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Impact of weed management strategies on yield and economics of Niger in the eastern Ghats highland agro-climatic zone of Odisha

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Abstract
The experiment entitled "Impact of weed management strategies on yield and economics of niger [*Guizotia abyssinica* (L.f.) Cass.] was conducted in Eastern Ghats high land agro-climatic zone of Odisha" under AICRP on Niger at Regional Research and Technology Transfer Station, Semiliguda during *kharif* season of 2023.The soil of the experimental site was sandy loam in texture, well drained and acidic in reaction (pH 5.8) with low organic carbon (4.5 g kg $^{-1}$). The values of soil N, P_2O_5 and K_2O were in the range of 180, 16.50 and 245 kg ha$^{-1,}$ respectively. The climate of the region is warm and humid with an average annual rainfall of 1567.2 mm, out of which 85% is received from mid June to mid October with occasional showers in winter and summer months. The crop was sown on 12thAugust with a spacing of 30 cm x 10 cm and harvested on 7th December. The experiment was laid out in a randomised block design replicated thrice with imposition of eight treatment combinations as T_1- Weedy check, T_2- Two hand weedings at 20 & 40 DAS, T_3- Inter cropping of Niger + Finger millet (3:2), T_4- Chemical stale seed bed (application of Glufocinate 15 days before sowing), T_5- Application of Pendimethalin 30% EC @ 750 g a.i ha^{-1} as pre emergence (PE) spray, T_6- Application of Pyroxasulfone 85% WG @ 50 g a.i ha^{-1} as PE, T_7- Application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL @ 100 g a.i ha^{-1} as post emergence (PoE) spray at 2-4 leaf stage of weed, T_8- Application of Oxyfluorfen 23.5% EC @ 75 g a.iha^{-1} as pre emergence (PE) spray to evaluate the efficacy of herbicides and cost effective weed management option in niger. Two hand weedings at 20 and 40 DAS (T_2) improved yield contributing characters *viz*. number of capitula plant^{-1} (75.9), number of seeds capsule^{-1} (29.9), seed yield (687.5 kgha^{-1}), straw yield (1085.7 kg ha^{-1}) and harvest index (38.77%) and was statistically at par with application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL (T_7). However, application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL was found economically more remunerative as compared to other weed management strategies with highest net return per ha (Rs. 33,336) and B:C ratio (2.99) and hence can be recommended to the farmers.

Keywords: Niger, weed management, hand weeding, Glufocinate, intercropping, pendimethalin, imazethapyr, pyroxasulfone, oxyfluorfen, yield and economics

1. Introduction
Niger [*Guizotia abyssinica* (L.f.) Cass.] is an important minor herbaceous oilseed crop cultivated in different parts of India and Ethiopia since 5000 years (Deme *et al*., 2017) [1]. In India, niger is cultivated in an area of about 2.61 lakh hectare with annual production of 0.84 lakh tonnes and productivity of 321 kg ha^{-1}contributing only 3% to total oilseed production pool making the country a leading producer and exporter of niger in the world. Niger is predominantly cultivated in marginal and sub marginal lands and hill slopes by the tribal fraternity of India and considered as "life line of tribal agriculture and economy" providing food and nutritional security (Padhi *et al.* 2023) [19]. Niger seeds contain high-quality oil comparable to olive oil with great nutritional value having more than 70% unsaturated fatty acids with wide range of medicinal benefits (Deme *et al.*, 2017; Mohseni *et al.*, 2020 and Panda *et al.*, 2021) [1, 3, 2]. The seeds contain 35-45% oil and 18-20% protein with a pleasant aroma similar to desi ghee (Panda *et al*., 2021) [2]. In Odisha, it is mostly grown in tribal dominated districts of eastern ghats (Koraput and Nawarangpur districts), north eastern Ghats Rayagada, Kandhamal and Gajapati

