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# Effect of summer legumes on growth and yield of succeeding direct-seeded rice (*Oryza sativa* L.) under different nitrogen levels

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## Abstract
A field experiment was conducted at Research Farm of Tirhut College of Agriculture, RPCAU, Pusa, Bihar during *kharif* 2014 to assess the effect of summer legumes on growth and yield of succeeding direct-seeded rice (*Oryza sativa* L.) under different nitrogen levels.Rice sown after incorporation of dhaincha recorded significantly higher plant height and yield indices i. e. number of tillers, and panicle $m^{-2}$, length of panicle and grains $panicle^{-1}$ than crop sown after fallow. However, grain and straw yields were significantly higher when rice was seeded after dhaincha than crop seeded after mungbean, urdbean and fallow. Plant height, yield indices, garin and straw yields increased significantly with increasinglevels of nitrogen but significantly increase was recorded only upto 100% RDF further increase in nitrogen levels fail to produce significant effect on these parameters. The crop seeded after incorporation of green manure crops recorded significantly higher grain yield upto RDF. However, crop seeded after fallow recorded significantly higher grain yield upto 150% RDF.

**Keywords:** Dhaincha, Direct seeded rice, Mungbean, Green manure, Nitrogen levels, Urdbean

## Introduction
Rice is the major staple food of the world's population and its cultivation is an integral part of their culture. In India rice is grown in acreage of 43 million ha with a production of 104 million tonnes and productivity of 2,404 kg $ha^{-1}$ (Ministry of Agriculture, 2016-17). The corresponding figure for area, production and productivity for Bihar is reported as 3.3 million ha, 8.2 million tonnes and 2467 kg $ha^{-1}$, respectively (Directorate of Statistics & Evaluation, Patna, Bihar, 2016-17).
Rice is grown in both *Kharif* and *rabi* season under diverse ecological and climatic conditions apart from socio-economic diversities of the state. It is cultivated mainly through transplanting, after puddling which damages the soil structure and results in the formation of a hard pan. Puddling though, helps in retention of water and effective weed control, it requires more time, labour, energy and tillage operations for succeeding wheat crop. It also hinders the root growth of wheat which limits water uptake and consequently lower crop yield. Direct seeded rice (DSR), being cost effective, consumes less water and labour saving crop establishment method, is becoming popular (Bhushan *et al*., 2007 & Jehangir *et al*., 2007) [3, 6].
Direct seeded rice is becoming more popular as it eliminates many farm operations particularly nursery raising, puddling, transplanting and hence, it reduces the cost of production. DSR is an efficient resource conservation technology which saves the labour to the extent of about 40% and water up to 60% (Nainwal *et al*., 2013) [7].
Green manures usually perform multiple functions including soil improvement and soil protection, as well as enhancing soil microbial biomass and enzymatic activity. It is expected that regular incorporation of dhaincha, sunhemp, cowpea and mungbean before sowing of rice may improve the physio-chemical properties of the soil.
Nitrogen is a key player in increasing any type of agriculture production and is one of the most yield-limiting nutrients for annual crops. Inadequate nitrogen in soils show reduced leaf area limiting light interception thereby causing reduced photosynthesis which finally has an effect on biomass growth and grain yield. Nitrogen is the constituent of numerous important compounds, including amino acids, proteins (enzymes), nucleic acids, chlorophyll, and several plant hormones (Guo *et al.*, 2008) [5].

## Materials and methods
A field experiment was carried out at the Research Farm of Tirhut College of Agriculture, RPCAU, Pusa, Bihar during *kharif* 2014.

The soil of experimental field was calcareous clay-loam alkaline in reaction with pH 8.5. It was moderately fertile being low in organic carbon (0.41%), available nitrogen (204 kg N $ha^{-1}$), phosphorous (15.5 kg $P_2O_5$ $ha^{-1}$) and potassium (109 kg $K_2O$ $ha^{-1}$). The experiment was laid out in split-plot design. The treatment comprised three green manure crops, viz., dhaincha, mungbean, urdbean and one summer fallow of land in main plot and four nitrogen levels viz. 0, 50, 100 and 150% RDF in sub-plot and replicated thrice. During summer season three green manure crops, viz., dhaincha, mungbean and urdbean were sown in main plot and summer fallow was considered control. After 50 DAS the summer green manure crops were incorporated into the soil before sowing of rice. After incorporation of green manuring crops, each main plot was divided into four sub-plots, which received the nitrogen treatments. The rice variety 'MTU-1010' was sown in row 20 cm apart on 5 July 2014. The recommended dose of 60 kg $P_2O_5$, 40 kg $K_2O$ and 25 kg $ZnSO_4ha^{-1}$were uniformly applied to the crop as basal. Nitrogen was applied in three splits i.e. basal, tillering and panicle initiation. Two hand weeding was done at 25 and 50 DAS and cop received three irrigations.

## Results and discussion

### Plant height and yield attributes

The preceding summer green manure crops had significant effect on plant height and yield attributes of rice during the year of experimentation. Crop sown after incorporation of dhaincha recorded maximum plant height, tillers and panicles $m^{-2}$, panicle length and no. of grains $panicle^{-1}$which was at par with mungbean and urdbean these were recorded significantly higher values than the crop sown after fallow except panicle lenghth between urdbean and fallow. The panicle length recorded between the crop sown after incorporation of urdbean and fallow was at par. In addition to N supplementation, the biomass of these summer green manures also recycled considerable quantities of P, K and other nutrients, and thus might have improved fertility status, physical and biological properties of the soil (Bisht *et al*. 2006) [2]. Plant height, number of tillers $m^{-2}$, panicle $m^{-2}$, panicle length and grain $panicle^{-1}$was increased with increasing levels of nitrogen from 0 to 150% RDF but significantly increase was recorded only upto 100% RDF, further increase in nitrogen level fail to produce significant effect on these indices (Table 1). This might be due to availability of nutrients in appropriate amount and balanced proportion to the crop plant resulting in increase in these parameters. These results are in accordance with the finding of (Sharma *et al.* 2007) [9].

