Original Research Article

Green Manuring and Nitrogen Management for Sustainable Productivity of Niger [*Guizotia abyssinica*(L.f.) Cass.] in Odisha

ABSTRACT

Niger (*Guizotia abyssinica* Cass.), a minor oil seed crop is generally cultivated in marginal and sub marginal lands under poor agronomic practices without application of manures and fertilisers which causes great losses in its yield. However, the crop has got high yield potential if recommended agronomic package of practices are followed. Also the farmers always grow Niger without application of any organic or inorganic fertilisers. In view of this, a field experiment wascarried outunder All India Coordinated Research Project on nigerat Regional Research and Technology Transfer Station (OUAT), Semiliguda of Koraput district under Eastern Ghat High Land zone of Odisha in acidic soil during two consecutive *kharif* seasons of 2019 to 2020 to study the response of green manuring and nitrogen managementon growth and yield of niger.The experiment consisted of fourcrop sequences and fournitrogen levels with split plot design.Thedata revealed that growing of niger crop after incorporation of cowpea as green manure along with application of recommended dose of fertilizer resulted significantly highest seed yield of 645.6 kg/ha and 684.1 kg/ha with a net monetary return of Rs.17939/ha and Rs.30853/haand benefit cost ratio of 1.7 and 2.9 during the year 2019 and 2020 respectively.

Key words: *Niger;green manures;cowpea; seed yield; economics*

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1. INTRODUCTION

Niger (*Guizotiaabyssinica*(L.f.) Cass.)is one of the most important minor oilseedcrop. It is an important edible oilseed crop of Indian tribal communities, which contains edible oil 38–43%, protein 20% and sugar 12%. The nigeroilis used in foods, paints, soft soaps, lighting, lubrication and cosmetics (DOR, 2013). In India about 75% of the harvested seeds are used for oil extraction and the rest is exported for bird food. Roasted or fried seeds are eaten as snacks or used as a condiment. The press cake after oil extraction contains 31–40% protein and is used as cattle feed(Dalei et al., 2014). As because niger can be grown with minimum agro inputs, it is

considered to be a crop for resources poor farmers particularly in developing countries like India. It is most hardy and drought tolerant occupying a prominent place where moisture is the limiting factor and soils are sub-marginal to marginal in several parts of the countryIt is grown in India in an area of about2.99 lakh hawith a production of0.98 lakh tonnesand a productivity of 327 kg/ha [1].In the state of Odisha, it covers an area of 0.65 lakh ha with a production of 0.23 lakh tonnes and productivity of 360kg/ha [1].Since the crop is cultivated by poor tribal farmers in the interiors of villages in scattered fields with minimum agro inputsand without application of any organic manures, potential yield of the crop could not be achieved. As a result of which very low yield of niger is realized by the farmers and soil health is badly affected. In niger, though research information on these aspects are available and it is very meager, so still a few more technical information are to be found out.Therefore, the present investigation was carried out to study the response of green manuring and nitrogen managementon growth and yield of niger.

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2. MATERIALS AND METHODS

2.1 Experimental site

To achieve the objectives of the programme, a field experiment was conducted under AICRP on nigerat Regional Research and Technology Transfer Station (OUAT), Semiligudaunder Koraput districtin Eastern Ghat High Land zone of Odisha during two consecutive *kharif* seasons of 2019and 2020. The farm is located in the geographical parallels of $18^0$42'N latitude, $82^0$30'E longitude and an altitude of 884.0 m. The region is marked by its warm and humid climate with an average annual rainfall of 1500 mm, most of which is received from middle of June to middle of October.

2.2 Soil characteristics

The soil samples collected from field were air dried, grounded with mortar pestle and sieved in 2 mm sized mesh (Brady 1990). The soil of experimental sitewas red, sandy loam in texture and acidic in reaction (p^H=5.8) with low organic carbon (4.5 g/kg), available N (170 kg/ha), available P (16 kg/ha)andavailable K (145 kg/ha), respectively.

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2.3 Experimental Design

The experiment consists of four crop sequences *viz.*C_1-Dhanicha Green Manuring-Niger (Dhanicha GM-Niger), C_2- Sunhemp Green Manuring-Niger (Sunhemp GM-Niger), C_3-CowpeaGreen Manuring-Niger (Cowpea GM-Niger) andC_4- Fallow-Niger and four nitrogen levels *viz.*N_1-No Nitrogen (No N),N_2-50 % RDN, N_3-75% RDN andN_4- 100 % RDN(Table-

1).The experiment wasevaluated in split plot designwith three replications for statistical analysis. The green manuring crops *viz.*dhanicha, sunhempand cowpea were sown in experimental plots as per the treatments. These green manuring crops were incorporated in the soil 45 days after sowing.The nigercrop cv. Utkal Niger-150 was sown with seed rate of 10 kg/ha with a row spacing of 30 cm. The intra-row spacing of 10 cm was maintained by thinning operation. The thinning and weeding operations were carried out on 15 and 21 days after sowing in every year under the experimentation.The recommended dose of P and K fertilizers (40:40PK kg/ha) was applied to the crop as basal. As per the treatment ½ N fertilizer was applied as basal and rest ½ N was applied after three weeks after sowing of niger.The crop was harvested at physiological maturity. The periodical biometric and post harvest observations were taken at regular interval.

