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Green fodder yield in Jharkhand under integrated nutrient management in fodder oat and *Lathyrus* intercropping system

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Abstract
A field experiment entitled "Integrated nutrient management in fodder Oat + *Lathyrus* intercropping system" was carried during *Rabi* 2017-18 at forage research field situated at Ranchi veterinary college campus of Birsa Agricultural University, Kanke, Ranchi. The experiment was laid out in Split-plot Design with three replications. Total 12 treatment combinations were taken from four intercropping system *viz.*Sole oat, sole *lathyrus*, oat+*lathyrus* (3:2) and oat + *latrhyrus* (3:3) in main plot and three integrated nutrient management(100 % RDF as Inorganic, 50% N of RDF + 50% N of RDF (FYM) and 50% N of RDF+ 50% N of RDF (V. Comp) under sub plot. The highest green fodder yield of sole fodder oat at 100 % RDF as inorganic was 368.34 q ha^{-1}, while sole *lathyrus* at 100 % RDF (inorganic) produced (137.33 qha^{-1}) geen fodder which was at par with sole *lathyrus* (136.67 qha^{-1}) at 50% N of RDF (inorganic) + 50 % N of RDF (vermicompost). Total maximum green fodder yield under sole oat (368.34 qha^{-1}) at 100 % RDF (inorganic) and 363.34 q/ha at 50% N of RDF (inorganic) + 50% N of RDF (vermicompost) under oat+ *lathyrus* (3:2) were at par with each other.

Keywords: Green fodder yield, nutrient management, oat

Introduction
The Animal Husbandry and livestock sectors are critical for the rural economy, especially the small and marginal farmers. They not only contribute to their income but also their best insurance against any natural calamity. The livestock sector alone contributes nearly 25.6% of Value of Output at current prices of total value of output in Agriculture, Fishing & Forestry sector. The overall contribution of Livestock Sector in total GDP is nearly 4.11%at current prices during 2012-13 (19th Animal Census, 2012). Livestock sector of Jharkhand among the newly created state reserved their position and became a key component of the diversified agricultural system through upliftment of rural economy by providing gainful employment opportunities to small and marginal farmers. Jharkhand faces pressure to feed the 32 million human and 3.42 % of national livestock population with just 2.42 % land of the country. In this state livestock is rearing over 0.12 %of fodder area and 0.95 % of grazing land and contributing equal percentage of fodder and milk (0.9%) yield in national pool with 180 g/day/capita available milk for Jharkhand people against the 240 g/day/capita for national average (Anonymous, 2016) [3]. As feed and fodder contains about 55-60 per cent of total cost of milk production (Singh, K.A.2008) [4]; thus, good quality of green fodder having sufficient nutritive value is the demand of the day.
In India, oat was introduced in the early .

However, in some areas, it is grown for grain to be used as baby food, breakfast food and animal feed. It is grown in Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, Himachal Pradesh, Rajasthan, Bihar, Gujarat, Andhra Pradesh and Tamil Nadu. There are some constraints that limit the production of oats in India. The main constraint is that the people still consider it as a minor cereal, so it is generally cultivated for fodder purpose in small areas as livestock feed. Since it is considered minor there is inadequate supply of nutrients to the crop, which results in low productivity. Adopting proper techniques of cultivation and nutrient management can lead in better grain and fodder productivity (Amarjeet Kujur and Thomas Abraham, 2017) [1]. Jharkhand meets hardly 50 per cent of the feed and fodder requirement for their livestock. The farmers face green fodder deficiency in winter when they have only paddy straw, dry stalks of summer cereal fodders or dry summer grasses. Thus, there is needed to grow green fodder during *Rabi* season from available limited irrigation resources

