Influence of green manuring and organic sources of nutrient application on scented rice (*Oryza sativa*) - linseed (*Linum usitatissimum*) cropping system

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**ABSTRACT**

A field experiment was carried out during *kharif*, 2012 to summer, 2013 under rainfed condition in the organic block of Assam Agricultural University, Jorhat to find out the effect of different green manuring practices and other organic sources of nutrient on productivity of scented (*joha*) rice and their residual effect on linseed crop. Results revealed that though green manuring practice had no significant effect on yield and yield attributes of both scented (*joha*) rice and succeeding relayed linseed crop but higher values were recorded with the incorporation of dhaincha as *in-situ* green manuring in respect of all the yield attributes and yield of both the main and succeeding crops. Among various organic sources of nutrient, application of enriched compost produced the highest yield in both scented rice as well as linseed crop. The increase in grain yield of scented rice with enriched compost over the other sources of organic nutrient and control treatment ranged from 7.33 to 30.04 per cent. The corresponding increase in case of linseed crop ranged from 29.1 to 39.8 per cent which reflected better residual effects of both the sources of nutrient on linseed crop. The residual available nutrient contents in soil after harvest of linseed crop showed similar trends and increased all the major nutrients over their initial status.

**Key words:** Green manuring, Linseed, Organic source, Residual effect, Scented rice.

**INTRODUCTION**

Organic inputs are regarded as the key to eco-friendly and sustainable agriculture. Use of green manure, farmyard manure and other organic sources of nutrient not only helps in supplementing nutrient requirement of crops but also improves soil physical, chemical and biological properties (Yadav *et al.*, 2009). Addition of organic inputs gaining attention in recent years under organic cultivation. One of the important aspects in organic farming is the soil fertility/nutrient management of crops and cropping system to optimize crop productivity. Rice is considered as the main staple food crop of Assam more particularly the scented (*joha*) rice is known for its unique aroma, superfine kernel, good cooking qualities, excellent palatability and can earn good revenue. Information regarding the influence of various organic sources of nutrient on crop productivity is very important to the farmers engaged in organic farming. The present study was initiated to compare the performance of different organic sources on the productivity of scented (*joha*) rice and their residual effect on linseed crop.

**MATERIALS AND METHODS**

A field experiment was conducted in the organic block located at the Instructional-cum-Research Farm of Assam Agricultural University, Jorhat from *kharif*, 2012 to summer season of 2013 under rainfed condition. The treatments consisted of 3 green manuring practices (Fallow, cowpea and dhaincha) in main plots and 5 sources of organic nutrient (control, rice straw, fresh cowdung, farmyard manure and enriched compost) in sub plots of split-plot design with 3 replications. The soil of the experimental plot was sandy-loam in texture having organic carbon 0.45%, available N 243.4 kg/ha, available P 8.8 kg/ha and available K 101.2 kg/ha with pH 5.0. Seeds of green manuring crop viz., cowpea (*Vigna unguiculata*) and dhaincha (*Sesbania rostrata*) were sown *in situ* in the experimental plot as per treatment on 12 April, 2012 @ 35 and 40 kg/ha, respectively. The green manures were incorporated on 4 July, 2012. The growth of green manuring crops and nutrient contents on dry matter basis at the time of incorporation of green manures and other organic sources of nutrients are given in Table 1. Thirty days old seedlings of local scented (*joha*) rice were transplanted in puddle soil 20 days after incorporation of green manures, on 24 July, 2012. All the organic sources of nutrient were incorporated @ 10 t/ha one day ahead of planting rice seedlings except rice straw which was incorporated 7 days ahead. The enriched compost was prepared by mixing with rock phosphate, Azotobacter, Azospirillum and PSB @ 10 per cent of the total compost weight and incubated for 24 hours. Seeds of linseed were sown broadcast @ 30 kg/ha as relay at 50 per cent flowering stage of rice crop. The scented rice crop was harvested on 23 November, 2012 and linseed on 18 March, 2013. Observations were made on growth, yield attributes and yield of both the crops and data were

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analyzed statistically following the method described by Sukhatme and Amble (1978). Total rainfall received by rice and linseed crop was 707.6 and 48.4 mm distributed in 56 and 23 days, respectively.

