after end of incubation study not much more influenced by different green manure treatments.

Organic Carbon

The organic carbon content of soil after end of incubation study was found increased in green manure residue incorporation than unamended soil (Table 4.10). Among the green manure residues subabul (T₂) recorded significantly higher soil organic carbon content (0.50%) closely followed by glyricidia (0.49%). It was lowest in unamended soil (0.39%). The increase in organic carbon content in green manure residues could be attributed to direct incorporation of organic matter on basis of carbon content in the soil. The subsequent decomposition to these materials might have

resulted in the enhanced organic carbon content in soil. Similar results were also reported by Bhandari *et al.* (1989) [3].

Available Nitrogen

The available nitrogen content of soil after end of incubation study differ significantly with incorporation of green manure crop residues (Table 4.10). It was ranged from 77.17 to 82.28 mg kg⁻¹. The highest available N content in soil 82.28 mg kg⁻¹ was recorded with incorporation of glyricidia. However, it was at par with subabul and cowpea treatments. The increase in soil available nitrogen content with green manure crop residue may due to direct addition of nitrogen through green manure crop residue to available pool of soil. Similar results were reported by Bhandari *et al.* (1992) [4]. This may be attributed to addition of higher organic matter to incorporation of green manure residues and its decomposition. The decomposition of organic matter is accompanied by release of appreciable amount of CO₂, when dissolved in water form a carbonic acid which is capable of weathering certain primary minerals. The increase in available N due to organic material application might also be attributed to greater multiplication of microbes caused by addition of organic material for the conversion of organically bound N to inorganic form. The

favorable condition under green manure crop residue addition might have helped in mineralization of soil leading to build up of higher available N in soil.

Available Potassium

The available K content of soil after end of incubation study varied significantly due to different green manure crop residues (Table 4.10). the application of glyricidia crop residue reported significantly higher amount of available K

(111.66 mg kg⁻¹). However, it is on par with all treatments except neem leaves (105 mg kg⁻¹). The increase in available K may be attributed due to the direct addition of potassium to available pool of soil. The beneficial effect of organic matter on the availability K may be ascribed to the reduction of fixation and release of K due to interaction of organic matter with clay besides the direct addition of K to the available K pool of the soil. Similar results were also reported by Bhandari *et al.* (1989) [3].

Table 2: Effect of green manures on soil properties at the end of experiment

Treatment details	pH	EC (dSm ⁻¹)	Calcium carbonate (%)	Organic carbon (%)	Avail. N (mg kg ⁻¹)	Avail. K (mg kg ⁻¹)
Subabhul	7.7	0.24	4.77	0.50	81.21	110
Glyricidia	7.68	0.24	4.8	0.49	82.28	111.66
Dhaincha	7.60	0.22	4.79	0.45	79.90	108.33
Sunnhemp	7.63	0.23	4.77	0.44	79.40	106.33
Neem leaves	7.62	0.26	4.78	0.43	78.66	105
Cowpea	7.64	0.23	4.77	0.46	80.58	108.33
Control	7.66	0.25	4.78	0.39	77.17	103.33
SE ±	0.06	0.01	0.02	0.01	1.36	4.84
CD at 5%	NS	NS	NS	0.03	4.17	14.90

Table 3: Effect of green manures on secondary nutrients and micronutrients of soil

Green manures	Exchangeable Ca and Mg {C mol (p ⁺) kg ⁻¹ }		Available micronutrient (mg kg ⁻¹)			
	Ca	Mg	Fe	Mn	Zn	Cu
Subabhul	22.40	9.80	4.88	3.18	1.14	1.21
Glyricidia	22.7	9.90	5.14	3.21	1.15	1.26
Dhaincha	20.93	9.65	4.94	3.06	1.11	1.16
Sunnhemp	20.46	9.33	5.07	3.00	1.07	0.89
Neem leaves	20.30	9.06	5.06	2.95	1.06	0.87
Cowpea	21.33	9.7	5.09	3.13	1.13	1.17
Control	20	8.43	5.05	2.91	0.92	0.94
SE ±	0.43	0.25	0.15	0.10	0.03	0.02
CD at 5%	NS	NS	NS	NS	NS	NS

Summery and conclusion

A laboratory experiment was conducted to study the, Mineralization of nitrogen, phosphorus and sulphur from various sources of green manures incorporated in Entisol.” During Dec-2018 to March-2019 at ambient condition in laboratory of Soil Science and Agricultural Chemistry section, RSCSM College of Agriculture, Kolhapur. The experiment was laid out in randomized block design which consisted of seven treatments and three replications.

The pot culture incubation study was carried out with various green manure sources which were added on the basis of carbon content and their incubation study was carried out. The mineralization of nitrogen, phosphorus and sulphur was recorded at the intervals of 0, 30, 60, 90 and 120 days. The results of experiments are summarized as below.

Characterization and C: N Ratio of Different Green Manures

In this study seven green manure sources were characterized for important quality parameters *viz.*, total N, P, K, S, C and their C:N ratio and also for micronutrients *viz.*, Fe, Mn, Zn, Cu. The N concentration in green manure crop residues ranged from 2.01 percent in sunnhemp to 3.16 percent in cowpea; P concentration ranged from 0.15 percent in subabul to 0.75 percent in cowpea; K concentration ranged from 0.16 percent in subabul to 4.60 percent in glyricidia; C concentration from 33.0 percent in glyricidia to 52.3 in neem leaves; S concentration ranged from 0.26 percent in subabul to dhaincha 0.46 percent. There were wide variation in C:N

ratio of green manures. Ratios of C:N for residues varied from 11.97 in glyricidia to 20.89 in sunnhemp.

Effect of Incorporation of different Green Manure Crops on the Soil Properties after the end of Mineralization Study

The pH, EC, CaCO₃ percent, exchangeable Ca and Mg and micronutrients *viz.*, Fe, Mn, Zn, Cu were not affected significantly due to various sources of green manures after the end of incubation study. But organic carbon recorded statistically significant effect of incorporation of green manure sources, the highest amount of organic carbon was recorded in treatment subabul (0.50%) followed by glyricidia (0.49%). Also available N and available K recorded significant effect than that of unamended soil. Avail. N was recorded highest amount of available N glyricidia (82.28 mg kg⁻¹) and also available K was recorded highest amount in glyricidia (111.66 mg kg⁻¹). The lowest amount of available N and available K was recorded in unamended soil (77.17 and 103.3 mg kg⁻¹, respectively).

Conclusion

- I. Among the different sources of green manures cowpea recorded the highest amount of total nitrogen, phosphorus and potassium content. Neem leaves recorded the highest amount of total carbon and glyricidia recorded the narrow C:N ratio.
- II. The application of various green manures sources not showed the significant effect on soil properties of pH, EC, equivalent percent CaCO₃, exchangeable Ca and Mg

and on micronutrients but significantly increased the available N and available K after the end of incubation period.

- III. The study indicated that various sources of green manures incorporated in soil increased the mineralization of nitrogen, phosphorus and sulphur in soil. The results of present investigation are based on one trial conducted for study. For confirmation of these results the multilocation trials with field experiments on various types of soils is necessary.

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