2.4 Statistical Analysis

The experimental data collected during the crop growth and harvest were analysed statistically following the procedure as described by Gomez and Gomez (1984). Treatment differences were tested at 5% level of significance by F test and using analysis of variance (ANOVA) for making comparison among treatment means for various yield and yield components of Niger. Least significance difference (LSD) was done at P=0.05.

3. RESULTS AND DISCUSSION

3.1 Effect on growth parameters

The perusal of data shown in Table1revealed that both crop sequences and nitrogen levels had no significant effect on plant height and number of branches plant^{-1}at harvest during both the years of investigation. However maximum plant heights of 234.7 cm and 217.4 cmwere recorded with crop sequences Sunhemp GM-Niger during 2019 and Fallow-Niger during 2020 respectively. Plant heights were recorded maximum with 100% RDNduring 2019 (238.0 cm) and No-Nitrogen during 2020 (222.1 cm). During 2019 maximum number of branches per plant (9.0) was recorded with both crop sequences Dhanicha GM-Niger and Sunhemp GM-Niger whereasduring 2020 maximum number of branches per plant (8.1) was recorded with crop sequence Cowpea GM-Niger. 100% RDN recorded maximum number of branches per plant (9.1 and 8.1) during both the years 2019 and 2020 respectively. 75% RDN also recorded equal number of branches per plant (8.1) as that of 100% RDN during the year 2020. Days to 50% flowering was significantly higher (87.5 days) with Fallow-Niger crop sequence which was at par with that of Dhanicha GM-Niger (87.3 days)andSunhemp GM-Niger (87.2 days) during 2019 whereas days

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to 50% flowering was significantly higher (65.6 days) with Cowpea GM-Niger crop sequence during 2020. Nitrogen level of 75% RDN recorded significantly moredays to50% flowering (87.6 days) which was at par with as that of 50% RDN and 100% RDN (87.3 days) during 2019 whereas 50% RDN recorded significantly moredays to50% flowering (64.7 days) which was at par with as that of No N (64.6)and75% RDN (64.0 days) during 2020.

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Table 1. Growth parameters as influenced by green manuring and nitrogen levels in niger

Treatment	Plant height (cm)		No. of branches per plant		Days to 50% flowering	
	2019	2020	2019	2020	2019	2020
Crop sequence (C)						
C_1-Dhanicha GM-Niger	230.6	216.8	9.0	8.0	87.3	63.8
C_2-Sunhemp GM-Niger	234.7	216.7	9.0	8.0	87.2	63.8
C_3-Cowpea GM-Niger	232.9	216.4	8.9	8.1	86.9	65.6
C_4-Fallow-Niger	234.2	217.4	8.8	7.9	87.5	63.2
SEm(±)	3.7	5.1	0.2	0.1	0.1	0.3
CD (p=0.05)	NS	NS	NS	NS	0.4	1.0
Nitrogen levels (N)						
N_1-No N	228.7	222.1	8.7	7.8	86.6	64.6
N_2-50 % RDN	232.9	215.6	9.0	8.0	87.3	64.7
N_3-75% RDN	232.8	211.9	9.0	8.1	87.6	64.0
N_4-100 % RDN	238.0	217.7	9.1	8.1	87.3	63.1
SEm(±)	3.5	5.4	0.2	0.1	0.2	0.2
CD (p=0.05)	NS	NS	NS	NS	0.5	0.7
Interaction (C X N)						
SEm(±)	40.3	10.7	2.0	0.3	1.7	0.5
CD (p=0.05)	123.5	31.3	5.9	0.8	4.9	1.3
Interaction (N X C)						
SEm(±)	9.9	10.6	0.4	0.3	0.4	0.5
CD (p=0.05)	29.0	32.4	1.1	0.8	1.3	1.5

3.2 Effect on yield attributes

Data presented in Table 2 revealed thateffect of crop sequences on the number of capitula plant^{-1}was found non-significant during both the years of experiment. However maximum number of capitula plant^{-1} (119.2 and 87.5) was recorded with crop sequence Cowpea GM-Nigerduring 2019 and 2020 respectively. 100% RDN recorded significantly highernumber of capitula plant^{-1} (123.0) at par with 50% RDN (113.3) and 75% RDN (117.1) during the year 2019.Crop sequence of Cowpea GM-Nigerrecorded significantly higher number of seeds capitula^{-1} (27.2 and 27.5)at par withDhanicha GM-Niger (25.2 and 26.0)and Sunhemp GM-Niger (25.0 and 26.7)during 2019 and 2020 respectively. 100% RDN recorded significantly highernumber of seeds capitula^{-1} (26.3) at par with 50% RDN (25.1) and 75% RDN (25.8) during the year 2019.Effect of nitrogen levels on the number of capitula plant^{-1} and number of seeds capitula^{-1} was found non-significant during both the years of investigation.