districts) & north central plateau (Keonjhar and Mayurbhanj districts) agro climatic zone during *kharif* season in an area of about 35.25 thousand hectares with a productivity of 371 kg per hectare (OAS 2022-23) [4]. Being a *kharif* crop, weed infestation is a major threat to the crop. It is estimated that around 50-70% of the labour engaged in the crop production is diverted to weeding. Weeds cause yield loss up to 85% in niger by competing with the crop for water, light and nutrients and by allelopathic effect. Coexistence with weeds can modify plant morphology, biomass accumulation, plant growth and successively the yield of crops by interfering with different metabolic processes (Oimbo *et al.*, 2018) [5]. Major weed flora found in niger fields are *Cuscuta spp.*, *Alternanthera spp.*, *Cynodon spp*, *Eleusine indica*, *Thornless mimosa*, *Cyperus rotundus*, *Cyperus iria*, *Cyperus campestris*, *Parthenium hysterophorus*, *Commelina benghalensis*, *Euphorbia hirta*, *Phyllanthus niruri*, *Chenopodium album* and *Amaranthus species* (Rajput, 2017) [6].Keeping in view of the above facts and the higher cost incurred in weed control, the present study aimed to find out a suitable weed control measure for improving the productivity of niger.

2. Materials and Methods

A field experiment was conducted during *Kharif* season of 2023 under AICRP on Niger at Regional Research and Technology Transfer Station, Semiliguda of Odisha University of Agriculture & Technology (OUAT). 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 above msl. The region is characterised by warm and humid climate with average annual rainfall of 1567.2 mm, out of which 85% is received from mid June to mid October with occasional showers received during winter and summer months. The soil of experimental site was sandy loam in texture, well drained and acidic in reaction (pH 5.8) with low organic carbon (4.5 g kg^{-1}). The soil available nitrogen content was low (180 kg ha^{-1}), available phosphorus content was medium (16.50 kg ha^{-1}) and the available potassium content was medium (245 kg ha^{-1}). The soil was rich in oxides of iron and aluminium and deficient in Boron, Zinc and Molybdenum. Seeds of the variety, Utkal Niger 150 were sown on 12thAugust 2023 with seed rate of 10 kg ha^{-1} and spacing of 30 m x 10 cm. The recommended dose of fertilizer (RDF) applied was 40: 40: 20: kg N-P_2O_5-K_2O $ha^{-1}$of which 50% N, 100% P_2O_5 and K_2O were applied as basal and rest 50% N top dressed at three weeks stage. The experiment was laid out in randomised block design assigned with eight treatment combinations,T_1-Weedy check, T_2-Two hand weedings at 20 and 40 days after sowing (DAS), T_3- Inter cropping of Niger + Finger millet (3:2), T_4- Chemical stale seed bed (application of Glufocinate 15 days before sowing), T_5- Application of Pendimethalin 30% EC @ 750 g a.i ha^{-1} as pre-emergence (PE) spray, T_6- Application of Pyroxasulfone 85% WG @ 50 g a.i ha^{-1} as PE, T_7- Application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% soluble liquid (SL) @ 100 g a.i ha^{-1} as post emergence (PoE) spray at 2-4 leaf stage of weed, T_8- Application of Oxyfluorfen 23.5% EC @ 75 g a.i ha^{-1} as pre emergence (PE) spray to evaluate the efficacy of herbicides and cost effective weed management option in niger. A knapsack sprayer equipped with a flat fan nozzle was used to apply pre-emergence herbicides within 24 hours of sowing using 500 litres of water per hectare. In case of hand weeding treatments, weeds were removed manually with a trowel at 20 and 40 DAS.Weed density was assessed at 30 DAS and 60 DAS from each plot using a quadrate size of 0.25 m^2 (0.5 m x 0.5 m). Two quadrates were selected randomly in each plot. Weeds collected from a 0.25 m^2 area were identified, counted and expressed in numbers m^{-2}. The crop was harvested at physiological maturity on 7th December, 2023.The periodical biometric and post-harvest observations were taken at regular intervals. The harvested produce from each treatments were tied in separate bundles and weighed with the help of a spring balance and converted into kg ha^{-1}. Weed control efficiency (WCE) and Weed Index (WI) were calculated by using the prescribed formulae.

$$WCE = \{(WDC-WDT) / WDC\} \times 100$$

Where,
WCE-Weed control efficiency, WDC- Weed density in control plot and WDT- Weed density in treated plot

$$WI = \{(YT-YC) / YT\} \times 100$$

Where,
WI - Weed index, YT-Yield from treated plot and YC- Yield from control plot

The experimental data collected during the crop growth and harvest were analysed statistically following the procedure as described by Gomez and Gomez [7].