RESULTS AND DISCUSSION

Effect on scented rice: Incorporation of different green manuring crops before transplanting rice could not influence significantly the grain and straw yields as well as all the yield attributes except that of plant height (Table 2). However, green manuring with dhaincha recorded higher values in all the yield attributes and yield of rice. The increase in grain yield with incorporation of dhaincha over the fallow and cowpea green manuring was 11.07 and 4.35 per cent, respectively. The corresponding increase in straw yield was 8.41 and 1.22 per cent. Incorporation of more green matter through dhaincha added more organic matter into the soil which increased the plant nutrients and ultimately reflected on yield of rice (Table 1). Green manuring had numerous advantages in increasing yield of rice as reported by many workers (Duhan et al., 2004; Mandal et al., 2007; Deshpande and Devasenapathy, 2010; Kumari et al., 2010).

Application of different organic sources of nutrient as a whole showed positive impact on most of the growth, yield attributing parameters and yield of scented rice over the control (Table 2 & 4). Among the organic sources of nutrient, enriched compost recorded significantly higher grain and straw yields as well as all the yield attributes over the other sources of nutrients. The increase in grain yield of scented rice with the application of enriched compost over that of control, rice straw, fresh cowdung and farmyard manure was 30.04, 7.33, 6.23 and 16.85 per cent, respectively. The corresponding increase in straw yield was 22.85, 11.22, 8.17 and 18.98 per cent. The increase in grain and straw yield with enriched compost application may be attributed to higher yield attributes due to increased availability of plant nutrients from enriched compost and maintained favourable physical, chemical and biological environment which ultimately reflected in increasing the yield parameters and yield. Similar findings were also reported by Kavitha and Subramanian (2007) and Bora et al. (2014).

Effect on linseed: The green manuring practice had no any significant effect on all the growth, yield attributing parameters and yield of succeeding linseed crop (Table 3 & 4). However, green manuring with dhaincha resulted in higher values of all the yield attributes as well as seed and stover yields of linseed due to more addition of biomass in case of dhaincha over the other two practices. The results corroborate the findings of Matiwade and Sheelavantar (1994) and Mandal et al. (2007) who also reported that Sesbania species

| Nutrient sources | Dry matter (%) | Major nutrients (%) | N | P | K |
|------------------|----------------|---------------------|---|---|---|
| Rice straw       | 63.8           |                     | 0.35 | 0.03 | 0.59 |
| Fresh cowdung    | 21.2           |                     | 0.42 | 0.09 | 0.08 |
| Farmyard manure  | 38.9           |                     | 0.52 | 0.17 | 0.42 |
| Enriched compost | 42.5           |                     | 0.92 | 0.68 | 0.72 |
| Cowpea           | 25.5 (20.6)    |                     | 0.75 | 0.06 | 0.48 |
| Dhaincha         | 28.2 (27.4)    |                     | 0.62 | 0.05 | 0.42 |

Figure in parentheses represents green matter (t/ha).

| Treatment             | Plant height (cm) | Panicles/m² | Panicle length (cm) | Filled grains/panicle | Unfilled grains/panicle | 1000 grain weight (g) |
|-----------------------|------------------|-------------|---------------------|-----------------------|-------------------------|-----------------------|
| Green manuring        |                   |             |                     |                       |                         |                       |
| Fallow                | 143.0            | 228.8       | 24.4                | 133.4                 | 22.7                    | 13.38                 |
| Cowpea                | 143.7            | 238.6       | 25.1                | 135.9                 | 23.3                    | 13.52                 |
| Dhaincha              | 145.3            | 241.7       | 25.2                | 137.1                 | 24.7                    | 13.56                 |
| S.Em(±)               | 0.42             | 5.24        | 0.16                | 2.50                  | 0.58                    | 0.058                 |
| CD (P=0.05)           | 1.6              | NS          | NS                  | NS                    | NS                      | NS                    |
| Organic sources of nutrient |               |             |                     |                       |                         |                       |
| Control               | 134.8            | 194.8       | 23.5                | 127.4                 | 19.1                    | 13.33                 |
| Rice straw            | 146.4            | 245.1       | 25.3                | 134.9                 | 25.3                    | 13.55                 |
| Fresh cowdung         | 144.1            | 252.5       | 25.7                | 138.5                 | 24.2                    | 13.43                 |
| Farmyard manure       | 143.2            | 238.5       | 24.4                | 134.4                 | 24.4                    | 13.44                 |
| Enriched compost      | 151.4            | 251.0       | 25.4                | 144.8                 | 24.8                    | 13.68                 |
| S.Em(±)               | 1.64             | 6.31        | 0.37                | 5.39                  | 1.15                    | 0.132                 |
| CD (P=0.05)           | 4.8              | 18.4        | 1.1                 | 15.7                  | 3.4                     | NS                    |

