Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(2): 883-885
Received: 10-01-2020
Accepted: 12-02-2020

DS Jakhar
Chaudhary Charan Singh, Haryana Agricultural University, Krishi Vigyan Kendra, Sirsa, Haryana, India

Vinod Kumar
Chaudhary Charan Singh, Haryana Agricultural University, Krishi Vigyan Kendra, Mandkola, Haryana, India

Sunil Beniwal
Chaudhary Charan Singh, Haryana Agricultural University, Krishi Vigyan Kendra, Sirsa, Haryana, India

Corresponding Author:
DS Jakhar
Chaudhary Charan Singh, Haryana Agricultural University, Krishi Vigyan Kendra, Sirsa, Haryana, India

Carbon and nitrogen mineralisation in soil amended with different legume residues

DS Jakhar, Vinod Kumar and Sunil Beniwal

Abstract
As commercial fertilizers are becoming more costly, legume residues can serve as an alternative in increasing soil available nutrients for increased crop productivity. But in order to optimize the use of legume residues there is need to estimate their mineralization rate after being incorporated in the soil. Keeping in view the above, a screen house and laboratory experiment was conducted to study carbon and nitrogen mineralization pattern in soil amended with different legume residues. Four levels of N viz. 40, 80,120,160 mg N Kg^{-1} soils were applied through urea and legume residues. In laboratory, carbon and nitrogen mineralization from legume residues was studied at 7, 14, 28, 42 and 56 days incubation period. Carbon Mineralization expressed as percent of added carbon mineralized increased at a faster rate up to 28 days of incubation and attained a slower rate at 42 and 56 days in all the treatments. Amongst the legume residues, the percent of carbon mineralized in different treatments followed the decreasing trend as: pigeonpea>green gram>black gram>clusterbean>soybean>cowpea. The amount of nitrogen mineralized increased with incubation period. Highest mineralization was reported during early periods and decreased thereafter. After 56 days of incubation the magnitude of N mineralized (% of added N) was in order: Pigeonpea>greengram>blackgram>soybean>cowpea.

Keywords: Carbon, nitrogen, mineralisation and legumes crops

Introduction
The use of legume residues to maintain the N status of the soil provides a means of reducing our dependence solely on commercial nitrogenous fertilisers. As commercial fertilisers become more costly, legume residues become a vital source in providing the available soil N for maintaining crop productivity. So, recycling of crop residues is suggested as a potential means of sustaining soil fertility and productivity over the long-term (Singh and Rengel, 2007) [10]. In order to optimise the use of legume residue nitrogen for subsequent or companion crop it is necessary to estimate mineralisation rate after being incorporated in to the soil. Mineralisation of nitrogen from legume residues varies with C:N ratio, (Pathak and Sarkar, 1994), Polyphenol: N ratio (Oglesy and Fownes, 1992) [7] and lignin: N or (Lignin+ polyphenol): N ratio (Handayanto et al. 1994). The quantification of carbon mineralisation in the crop residues and green manures treated soils has been made for predicting the potentially available N to crops under different management practices. As carbon makes approximately 40 percent of the total dry plant biomass, carbon mineralisation is often used as general indicator of the persistence or decomposability of organic materials (Janzen and Kucey, 1988) [4]. In India, a large part of inorganic N is applied through urea. The losses of applied nitrogen through ammonia volatilisation from soil are very common. Such losses can be minimized by addition of organic residues with fertilizers.

Materials and Methods
For the study, soil samples and of the surface layer and fifty days old legume residues were collected from Research Farm of CCS HAU Hisar. The residues were oven dried at 55^0C and ground in Willey Mill. The residues so prepared were analysed for their total C, N, lignin, polyphenol, KCL extracted inorganic N and organic N.
In laboratory, an experiment was designed to study Carbon and Nitrogen mineralisation in the soil amended with legume residues. The level of N was kept 100 mg N kg^{-1} through legume residues. The temperature was fixed at 25±1° C. The soil under study was sandy loam and moisture was kept at field capacity. The experiment was replicated thrice under CRD design. The carbon and nitrogen mineralisation was studied at 0, 3, 7, 14, 28, 42 and 56 days. For carbon mineralisation, CO_2 evolution and for N mineralisation, NH_4^+-N and NO_3^--N in the soil at different time intervals was recorded. The Carbon Mineralisation was estimated by method as outlined by Debnath and Hajra (1972) [3] where as the N mineralisation was studied by

extracting the samples with 2MKCl containing 5µg g-1 PMA (phenyl mercuric acetate) in 1:2 soil - extractant ratio and samples were analysed for NH_4^+- N and NO_3^-- N by steam distillation method (Keeney and Nelson, 1982) [6].