Materials and method

A field experiment was conducted at Forage research field situated at College of Veterinary Science and Animal Husbandry of Birsa Agricultural University, Kanke, Ranchi during *Rabi* season in 2017-18. The soil was sandy loam in texture having sand (56.8%), silt (28.0%) and clay (15.2 %) with bulk density 1.54 Mgm^{-3}, good water retention (FC 21.5 % and PWP 11.36 %), good soil aggregation (GMD 0.677 mm) and water holding capacity (38.7 %). The soil reaction was acidic in nature with low available N and P, medium in available K and just above critical limit for available S content in soil. The intial organic carbon (4.90 g kg^{-1}) with available nitrogen (212.0 kg ha^{-1}), available phosphorus (24.3 kg ha^{-1}) and available potassium (144.7 kg ha^{-1}).In terms of biological properties of soil the population of *Azotobactor* (3.2 x 10^4 cell g^{-1} soil), *Actinomycetes* 12 x 10^6 cell g^{-1} soil) and CO_2 evolution (107 mg kg^{-1} soil day^{-1}) was present in soil before the experimentation. The experiment was conducted in Split-plot design with four cropping system as main plot treatment (T_1- Sole oat, T_2-Sole Lathyrus, T_3- Oat + Lathyrus (3:2) and T_4- Oat + Lathyrus (3:3) and three integrated nutrient management as Sub-plot (F1- 100% RDF (inorganic), F2- 50% N of RDF (inorganic) + 50% N through FYM and F3-50% N of RDF (inorganic) + 50% N through Vermi-compost). The fodder oat cultivar- JHO-99-2 and *lathyrus* cultivar Mahateora was sown in second week of November. Nutrient requirement were met through urea, Single super Phosphate, Muriate of potash, FYM and Vermi-compost. Inoculation of Rhizobium @ 500 g ha^{-1} in *Lathyrus* and *Azotobactor* @ 500 gha^{-1} in oat were carried through seed treatment. The collected data were subjected to statistical analysis in standard format of split plot design and presented below in tabular and graphical form.

Result and Discussion

Green as well as dry fodder yield were recorded by harvesting gross plot in each treatment and then converted into q ha^{-1}.

Fodder Oat yield

Harvesting of fodder oat was taken at 70 days after sowing which is presented table in 4.5. Result showed that intercropping system and integrated nutrient management has significantly affected the fodder yield of oat in terms of green forage yield (GFY).

Sole oat grown with 100 % RDF (inorganic) produced more green fodder yield (368.34 q ha^{-1}) which was significantly higher over all other treatment combinations of different intercropping system and integrated nutrient management (Table 1.). Among the inter cropped, oat+ *lathyrus* (3:2) grown at 100 % RDF (inorganic) produced highest GFY (291.67q ha^{-1}) which was at par with same grown at 50% N of RDF (inorganic) + 50 % N of RDF (vermicompost). Oat grown as intercropped with *lathyrus* in 3:2 ratio at 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost) produced higher tillers per square meter (312), plant height (145.2), LAI (4.29) which ultimately converted into green fodder production of 364.34 qha^{-1}.Amonge *et al.* (2012)and Raja (2013) also reported similar results. Maximum green fodder oat yield of 368.34 qha^{-1} was recorded under sole oat sown with 100 % recommended dose of fertilizer through in organic sources which was at par with oat + *lathyrus* (3:2) grown at 50 % N of RDF (inorganic) + 50 %N of RDF (vermicompost).

Fodder *Lathyrus* yield

Harvesting of fodder *lathyrus* was also carried with oat at 70 days after sowing. Green fodder yield (GFY) of *lathyrus* were recorded and converted into qha^{-1} is presented at under mentioned table 1. Result showed that, intercropping system and integrated nutrient management significantly affect the GFY of *lathyrus*.

Oat+ *lathyrus* (3:3) grown at 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost) produced higher yield (91.67 q ha^{-1}) than oat + *lathyrus* (3:2) at any nutrient management. Besides it, 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost) was significantly superior to 50 % N of RDF (inorganic) + 50 % N of RDF (FYM) and at par with 100 % RDF as Inorganic under different cropping system.

Besides it, the sole *lathyrus* grown at different nutrient management produced at par green fodder yield, however, it was higher at 137. 00 qha^{-1} at 100 % RDF as inorganic. Sole *lathyrus* grown at 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost) produced longer vine length (109.67 cm), GFY (136.67 qha^{-1}) at harvest. This might be due to plenty supply of N along with P and K, which increased the protoplasmic constituents and accelerated the process of cell division and elongation (Babalad *et al.*, 1993; Joon *et al.*, 1993; Pisal *et al.*, 1993 and Pradhan and Mishra, 1994) [6, 7, 10, 11].

