



# International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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2022; 5(2): 35-38

Received: 18-05-2022

Accepted: 21-07-2022

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## Yield and economics of late sown *Rabi* fodders with different plant stands and nutrient support in Jharkhand

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**DOI:** <https://doi.org/10.33545/2618060X.2022.v5.i2a.109>

### Abstract

A field experiment was conducted at Forage Research field under BAU, Ranchi (Jharkhand) to utilize the rice-fallow land under late sown condition.

Finding showed that, *Rabi* fodder viz Oat, Rye grass and Berseem grown with 25 per cent more seeds or plant population and fertilized with 50 per cent more nitrogen than their respective doses recorded better growth and yield than lower levels of plant density and nitrogen levels. In Oat, Rye grass & Berseem the more Green fodder yield (GFY 353.61, 282.63 & 430.61 q ha<sup>-1</sup>), Dry fodder yield (DFY 113.7, 57.52 & 79.69 q ha<sup>-1</sup>) and per day productivity (3.21, 2.57 & 3.91 q ha<sup>-1</sup> day<sup>-1</sup>) were observed. Maximum gross return (₹.1, 29,184 ha<sup>-1</sup>), Net return (₹. 94,589 only) and profitability Rs. 860 ha<sup>-1</sup> day<sup>-1</sup> were recorded under Berseem sown with 125 per cent recommended seed rate at 150 per cent RDN.

**Keywords:** Rice-fallow, nitrogen level, late sown *Rabi* fodder crops, rye grass, berseem, oat, yield and economics.

### Introduction

India with 2.4 per cent of the land and 4.0 per cent of water resources supports livelihood to 17.84 per cent of global human population as well as nearly 20 per cent of the world livestock. Among the different state Jharkhand have some typical situation with regards to its topography and soil characteristics. Paddy is the major crop, which get delayed due to monsoon situation which resulted into fallow situation after rice.

Thus, there is scope to grow Oat, Rye grass and Berseem fodder during late *Rabi* season under limited irrigation condition. Thus, in order to fulfil our quality fodder requirement, to mitigate the shortage of green fodder during lean period study was carried.

### Materials and Methods

A Field experiment was conducted during *Rabi* season of three consecutive years 2019, 2020 and 2021 at Agrostology unit of Ranchi veterinary college, kanke which is situated at 23° 34' N latitude and 85° 31' E longitudes at an altitude of 645.45 MSL. Jharkhand has humid sub-tropical climate, features of hot dry summers and cool dry winters. The experiment was laid out in sandy loam in texture, slightly acidic in reaction soil with 3.50 g kg<sup>-1</sup> organic carbon, water holding capacity 37%, Permanent wilting point 10.46% , Field capacity (at 0.33 bar) 22.50%, Soil Ph 5.94, Available N (210.5 kg/ha), Available P<sub>2</sub>O<sub>5</sub> (23.3 kg ha<sup>-1</sup>) and Available K<sub>2</sub>O (135.6 kg ha<sup>-1</sup>). The experiment was design in Factorial Randomized Block (FRBD) with three factors- Factor A: Fodder Crops (3)- Oat, Rye grass and Berseem; Factor B: Seed rate (2) - 100% RSR & 125% RSR and Factor C: Nitrogen levels (3)-100% RDN, 125% RDN & 150% RDN, which comprises total eighteen treatments combinations, replicated thrice. Initially well decomposed Farm Yard Mannure @10 tons/ha were applied. Application of farm yard manure (FYM) as well as Inoculation of Rhizobium @ 500 g ha<sup>-1</sup> and Azotobactor @ 500 g ha<sup>-1</sup> was carried through seed treatment. The recommended seed rate (RSR) Oat: 80 kg ha<sup>-1</sup>, Rye grass: 12 kg ha<sup>-1</sup> and Berseem: 25 kg ha<sup>-1</sup>, Recommended dose of fertilizer (RDF) was Oat and Rye grass- 80:40:30 (N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>), Berseem: 30:80:30 (N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup>).