Table 1: The basic physic-chemical characters of the soil used in the study

Sand	68.2
Silt	12.9
Clay	18.9
Texture	Sandy Loam
Soil Texonomy	Fine Loamy, Calcareous, hyperthermic, aridic, Ustochrepts
pH (1:2)	7.91
EC (1:2)	0.48
Organic C (%)	0.40

Results and Discussion

The percent of C mineralised as CO_2-C evolved at different intervals as a result of decomposition of added legume residues has been presented in figure 1 and table 3. For ease of comparison of the rate of carbon mineralisation in various legume residues, the values have been presented as percent of added carbon mineralised.

Table 2: Chemical composition of legume residues used in the study

Legume Residue	Total N	Total C	Organic N	Inorganic N	Polyphenol	Lignin C	N ratio
Pigeon pea	2.30	43.01	2.07	0.23	3.23	4.80	18.7
Cowpea	1.70	49.6	1.52	0.18	3.99	7.46	29.2
Cluster bean	1.90	46.5	1.72	0.18	3.69	6.31	24.5
Green Gram	2.12	45.8	1.91	0.21	3.12	5.36	21.9
Soybean	1.80	49.1	1.66	0.14	3.59	6.19	27.3
Blackgram	1.95	47.7	1.72	0.23	2.32	7.76	22.6

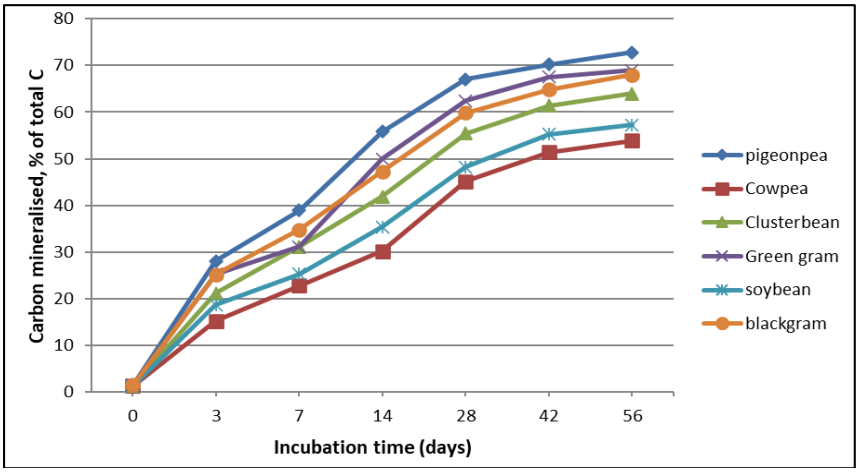

Fig 1: Relation between incubation time and %C expressed as % of the total C from different legume residues

Table 3: Carbon mineralised (Expressed as % of total C) during different incubation periods from legume residues

Days	Pigeon pea	Cowpea	Clusterbean	Greengram	Soybean	Blackgram
0	1.50	1.30	1.35	1.50	1.20	1.50
3	28.10	15.20	21.20	25.30	18.70	25.20
7	38.90	22.79	31.17	31.20	25.30	34.80
14	55.80	30.22	41.90	50.00	35.41	47.23
28	67.02	45.17	55.38	62.41	48.25	59.83
42	70.19	51.40	61.36	67.50	55.25	64.86
56	72.80	53.90	64.00	68.90	57.20	68.01

The percent of carbon mineralised from legume residues at 56 days ranged from 53.90 for cowpea to 72.80 for pigeon pea. The carbon mineralised from different legume residues increased at faster rate up to 28 days of incubation and attained a slower rate at 42 and 56 days in all the treatments. The amount of carbon mineralised in different legume residues followed a decreasing trend: Pigeonpea>greengram>blackgram>clusterbean>soybean>cow pea. The difference in the degree of mineralisation may be related to their C: N ratio. The legume residue having lower C: N ratio had higher C mineralisation and vice versa. Hence it can be concluded that the rate of carbon mineralisation was inversely proportional to the C: N ratio. Sur and Sinha (1982) [11] reported that cumulative amount of CO_2 released in the green gram straw, black gram straw, cowpea staw and rice straw varied according to their C: N ratio. The similar finding was also reported by Prasad and Sinha (1996) [9]. The increase in net cumulative CO_2–C flux and its rate throughout the incubation period was noticed by *Abera et. al.* (2012) [1] in (HB; *Phaseolus vulgaris* L.) and pigeon pea (PP; *Cajanus cajan* L.) residues (each at5 mg g^{-1} dry soil) under laboratory incubation for 100 to 135 days.