NS = Non-significant.
**Table 3**: Growth and yield attributes of linseed as influenced by residual effect of green manuring and organic sources of nutrient.

| Treatment           | Plant height (cm) | Branches/plant | Capsules/plant | Seeds/capsule | 1000 seed weight (g) |
|---------------------|------------------|----------------|----------------|---------------|----------------------|
| **Green manuring**  |                  |                |                |               |                      |
| Fallow              | 54.1             | 2.7            | 8.6            | 8.9           | 7.94                 |
| Cowpea              | 54.6             | 2.8            | 9.1            | 9.1           | 7.94                 |
| Dhaincha            | 57.0             | 2.9            | 10.4           | 9.2           | 8.00                 |
| S.Em(±)             | 0.75             | 0.05           | 0.94           | 0.09          | 0.015                |
| CD (P=0.05)         | NS               | NS             | NS             | NS            | NS                   |
| **Organic sources of nutrient** |                  |                |                |               |                      |
| Control             | 50.6             | 2.6            | 7.2            | 8.7           | 7.88                 |
| Rice straw          | 55.1             | 2.7            | 8.3            | 9.1           | 8.00                 |
| Fresh cowdung       | 55.9             | 2.8            | 9.6            | 9.0           | 8.06                 |
| Farmyard manure     | 56.5             | 2.8            | 9.2            | 9.2           | 7.93                 |
| Enriched compost    | 58.0             | 3.2            | 12.4           | 9.3           | 7.94                 |
| S.Em(±)             | 1.15             | 0.10           | 0.63           | 0.12          | 0.038                |
| CD (P=0.05)         | 3.4              | 0.3            | 1.8            | 0.3           | 0.11                 |

NS = Non-significant.

**Table 4**: Yield of scented rice and linseed and rice grain equivalent yield as influenced by green manuring and organic sources of nutrient.

| Treatment           | Scented rice yield (kg/ha) | Linseed yield (kg/ha) |          |          | Rice grain equivalent yield (kg/ha) |
|---------------------|-----------------------------|-----------------------|----------|----------|------------------------------------|
|                     | Grain | Straw | Harvest index (%) | Seed | Stover | Harvest index (%) |          |          |                      |
| **Green manuring**  |       |       |                   |       |        |                      |          |          |                      |
| Fallow              | 2250.86 | 5999.70 | 27.31          | 335.61 | 747.79 | 30.98                | 3206.02  |
| Cowpea              | 2424.06 | 6466.60 | 27.25          | 360.01 | 767.27 | 31.94                | 3450.75  |
| Dhaincha            | 2530.46 | 6540.40 | 27.89          | 366.67 | 838.88 | 30.42                | 3573.29  |
| S.Em(±)             | 130.61  | 196.72 | -               | 16.57  | 18.29  | -                    | 140.25   |
| CD (P=0.05)         | NS     | NS    | NS              | NS     | NS     | NS                   | NS       |
| **Organic sources of nutrient** |       |       |                   |       |        |                      |          |          |                      |
| Control             | 1913.89 | 5567.60 | 25.53          | 295.39 | 716.77 | 29.18                | 2793.37  |
| Rice straw          | 2529.89 | 6407.40 | 28.29          | 314.83 | 731.48 | 30.09                | 3524.79  |
| Fresh cowdung       | 2563.56 | 6629.40 | 27.86          | 348.16 | 769.43 | 31.15                | 3604.78  |
| Farmyard manure     | 2274.33 | 5851.50 | 27.95          | 321.37 | 714.81 | 31.01                | 3202.19  |
| Enriched compost    | 2727.33 | 7221.80 | 27.44          | 490.74 | 990.74 | 33.12                | 3924.96  |
| S.Em(±)             | 112.21  | 196.72 | -               | 15.68  | 31.08  | -                    | 135.56   |
| CD (P=0.05)         | 327.48  | 612.81 | -               | 45.77  | 90.72  | -                    | 401.12   |

NS = Non-significant; Price of rice grain Rs. 40.00/kg; Rice straw Rs. 5.00/kg; Linseed seed Rs. 20.00/kg; Linseed stover Rs. 2.00/kg.