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The crops cultivars were Oat (UPO-212), Rye grass (Makhan grass) and Berseem (Wardan). Crops were in good condition and irrigation and other Agronomical activity were practice on time. India with 2.4 per cent of the land and 4.0 per cent of water resources supports livelihood to 17.84 per cent of global human population as well as nearly 20 per cent of the world livestock. Among the different state Jharkhand have some typical situation with Fodder were harvested at proper stage for difrent crops data of represented sample were taken from randomly selected place.

## Results and Discussion

Results on yield and economic are elaborated with proper discussion here under different sub head as-

### Fodder yield

The fodder yield in terms of green fodder yield (GFY), Dry fodder yield ( DFY) and per day productivity was influenced in similar trend which was more under sown with 125 per cent RSR at 150 per cent RDN (Table 1).

*Rabi* fodder crops grown with 125 per cent RSR at 150 per cent RDN recorded more green fodder and dry fodder yield. Fodder oat was harvest twice pronounced as first and second cutting which was carried at 60 DAS and 110 DAS. The highest green fodder yield (GFY) during first cut (169.97 (q ha<sup>-1</sup>), second cut (183.63 q ha<sup>-1</sup>) *i.e.* in total (353.61 q ha<sup>-1</sup>), while dry fodder yield during the said cuts were 54.39 (q ha<sup>-1</sup>), 59.30 (q ha<sup>-1</sup>) and 113.70 (q ha<sup>-1</sup>) at first, second and total respectively.

Rye grass was harvested thrice and the highest green fodder yield (GFY) during first cut (91.68 (q ha<sup>-1</sup>), second cut (99.05 (q ha<sup>-1</sup>) and third cut (91.90 (q ha<sup>-1</sup>) *i.e.* in total (282.63 q ha<sup>-1</sup>) The similar trends in dry fodder yield were recorded as the GFY, which were 18.34 (q ha<sup>-1</sup>), 19.99 (q ha<sup>-1</sup>) & 19.19 (q ha<sup>-1</sup>) and 57.52 (q ha<sup>-1</sup>) at first, second, third and total respectively.

Berseem recorded green fodder yield (GFY) during first cut & nipping (141.13 q ha<sup>-1</sup>), second cut (149.82 q ha<sup>-1</sup>) and third cut (139.60 q ha<sup>-1</sup>) *i.e.* in total (430.61 q ha<sup>-1</sup>) and the dry fodder yield 25.40 (q ha<sup>-1</sup>), 27.70 (q ha<sup>-1</sup>) & 25.59 (q ha<sup>-1</sup>) and 79.69 (q ha<sup>-1</sup>) at respective cuts were recorded under same levels on seed rate and nitrogen levels. This is due to more population along with contribution of single plant at higher levels of nitrogen.

Amonge *et al.* (2012) [2] and Raja (2013) [6] also find similar results. Better utilization of resources result at the same levels of plant stand and nitrogen level, which finely converted to maximum green fodder Oat yield of 353.61 q ha<sup>-1</sup> and accordingly the higher dry fodder yield 113.70 q ha<sup>-1</sup>. There were increase of 46.4 per cent in GFY and 47.1 per cent in DFY due to additional intervention of 25 per cent increment in seed rate and 50 per cent increment in nitrogen dose under all other constant variation/ similar situation of climatic factors. This might be attributed to the more congenial condition for germination, led to more plant population in unit area and favorable climate under more easily available nutrient also due to incorporation of farm yard manure (FYM) as well as inoculation of bio-fertilizer (*Azotobacter*), which responds to better growth as well as yield attributes, finely converted into

yield.

Inoculation of bio-agents like *Rhizobium* helped not only in fixation of more atmospheric nitrogen in Berseem, similarly *Azotobacter* in non-legumes improved the microbial balance by producing metabolites that stimulated plant growth after germination, therefore resulted in improvement of growth parameters. Improvement in growth parameters due to *Azotobacter* inoculation was also reported by Sheoran *et al.* (2002) [7], Agrawal *et al.* (2002) [2] and Singh and Dubey (2008) [8]. Similar reasons were also reported by Jatasara *et al.* (2000) [5] in Oat

### Productivity per day

Productivity increased with increased of age as it was lower up to 60 DAS and then increased during second cut in Rye grass as well as Berseem. However overall average Productivity per day during the crop period in Oat 3.21 (q ha<sup>-1</sup>day<sup>-1</sup>), Rye grass (2.57 q ha<sup>-1</sup>day<sup>-1</sup>) and Berseem (3.91 q ha<sup>-1</sup>day<sup>-1</sup>) were recorded. This is due to symmetrical growth pattern of the crop and relatively lower growth at early stage due to lesser development of root system which related to the interaction of nutrient uptake and solar radiation harvest. Caballero, *et al.* (1994) [4] also reported similar results.