3. Results and Discussion

3.1 Weed density, weed control efficiency and weed index

Data presented in Table 1 indicated that total weed density increased gradually up to 60 DAS. At 60 DAS, the lowest weed density of 49.0 m^{-2} was reported with two hand weedings at 20 and 40 DAS and remained at par with application of pendimethalin 30% EC *fb* Imazethapyr 10% SL @ 100 g a.i ha^{-1} as PoE (56.6 m^{-2}). Highest weed density (261.9 m^{-2}) was recorded in the weedy check (control) treatment. Highest weed control efficiency and the lowest weed index were recorded with two hand weedings at 20 and 40 DAS (81.3 & 0, respectively) closely followed by application of pendimethalin 30% EC *fb* Imazethapyr 10% SL @ 100 g a.i ha^{-1} as PoE (78.4 & 7.3, respectively). The lowest weed control efficiency and highest weed index were recorded with weedy check (0, 64.4, respectively). Hand weedings at 20 and 40 DAS efficiently reduced the weed population and reduced the critical period for crop-weed competition and thus enabling the crop plants to utilize the resources more efficiently there by resulting in better expression of growth parameters, yield attributes and yield (Sanbagavalli *et al.* 2016) **[8]**and better smothering effect on weed plant at later stages of crop growth which leads to low weed density, higher weed control efficiency and lowest weed index compared to weedy check (Kaur and Singh 2017, Saha *et al.* 2021 and Shanmugapriya *et al.* 2022) [9, 10, 11].

3.2 Number of branches and capitula $plant^{-1}$

Data pertaining to number of branches and capitula $plant^{-1}$ as influenced by different treatments is presented in Table 1. Significantly higher number of branches and capitula $plant^{-1}$obtained in two hand weeding at 20 and 40 DAS (7.6 and 75.9, respectively) but was at par with Pendimethalin 30% EC fb Imazethapyr 10% SL @ 100 g a.i ha^{-1} as PoE (7.1 and 64.8, respectively). Weed removal by hand weeding at early crop growth stage reduced crop-weed competition and provided better growing environment for the crop plants for effective utilisation of insolation, applied nutrients and soil moisture resulting in more number of branches $plant^{-1}$ and higher flower heads $plant^{-1}$ than rest of the treatments. This corroborates with the findings of Saha *et al.* 2021 **[10]**, Shanmugapriya *et al.* 2022 **[11]** and Mishra and Choudhary 2022 **[12]**. Less branches and

capitula plant^{-1}was recorded in weedy check (6.3 and 35.9, respectively).

3.3 No. of seeds capitulum^{-1}

More number of seeds capitulum^{-1}was obtained (Table 1) with hand weeding at 20 and 40 DAS (29.9) and remained at par with application of Pendimethalin 30% EC *fb* Imazethapyr10% SL @ 100 g a.iha-1 as PoE (29.4). Less seeds capitulum^{-1}was found in weedy check (23.5). Similar results were recorded by Thakur and Dantre (2018) [13]and Verma *et al*. 2022 [14].

3.4 Seed yield

Maximum seed yield (Table 1) was obtained from hand weeding at 20 and 40 DAS (687.5 kg ha^{-1}) but was statistically at par with application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL@ 100 g a.i ha^{-1}as PoE (652.4 kg ha^{-1}). The possible reason might be due to efficient control of weeds, less competition between crop-weeds and better nutrient uptake by crop plants resulting in more accumulation of photosynthates in the sink and there by higher yield in the treatments. This corroborates the findings of Joshi *et al*. (2022) [15] and Sahoo *et al*. (2023) [16]**.** Minimum seed yield was obtained in weedy check (244.9 kgha^{-1}).