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3.3 Seed Yield

The data presented in Table 2 showed a significant effect of crop sequences and nitrogen levels on seed yield of Niger during both the years of experiment. Crop sequence Cowpea GM-Niger recorded significantly higher seed yield of 714.9 kg/ha and 668.3 kg/ha during 2019 and 2020 respectively.However it was at par with the seed yield recorded with Dhanicha GM-Niger (623.4 kg/ha) and Sunhemp GM-Niger (630.2 kg/ha) during the year 2020.Significantly higher seed yield of 645.6 kg/ha and 684.1 kg/ha was recorded with 100% RDN during 2019 and 2020 respectively. However it was at par with the seed yield recorded with 75% RDN (619.8 kg/ha) during the year 2019.

Table 2. Yield and yield attributes as influenced by green manuring and nitrogen levels in niger

Treatment	No. of capitula per plant		No. of seeds per capitula		Seed yield (kg/ha)	
	2019	2020	2019	2020	2019	2020
Crop sequence (C)						
C_1-Dhanicha GM-Niger	115.2	85.2	25.2	26.0	559.5	623.4
C_2-Sunhemp GM-Niger	116.1	84.3	25.0	26.7	622.0	630.2
C_3-Cowpea GM-Niger	119.2	87.5	27.2	27.5	714.9	668.3
C_4-Fallow-Niger	111.1	79.8	23.6	24.6	493.3	586.9

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SEm(±)	3.2	3.1	0.7	0.6	17.1	17.0
CD (p=0.05)	NS	NS	2.4	2.2	59.3	58.9
Nitrogen levels (N)						
N_1-No N	108.3	82.6	23.8	25.2	553.2	588.9
N_2-50 % RDN	113.3	86.0	25.1	26.8	571.0	609.1
N_3-75% RDN	117.1	84.5	25.8	25.9	619.8	626.6
N_4-100 % RDN	123.0	83.7	26.3	26.9	645.6	684.1
SEm(±)	4.3	2.4	0.7	0.7	20.9	12.3
CD (p=0.05)	12.5	NS	2.0	NS	61.0	35.9
Interaction (C X N)						
SEm(±)	45.5	4.8	7.7	1.4	226.6	24.6
CD (p=0.05)	136.6	13.9	23.4	4.0	683.7	71.8
Interaction (N X C)						
SEm(±)	12.1	5.1	1.9	1.3	59.1	27.3
CD (p=0.05)	35.3	16.0	5.6	4.1	172.5	85.3

3.4 Economics

The input and output prices of commodities prevailed during each year of investigation were taken into consideration for calculating cost of production, net monetary return (NMR) and benefit: cost ratio(B:C ratio) presented in Table 3.Crop sequence of Cowpea GM-Niger recorded higher NMR of Rs.17939/ha and Rs.30853/hawith B:C ratio 1.7 and 2.9 during both the years 2019 and 2020 respectively. 100% RDN recorded higherNMR of Rs. 15964/ha and Rs. 32001/ha with B:C ratio 1.7 and 3.0 during both the years 2019 and 2020 respectively.

Table 3.Net Monetary Return (NMR) and B:C ratio as influenced by green manuring and nitrogen levels in niger

Treatment	Net Monetary Return (Rs/ha)		B:C Ratio	
	2019	2020	2019	2020
Crop sequence (C)				
C_1-Dhanicha GM-Niger	10560	28076	1.4	2.8
C_2-Sunhemp GM-Niger	14157	28549	1.6	2.8
C_3-Cowpea GM-Niger	17939	30853	1.7	2.9
C_4-Fallow-Niger	9920	26521	1.5	2.8
Nitrogen levels (N)				
N_1-No N	10626	26397	1.5	2.8
N_2-50 % RDN	11565	27314	1.5	2.8
N_3-75% RDN	14420	28286	1.6	2.8
N_4-100 % RDN	15964	32001	1.7	3.0

4. CONCLUSION

Based on the seed yield and economic indices, it can be concluded that growing of Niger crop with incorporation of cowpea as green manure along with application of recommended dose of fertilizer is the most suitable sustainable practice for getting higher seed yield and monetary returns under Eastern Ghat High Land zone of Odisha.

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