### Economics

Gross return, net return and profitability are the basic tools which determine the feasibility in crops production. Maximum gross return (₹. 1,29,184 ha<sup>-1</sup>), Net return (₹. 94,589 only) and profitability Rs. 860 ha<sup>-1</sup> day<sup>-1</sup> were recorded under Berseem sown with 125 per cent recommended seed rate at 150 per cent RDN. This was due to combined effect of cost of input, output and production (GFY). Akbarnia *et al.* (2010) [3] and Yadav *et al.* (2012) also observed the similar trend and supported the justification.

### Summary and Conclusion

Growth of different Rabi fodders like oat, ryegrass and Berseem sown with different seed rate at different levels of nitrogen under similar ecology varied differently which resulted into different yield and economic. The highest green fodder and dry fodder yield of fodder oat (353.61, 113.7 q ha<sup>-1</sup>) rye grass (282.63, 57.52 q ha<sup>-1</sup>) and Berseem (430.6, 79.69 q ha<sup>-1</sup>) with 125 per cent recommended seed rate at 150 per cent RDN were significantly higher than other treatment combinations. The Berseem recorded highest per day productivity (3.91 q ha<sup>-1</sup>day<sup>-1</sup>) which was nearly 22 per cent more than fodder oat (3.21 qha<sup>-1</sup>day<sup>-1</sup>) and 52 per cent than rye grass (2.57 q ha<sup>-1</sup>day<sup>-1</sup>). The highest profitability (Rs. 860 ha<sup>-1</sup> day<sup>-1</sup>) was recorded under Berseem.

### Acknowledgment

I acknowledge the contribution and help of Dr Sushma Manjhi Agronomist, BAU Ranchi for her help during prepration of this research article.

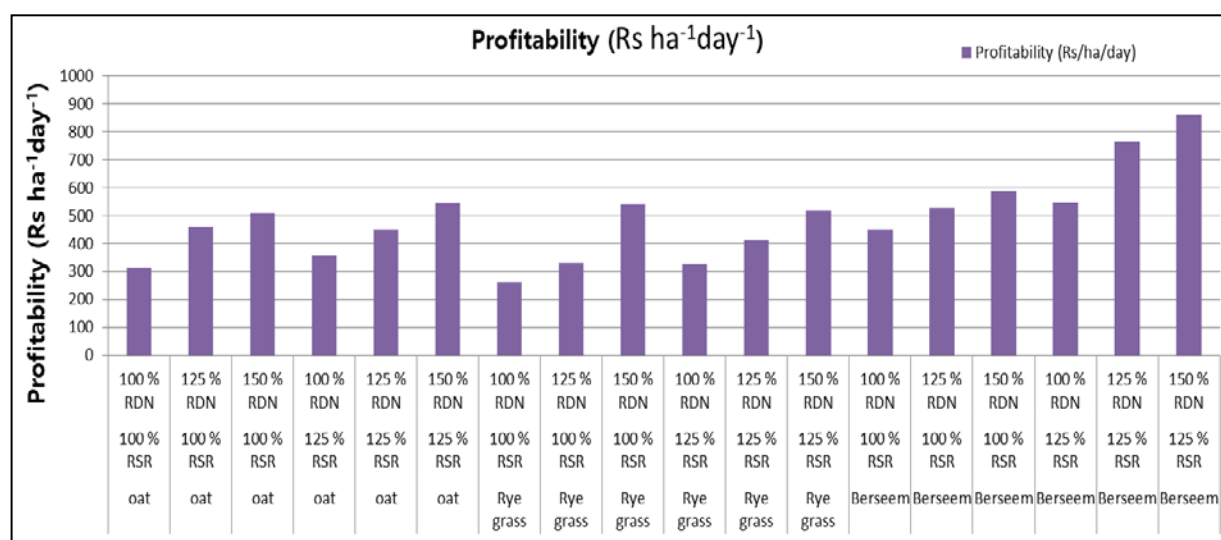
**Table 1:** Yield and productivity of different Rabi fodder crops influenced by plant density and nitrogen levels under late sown condition (three years pooled)