**Table 5**: Organic carbon and available nutrients after harvest of linseed as influenced by green manuring and organic sources of nutrient.

| Treatment           | Organic carbon (%) | Available nutrient (kg/ha) |          |          |                      |
|---------------------|--------------------|----------------------------|----------|----------|                      |
|                     | N                 | P                          | K        |          |                      |
| **Green manuring**  |                   |                            |          |          |                      |
| Fallow              | 0.48              | 263.34 (+7.57)             | 8.83 (+0.34) | 120.13 (+15.76) |
| Cowpea              | 0.52              | 288.75 (+15.71)           | 11.41 (+22.87) | 133.59 (+24.25) |
| Dhaincha            | 0.53              | 292.26 (+16.72)           | 12.02 (+26.79) | 134.78 (+24.91) |
| S.Em(±)             | 0.112             | 1.423                      | 0.413    | 0.896    |
| CD (P=0.05)         | NS                | 4.28                       | 1.23     | 2.68     |
| **Organic sources of nutrient** |       |                            |          |          |                      |
| Control             | 0.47              | 252.36 (+3.55)            | 8.69 (-1.26) | 115.72 (+12.55) |
| Rice straw          | 0.52              | 284.32 (+14.39)           | 10.52 (+16.35) | 133.02 (+23.92) |
| Fresh cowdung       | 0.53              | 286.01 (+14.89)           | 10.98 (+19.85) | 131.35 (+22.95) |
| Farmyard manure     | 0.52              | 289.21 (+15.84)           | 11.23 (+21.64) | 132.14 (+23.41) |
| Enriched compost    | 0.52              | 295.43 (+17.61)           | 12.35 (+28.74) | 135.23 (+25.16) |
| S.Em(±)             | 0.423             | 2.156                      | 0.539    | 1.232    |
| CD (P=0.05)         | NS                | 6.47                       | 1.62     | 3.69     |

1(Figures in parentheses represent the per cent increase (+) or decrease(-) over initial soil status).

NS = Non-significant.
was the best among different green manuring crops for increasing yield of rice.

Residual effect of various organic sources of nutrient significantly influenced all the growth, yield attributes and yield of rabi linseed crop grown as relay along with scented rice (Table 3). Among different sources, enriched compost recorded significantly higher seed and stover yield of linseed over the other sources of nutrients. The increase in seed and stover yield in case of enriched compost application over the control, rice straw, fresh cow dung and farmyard manure was 39.8, 35.8, 29.1, 34.5 per cent and 27.7, 26.2, 22.3, 27.9 per cent, respectively. The increase in seed and stover yield of linseed with the residual effect of enriched compost may be attributed to higher values of yield attributes due to increased availability of nutrients from enriched compost and additional advantages of rock phosphate, Azotobacter, Azospirillum and PSB used for enriching the compost which ultimately maintained a favourable environment for proper growth and development of crop. Harvest index also influenced similarly with that of seed yield.

**Rice grain equivalent yield:** Similar to grain and straw yields of both scented rice and linseed crop, rice grain equivalent yield was not influenced significantly due to different green manuring practices followed before rice. However, green manuring with dhaincha resulted in higher rice grain equivalent yield over cowpea. The per cent increase in rice grain equivalent yield due to green manuring with dhaincha over cowpea and fallow (no green manuring) was 3.43 and 10.28. This might be due to addition of higher quantities of green biomass by dhaincha than cowpea and release of more plant nutrients through mineralization in the system.

The organic sources of nutrients had significant influence on rice grain equivalent yield over the control. Among the sources, enriched compost without differing with each other could influence significantly the residual available N, P and K contents in soil over the fallow (no green manure) estimated after the harvest of linseed crop (Table 5). Green manuring with dhaincha recorded higher values and gain (increase) in respect of all the available nutrients over the initial status which may be due to more addition of organic matter into the soil and mineralization of organic sources.

Among the sources of organic nutrient, application of enriched compost recorded significantly higher and increase in residual available nutrients over the control. However, the differences between enriched compost and farmyard manure in case of available N; among enriched compost, farmyard manure and fresh cow dung in case of P and among enriched compost, farmyard manure and rice straw in case of available K contents were not significant. None of the green manuring practices and organic sources of nutrient could influence the organic carbon content in soil.

**CONCLUSION**

From the above study it can be concluded that under organic cultivation green manuring with dhaincha and application of enriched compost @ 10 t/ha to rice are found to be the best for getting higher productivity and residual available nutrients in scented rice-linseed cropping system.

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