3.5 Stover yield

Maximum stover yield (1085.7 kg ha^{-1}) was obtained with hand weeding at 20 and 40 DAS but remained statistically at par with the application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL @ 100 g a.i ha^{-1}as PoE (1052.9 kgha^{-1}). Minimum stover yield (Table 1) was obtained in weedy check (464.2kg ha^{-1}). Similar findings was reported by Suryavanshi *et al.*(2015) [17] and Sahoo *et al.*(2023) [16].

3.6 Harvest index (HI)

Data relating to HI (Table 1) indicated that highest value was recorded with hand weeding at 20 and 40 DAS (38.77%) closely followed by application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL@ 100 g a.i ha^{-1}as PoE (38.26%). Highest HI in hand weeding treatment might be due to lower crop-weed competition at early stages of crop growth, efficient utilisation of nutrients and insolation for optimum expression of growth and yield parameters and ultimately yield. This corroborates with the findings of Choudhary *et al.* 2022 [18] and Sahoo *et al.* (2023) [16].

3.7 Economics

Application of Pendimethalin 30% EC as PE *fb* Imazethapyr10% SL @ 100 g a.i ha^{-1}as PoE was found economically beneficial as compared to other weed management options with highest net returns (Rs.33,336 ha^{-1}) and B:C ratio (2.99) followed by hand weeding at 20 and 40 DAS with net returns and B:C of Rs.29668 ha^{-1} and 2.77, respectively due to higher cost of cultivation associated in hand weeding.

Table1: Impact of different weed management strategies on growth, yield attributes, yield, weed studies and economics of niger

	Treatments	Weed Density at 30 DAS (no.m^{-2})	Weed Density at 60 DAS (no.m^{-2})	No. of branches plant^{-1}	No. of capitula plant^{-1}	No. of seeds capitulum^{-1}	Seed yield kg ha^{-1}	Stover yield kg ha^{-1}	Harvest Index (%)	Weed control efficiency (%)	Weed index	Net monetary return (Rsha^{-1})	B:C ratio
T_1	Weedy check (control)	151.8	261.9	6.3	35.9	23.5	244.9	464.2	34.54	0	64.4	2238	1.14
T_2	Two hand weeding at 20 & 40 DAS	40.0	49.0	7.6	75.9	29.9	687.5	1085.7	38.77	81.3	0.0	29668	2.77
T_3	Inter cropping of Niger +Finger millet (3:2)	131.8	183.3	6.4	44.4	25.2	321.3	612.2	34.42	30.0	53.3	6656	1.4
T_4	Chemical stale seed bed (application of Glufocinate at 15 days before sowing)	142.5	193.1	6.4	27.5	24.9	298.8	512.6	36.83	26.3	56.7	6105	1.39
T_5	Application of Pendimethalin 30% EC @ 750 g a.i ha^{-1}as PE	49.1	62.6	6.7	64.0	28.6	580.3	970.8	37.41	76.9	15.6	25524	2.52
T_6	Application of Pyroxasulfone @ 50 g a.iha^{-1} as PE	57.0	81.8	6.4	48.5	25.7	423.9	874.9	32.64	68.8	38.3	14127	1.84
T_7	Application of Pendimethalin 30% EC as PE *fb*Imazethapyr 10% SL @ 100 g a.i ha^{-1}as PoE	47.9	56.6	7.1	64.8	29.4	652.4	1052.9	38.26	78.4	7.3	33336	2.99
T_8	Application of Oxyfluorfen @ 75 g a.i ha^{-1} as PE	54.0	65.8	6.5	52.1	26.8	539.1	968.4	35.76	74.9	21.6	22524	2.34
	Sem(±)	2.77	4.24	0.24	3.88	0.39	13.94	22.64					
	CD (P=0.05)	8.4	12.9	0.8	11.8	1.1	42.3	68.7					

4. Conclusion

Among the different weed management strategies followed in Niger, hand weeding at 20 and 40 DAS improved yield contributing characters, seed yield (kg ha^{-1}), straw yield (kg ha^{-1}) and harvest index (%) but was statistically at par with application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL@ 100 g a.i ha^{-1}as PoE. However, considering the economics of production, application of Pendimethalin 30% EC as PE *fb* Imazethapyr 10% SL@ 100 g a.i ha^{-1}as PoE was found profitable as compared to other weed management options with highest net return (Rs.33,336ha^{-1}) and B:C ratio (2.99).Hence, pre emergence application of herbicide, Pendimethalin 30% EC followed by post emergence application of herbicide, Imazethapyr 10% soluble liquid (SL) @ 100 g a.i ha^{-1} can be

recommended to the farming community of Eastern Ghats High land agro-climatic zone of Odisha.