### Grain yield

The crop sown after green manures crops produced significantly higher grain yield than crop sown after fallow. The crop sown after incorporation of dhaincha produce maximum grain and straw yield which was significantly higher than the crop sown after mungbean, urdbean (Table 2). Similarly the grain and straw yields recorded in rice crop sown after mungbean and urdbeanwere at par. It leads to recycling of nutrients and thus improved the growth, yield attributes and yield of rice. This finding was supported by (Singh and Shivay 2015) [10]. However, the grain and straw yield of rice increase significantly with increasing levels of nitrogen upto 100% RDF further increase in nitrogen levels did not significant effects on grain and straw yields. Significantly increase in grain and straw yield could be attributes to the fact that nitrogen application improved the N, P, and K uptake by the crop plant and ultimately photosynthesis activities, resulting laid down the foundation of higher yield. These results are in accordance with the finding of (Sharma *et al.* 2007) [9]. Interaction between green manuring and nitrogen levels turned out to be significant on grain and straw yields. The rice crop sown after incorporation of green manuringcrops recorded significantly higher grain and straw yieldsupto RDF. However, it increased significantly upto 150% RDF were sown after fallow (Table 3).

**Table 1:** Effect of summer green manuring and nitrogen levels on growth and yieldattributes of direct seeded rice.

| Treatment | Plant height (cm) at harvest | No. of $tillersm^{-2}$ at harvest | No. of $paniclem^{-2}$ | Penicle length (cm) | No. of grains $panicle^{-1}$ |
|---|---|---|---|---|---|
| **Green manur** | | | | | |
| Dhaincha | 85.15 | 291.25 | 275.00 | 24.77 | 118.93 |
| Mungbean | 82.69 | 273.75 | 259.58 | 23.61 | 114.65 |
| Urdbean | 81.94 | 269.17 | 254.58 | 23.02 | 111.40 |
| Fallow | 76.34 | 247.92 | 234.58 | 21.50 | 102.11 |
| SEm (±) | 1.45 | 6.01 | 5.25 | 0.50 | 2.34 |
| CD ( P=0.05) | 5.13 | 20.80 | 18.26 | 1.78 | 8.26 |
| **Nitrogen levels (%)** | | | | | |
| N0 RDF | 71.89 | 209.17 | 195.42 | 19.12 | 95.00 |
| N50 RDF | 80.49 | 262.92 | 248.33 | 22.50 | 109.57 |
| N100 RDF | 85.90 | 300.42 | 285.83 | 25.11 | 119.60 |
| N150 RDF | 87.90 | 309.58 | 294.17 | 26.18 | 122.93 |
| SEm (±) | 1.26 | 4.83 | 4.62 | 0.42 | 2.15 |
| CD (P=0.05) | 3.71 | 14.49 | 13.86 | 1.24 | 6.33 |

**Table 2:** Effect of summer green manuring and nitrogen levels on grain and straw yields of direct seeded rice.

| Treatment | Grain yield t $ha^{-1}$ | Straw yield t $ha^{-1}$ |
|---|---|---|
| **Green manur** | | |
| Dhaincha | 3.87 | 5.13 |
| Mungbean | 3.63 | 4.88 |
| Urdbean | 3.49 | 4.74 |
| Fallow | 2.91 | 4.13 |
| SEm (±) | 0.04 | 0.05 |
| CD ( P=0.05) | 0.15 | 0.19 |
| **Nitrogen levels (%)** | | |

| | | |
|---|---|---|
| N0 RDF | 2.59 | 3.62 |
| N50 RDF | 3.41 | 4.67 |
| N100 RDF | 3.88 | 5.24 |
| N150 RDF | 4.01 | 5.35 |
| SEm (±) | 0.04 | 0.05 |
| CD (P=0.05) | 0.13 | 0.14 |

**Table 3:** Interactioneffect of summer green manuring and nitrogen levels on grain and straw yields of direct seeded rice.

| Treatment | Grain yield t/ha | | | | Straw yield t/ha | | | |
|---|---|---|---|---|---|---|---|---|
| | **Dhaincha** | **Mungbean** | **Urdbean** | **Fallow** | **Dhaincha** | **Mungbean** | **Urdbean** | **Fallow** |
| N0 % RDF | 3.15 | 2.82 | 2.64 | 1.74 | 4.34 | 3.94 | 3.68 | 2.52 |
| N50% RDF | 3.82 | 3.56 | 3.41 | 2.86 | 5.12 | 4.81 | 4.66 | 4.08 |
| N100% RDF | 4.22 | 4.01 | 3.88 | 3.42 | 5.49 | 5.33 | 5.29 | 4.83 |
| N150% RDF | 4.30 | 4.11 | 4.01 | 3.60 | 5.58 | 5.43 | 5.32 | 4.81 |
| | | SEm (±) | | CD (P=0.05) | SEm (±) | | CD (P=0.05) | |
| Interaction (GM X N) | | 0.08 | | 0.27 | 0.10 | | 0.31 | |

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