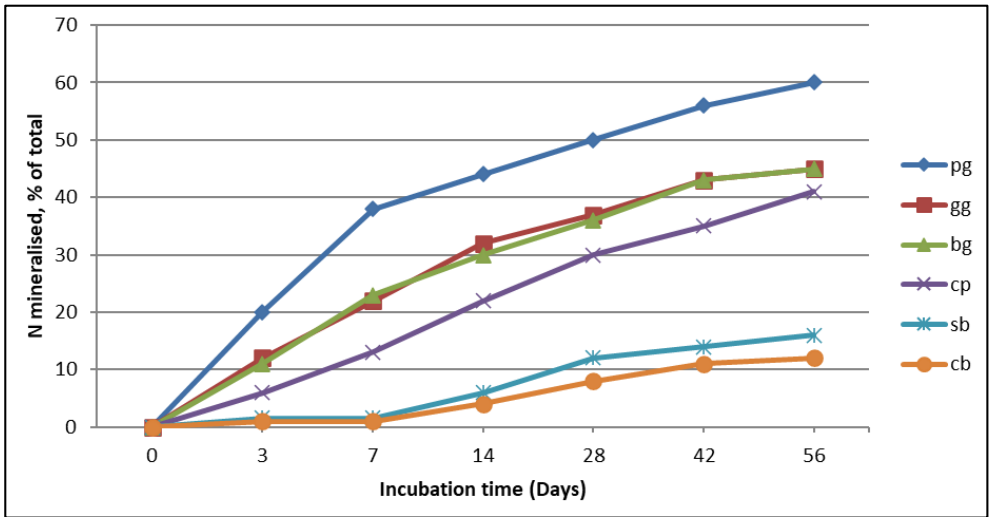

Fig 2: The amount of nitrogen mineralised (%) from different legume residues at different times of incubation

The amount of nitrogen mineralised (%) from different legume residues at different times of incubation is shown in Figure 2. The amount of N mineralised increased with increase in the incubation period. Highest mineralisation was reported during early periods of incubation and decreased with time. The highest amount of N mineralised was obtained for pigeon pea and lowest for clusterbean (11.20%). After 56 days of incubation, the magnitude N mineralised (% of added N) was in order: Pigeonpea>greengram>blackgram> cowpea >soybean>clusterbean. The amount of N mineralised from different legume residues was negatively correlated with their C: N ratios. The increase in N mineralisation with decrease in C:N ration has also been noticed by Abiven and Roucos (2007) [2] in a soil incorporated with plant residues.

References

1. Abera G, Meskel, Moskel WE, Bakken LR. Carbon and nitrogen mineralization dynamics in different soils of the tropics amended with legume residues and contrasting soil moisture contents. Biol Fert soil. 2012; 48(1):51-66
2. Abiven S, Recous. Mineralisation of crop residues on the soil surface or incorporated in the soil under controlled conditions**.** Biol. Fert soils. 2007; 43(6):849-852
3. Debnath MC, Hajra JM. Transformation of organic matter in soil in relation to mineralization of carbon of nutrient availability. J Indian Soc. Soil. Sci. 1972; 20: 95-102.
4. Janzen HH, Kucey RMN CN. S mineralization of crop residues as influenced by crop species and nutrient regime. Pl. Soil. 1988; 106:35-41.
5. Marschner P, Rengel Z. (ed.) Nutrient cycling in terrestrial ecosystems, Soil Biol, Springer
6. Keeney DR, Nelson DW. Nitrogen-inorganic forms. In methods of soil analysis. Part 2. Chemical and micrbiological properties. Angro. Monograph No. 9 (2nd Ed.) A. L. Am. Soc. Agron. Medison, WI. 1982, 643-698.
7. Oglesby KA, Fownes JH. Effect of chemical compostition on nitrogen mineralization from green manures of seven tropical leguminous trees Pl. Soil. 1992; 143:127-132.
8. Pathak H, Sarkar MC. Nitrogen mineralization in manure amended soils in relation to water regime. J Indian Soc. Soil Sci. 1995; 42:261-267.
9. Prasad, Sinha SK. Kinetics of carbon mineralization in calcarious soil amended with crop residues and organic manures. J Indian Soc. Soil Sci. 1996; 44(4):772-774.
10. Singh B, Rengel Z. The role of crop residues in improving soil fertility-In, 2007.
11. Sur HS, Sinha MK. Kinetics of carbon mineralization in an Aridisol Mixed with various organic materials. J Indian Soc. Soil Sci. 1982; 30(3):270-274.