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Conflict of Interest
None

6. References

1. Deme T, Haki DG, Retta N, Woldegiorgis A, Geleta M. Mineral and anti-nutritional contents of Niger seed (*Guizotia abyssinica* (L. F.) Cass.). Foods. 2017;6:27-37.
2. Panda D, Palita SK. Potential of underutilized wild crops in Koraput, Odisha, India for improving nutritional security and promoting climate resilience. Curr Sci. 2021;120(6):989-996.
3. Mohseni NM, Mirzaei H, Moghimi M. Optimized extraction and quality evaluation of Niger seed oil via microwave-pulsed electric field pretreatments. Food Sci Nutr. 2020;8(3):1383-1393.
4. OAS. Odisha Agriculture Statistics 2022-23. Published by Department of Agriculture and Farmers' Empowerment, Government of Odisha.
5. Oimbo LM, Lucas N, Elmad A. Allelopathic effect of Niger plant (*Guizotia abyssinica* L.) on abundance of selected weeds. Emer Life Sci Res. 2018;4(2):38-44.
6. Rajput E. Cropping system and weed infestation on crops in Chhattisgarh plains. Int J Pharmacogn Phytochem. 2017;1(3):31-42.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. New York: John Wiley & Sons; 1984. p. 97-101.
8. Sanbagavalli S, Chinnusamy C, Thiruvarassanm S, Marimuthu S. Evaluation of efficient weed management practices on growth and yield of groundnut. Int J Agric Sci. 2016;8:3310-3313.
9. Kaur J, Singh A. Direct seeded rice: Prospects, problems/constraints and researchable issues in India. Curr Agric Res. 2017;5:13-32.
10. Saha S, Munda S, Singh S, Kumar V, Jangde HK, Mahapatra A, *et al*. Crop establishment and weed control options for sustaining dry direct seeded rice production in eastern India. Agronomy. 2021;11:389-409.
11. Shanmugapriya P, Rathika S, Ramesh T, Janaki P. Response of transplanted finger millet to weed management practices under sodic soil condition. J Appl Nat Sci. 2022;14:263-268.
12. Mishra JS, Choudhary VK. Weed and nutrient interactions in dryland agriculture. Indian J Fertil. 2022;18(11):1148-1158.
13. Thakur K, Dantre C. Weed dissemination and effect on yield of Niger by pre-application of herbicides. Indian J Weed Sci. 2018;43(15):165-188.
14. Verma S, Lakpale R, Verma C, Kashyap TL, Raj S. Effect of different weed management practices on productivity and economics of Niger (*Guizotia abyssinica*). Pharma Innov J. 2022;11(3):1982-1985.
15. Joshi N, Joshi S, Sharma JK, Shekhawat HS, Shukla UN. Efficacy of sequential application of pre- and post-emergence herbicides for weed management in sesame. Indian J Weed Sci. 2022;54(3):279-282.
16. Sahoo S, Dash R, Jena S, Satapathy M, Kar I, Mishra J, *et al*. Weed dynamics and crop productivity as influenced by weed management practices and fertility levels in groundnut (*Arachis hypogaea* L.). Legume Res. 2023. DOI: 10.18805/LR-5197.
17. Suryavanshi VP, Suryavanshi SB, Jadhav KT. Influence of herbicides on yield and economics of kharif sunflower. J Crop Weed. 2015;11(1):168-172.
18. Choudhary VK, Dubey RP, Mishra JS. Weed management in oilseed crops - a review. Indian J Weed Sci. 2022;54(4):411-420.
19. Padhi SK, Sahoo A, Panda D. Nutritional and nutraceutical variability in neglected Niger (*Guizotia abyssinica* (L.f.) Cass.) accessions from Eastern Ghats of India. Oil Crop Sci. 2023;8:174-183.