| Treatments |          |          | Green Fodder Yield (q ha <sup>-1</sup> ) |                     |                     |        | Dry Fodder Yield (q ha <sup>-1</sup> ) |                     |                     |        | Productivity (qha <sup>-1</sup> day <sup>-1</sup> ) |                     |                     |         |
|------------|----------|----------|--|---------------------|---------------------|--------|--|---------------------|---------------------|--------|---|---------------------|---------------------|---------|
|            |          |          | 1 <sup>st</sup> Cut                      | 2 <sup>nd</sup> Cut | 3 <sup>rd</sup> Cut | Total  | 1 <sup>st</sup> Cut                    | 2 <sup>nd</sup> Cut | 3 <sup>rd</sup> Cut | Total  | 1 <sup>st</sup> Cut                                 | 2 <sup>nd</sup> Cut | 3 <sup>rd</sup> Cut | Average |
| Oat        | 100% RSR | 100% RDN | 115.00                                   | 126.39              | --                  | 241.39 | 36.80                                  | 40.11               | --                  | 76.91  | 1.97  | 2.56                | --                  | 2.19    |
|            |          | 125% RDN | 149.88                                   | 161.93              | --                  | 311.82 | 47.96                                  | 52.30               | --                  | 100.26 | 2.50  | 3.24                | --                  | 2.83    |
|            |          | 150% RDN | 160.70                                   | 173.62              | --                  | 334.32 | 51.42                                  | 56.07               | --                  | 107.49 | 2.68  | 3.47                | --                  | 3.04    |
|            | 125% RSR | 100% RDN | 128.77                                   | 139.12              | --                  | 267.88 | 41.21                                  | 44.93               | --                  | 86.13  | 2.15  | 2.78                | --                  | 2.44    |
|            |          | 125% RDN | 149.37                                   | 161.38              | --                  | 310.74 | 47.80                                  | 52.12               | --                  | 99.91  | 2.49  | 3.23                | --                  | 2.82    |
|            |          | 150% RDN | 169.97                                   | 183.63              | --                  | 353.61 | 54.39                                  | 59.30               | --                  | 113.70 | 2.83  | 3.67                | --                  | 3.21    |
| Rye grass  | 100% RSR | 100% RDN | 58.72                                    | 63.44               | 62.17               | 184.32 | 11.74                                  | 12.80               | 12.29               | 36.84  | 0.98  | 2.54                | 2.49                | 1.68    |
|            |          | 125% RDN | 66.96                                    | 72.34               | 70.89               | 210.19 | 13.39                                  | 14.60               | 14.02               | 42.01  | 1.12  | 2.89                | 2.84                | 1.91    |
|            |          | 150% RDN | 91.68                                    | 99.05               | 87.07               | 277.80 | 18.34                                  | 19.99               | 19.19               | 57.52  | 1.53  | 3.96                | 3.80                | 2.52    |
|            | 125% RSR | 100% RDN | 66.96                                    | 72.34               | 70.89               | 210.19 | 13.39                                  | 14.60               | 14.02               | 42.01  | 1.12  | 2.89                | 2.84                | 1.91    |
|            |          | 125% RDN | 77.26                                    | 83.47               | 81.80               | 242.53 | 15.45                                  | 16.85               | 16.17               | 48.47  | 1.29  | 3.34                | 3.27                | 2.20    |
|            |          | 150% RDN | 91.68                                    | 99.05               | 91.90               | 282.63 | 18.34                                  | 19.99               | 19.19               | 57.52  | 1.53  | 3.96                | 3.88                | 2.57    |
| Berseem    | 100% RSR | 100% RDN | 87.56                                    | 94.60               | 90.82               | 272.98 | 15.76                                  | 17.18               | 16.50               | 49.44  | 1.46  | 3.78                | 3.63                | 2.48    |
|            |          | 125% RDN | 96.83                                    | 104.62              | 100.43              | 301.88 | 17.43                                  | 19.00               | 18.24               | 54.68  | 1.61  | 4.18                | 4.02                | 2.74    |
|            |          | 150% RDN | 104.04                                   | 112.41              | 107.91              | 324.36 | 18.73                                  | 20.42               | 19.60               | 58.75  | 1.73  | 4.50                | 4.32                | 2.95    |
|            | 125% RSR | 100% RDN | 100.95                                   | 109.07              | 104.70              | 314.73 | 18.17                                  | 19.81               | 19.02               | 57.00  | 1.68  | 4.36                | 4.19                | 2.86    |
|            |          | 125% RDN | 128.77                                   | 136.73              | 129.13              | 394.63 | 23.18                                  | 25.27               | 24.26               | 72.71  | 2.15  | 5.56                | 5.34                | 3.59    |
|            |          | 150% RDN | 141.13                                   | 149.82              | 139.67              | 430.61 | 25.40                                  | 27.70               | 26.59               | 79.69  | 2.35  | 6.10                | 5.85                | 3.91    |