Total green fodder yield

Total green fodder yield under sole oat at 100 % RDF as Inorganic (368.34 qha^{-1}) and oat + *lathyrus* (3:2) grown at 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost) (364.34 qha^{-1}) were at par to each other. Sole oat at different nutrient management produced lower fodder yield which was nearly 182.6 per cent lower than the highest produced.

Total green fodder yield under sole oat and oat+ *lathyrus* (3:2) cultivated with 100 per cent RDF from inorganic sources was at par with oat+ *lathyrus* (3:2) grown at 50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost). Maximum green fodder yield under sole oat at 100 % RDF (inorganic) was about 182.60% more than minimum under sole *lathyrus* grown at 50 %t N of RDF (inorganic) + 50 %N of RDF (FYM), This is due to combined effect of growth and yield attributing characters of individual crop due to availability of nutrient and amount of sun light received. As intercropped *lathyrus* received less amount of radiation and faces competition for nourishment, while oat get better

opportunity with regards to above inputs under inter cropped. Apart from the above facts *lathyrus* as intercropped accelerate the growth of oat by adding nutrient. Backiyavathy *et al.* (2006) [5] and Meena *et al.* (2018) [8] also reported the response of vermicompost and FYM on yield of fodder produced.

Table 1: Green fodder yield (qha^{-1}) as influenced by integrated nutrient management in fodder Oat + *Lathyrus* intercropping system

Intercropping system (A)	Integrated Nutrient Management (B)									Mean		
	100 % RDF as Inorganic			50 % N of RDF (inorganic) + 50 % N of RDF (FYM).			50 % N of RDF (inorganic) + 50 % N of RDF (vermicompost)					
	Oat	*Lathyrus*	Total	Oat	*Lathyrus*	Total	Oat	*Lathyrus*	Total	Oat	*Lathyrus*	Total
Sole Oat	368.34	----	368.34	319.00	----	319.00	323.67	----	323.67	337.00	----	337.00
Sole *Lathyrus*	----	137.00	137.33	----	130.33	130.34	----	136.67	136.67	-----	134.78	134.78
Oat+*Lathyrus* (3:2)	291.67	71.67	363.34	277.00	59.67	336.67	280.00	84.34	364.34	282.89	71.89	354.78
Oat+*Lathyrus* (3:3)	216.34	91.00	307.34	192.34	89.00	281.34	219.34	91.67	311.00	209.34	90.56	299.89
Mean	292.11	99.90	294.08	262.78	93.00	266.83	274.33	104.40	283.92			
				Oat			*Lathyrus*			Total green fodder		
				S. Em±		LSD at ±5%	S. Em±		LSD at 5%	S. Em±		LSD at 5%
Between A				6.45		25.18	0.97		3.79	7.49		25.86
Between B				5.68		17.56	2.14		6.63	4.90		15.16
C. Interaction (A x B)												
Between B at same level of A				7.17		20.09	1.68		9.83	6.97		17.79
Between A at same or different level of B				7.89		28.61	2.70		8.60	8.67		28.91
CV %				7.12			7.51			6.03		

Conclusion

In general, the result of this experiment shows that the highest green fodder yield of sole fodder oat at 100 % RDF as inorganic was 368.34 q ha^{-1}, while sole *lathyrus* at 100 % RDF (inorganic) produced (137.33 qha^{-1}) green fodder which was at par with sole *lathyrus* (136.67 qha^{-1}) at 50% N of RDF (inorganic) + 50 % N of RDF (vermicompost). Total maximum green fodder yieldunder sole oat (368.34 qha^{-1}) at 100 % RDF (inorganic) and 363.34 q/ha at 50% N of RDF (inorganic) + 50% N of RDF (vermicompost) under oat+ *lathyrus* (3:2) were at par with each other. On the basis of the findings of the experiment it may be concluded that, the fodder oat + *lathyrus* (3:2) grown at 50 % N of RDF + 50 % N of RDF (vermicompost) will be beneficial for maximum green fodder yield during *Rabi* season from available limited irrigation resources in Jharkhand.

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