**Table 2:** Gross return (₹/ha) of different Rabi fodder crops influenced by plant density and nitrogen levels under late sown condition (three years pooled)

| Treatments | Oat      |          | Rye grass |          | Berseem  |          | Mean      |
|------------|----------|----------|-----------|----------|----------|----------|-----------|
|            | 100% RSR | 125% RSR | 100% RSR  | 125% RSR | 100% RSR | 125% RSR |           |
| 100% RDN   | 61,613   | 66,971   | 55,297    | 63,058   | 81,893   | 94,418   | 70,542    |
| 125% RDN   | 77,954   | 77,686   | 63,058    | 72,759   | 90,564   | 1,18,389 | 83,402    |
| 150% RDN   | 83,580   | 88,402   | 86,341    | 84,789   | 97,308   | 1,29,184 | 94,934    |
| Mean       | 74,382   | 77,686   | 68,232    | 73,535   | 89,921   | 1,13,997 |           |
|            | A        | B        | C         | A x B    | A x C    | B x C    | A x B x C |
| S.Em       | 193      | 158      | 193       | 273      | 334      | 273      | 473       |
| LSD at 5%  | 555      | 453      | 555       | 785      | 961      | 785      | 1359      |

\*A: Crops, B: Seed rate and C: Nitrogen levels.

**Fig 1:** Profitability (Rs ha<sup>-1</sup> day<sup>-1</sup>) of Rabi fodder crops with different seed rate and nitrogen levels under late sown condition**Table 3:** Net return (₹/ha) of different Rabi fodder crops influenced by plant density and nitrogen levels under late sown condition.

| Treatments | Oat      |          | Rye grass |          | Berseem  |          | Mean      |
|------------|----------|----------|-----------|----------|----------|----------|-----------|
|            | 100% RSR | 125% RSR | 100% RSR  | 125% RSR | 100% RSR | 125% RSR |           |
| 100% RDN   | 34,617   | 39,021   | 28,937    | 35,903   | 49,513   | 60,051   | 41,340    |
| 125% RDN   | 50,574   | 49,352   | 36,314    | 45,220   | 58,071   | 83,908   | 53,907    |
| 150% RDN   | 56,030   | 59,898   | 59,427    | 57,080   | 64,700   | 94,589   | 65,287    |
| Mean       | 47,074   | 49,424   | 41,559    | 46,068   | 57,428   | 79,516   |           |
|            | A        | B        | C         | A x B    | A x C    | B x C    | A x B x C |
| S.Em       | 193      | 158      | 193       | 273      | 334      | 273      | 473       |
| LSD at 5%  | 555      | 453      | 555       | 785      | 961      | 785      | 1359      |

\*A: Crops, B: Seed rate and C: Nitrogen levels

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