Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 584-595

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.076

Effect of Integrated Nutrient and Various Weed Management Practices on Weed Dynamics in Rice Crop in Rice-groundnut Cropping System under Irrigated Medium Land Situation

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Keywords

Green manuring, Weed density, Weed index, Grasses, Sedges, Broad leaved weeds

Article Info

Accepted:
15 February 2021
Available Online:
10 March 2021

A B S T R A C T

A field investigation was conducted at Instructional farm of Krishi Vigyan Kendra Kendrapara, Odisha during *kharif* and *rabi* seasons of 2013-14 and 2014-15 in rice-groundnut cropping system under irrigated medium land situation. The soil of the experimental site was sandy loam in texture with pH of 5.7, organic carbon of 0.52 % having available soil nitrogen, phosphorus and potassium of 390.9 kg/ha, 10.1 kg/ha and 190.1 kg/ha respectively. Rice crop (var. Sahabhagi dhan) was transplanted in *kharif* season under the experiment taking nine treatments having three levels each of nutrient management and weed management practice with three replications in randomized block design. Further during *rabi* season each main plot was divided into two sub-plots taking groundnut (var. Devi) with two levels of weed management practices under split plot design. The results revealed that broad leaved weeds infested the rice crop to the tune of 42 %, followed by sedges (39 %) and grassy weeds (19%).The major broad leaved weeds of rice were *Ludwigia parviflora* and *Sphenoclea zeylanica* ,sedges such as *Cyperus iria* and *Cyperus difformis* and grasses like *Echinocloa colona*. Minimum weed density was observed rice crop in treatment of RDF (75% N) with green manuring of *dhaincha (Sesbania aculeata)* coupled with pre emergence application of herbicide oxadiargyl at 3 DAT followed by post emergence bispyribac-sodium at 20 DAT .Maximum weed density, weed dry matter accumulation was observed when there is application of RDF without green manuring and weedy check plot. The weed index of 49.1 % and 48.5 % was observed during 2014 and 2015 respectively from weedy check plot.

Introduction

Rice is cultivated in 112 countries of world covering every continent and it is consumed by 2.5 billion people in developing countries, mostly in Asia (90%) and the rest (10%) in America, Africa, Australia and Europe. To meet global rice demand, it is projected that an additional 96 million tons of milled rice will be needed by 2040 as compared to 2015 (Valera and Belie, 2020). Though eastern India occupies 61.3% of the rice area of the country (27 million ha), it contributes only 48% of the total rice production and it has

much lower growth rate of rice yield compared to other regions of the country.

Complementary use of organic and biological source of plant nutrient along with chemical fertilizer is of great importance for the maintenance of soil health and productivity, especially under intensive cropping system. Integrated use of organic manures and chemical fertilizers has advantages over use of only organic manures or chemical fertilizers. As a green manure crop, *dhaincha* can substitute for applied fertilizer nitrogen (Raju and Reedy, 2000) in addition to supplying organic matter for the restoration of soil physical conditions.

The use of *dhaincha (Sesbania aculeata)* as green manure improves soil productivity through biological nitrogen fixation. *Dhaincha* as green manure increases uptake of P, K, Zn, Fe, Mn, and Cu by rice plants (Vaiyapuri and Sriramachandrasekharan, 2001).

Weeds play a key role and reduce the crop yield by more than 35 % on an average (Sattin and Berti, 2003).Weed infestation in rice remains the largest constraint, limiting its productivity. A major hindrance in the successful cultivation of rice is heavy infestation of weeds (Parthipan *et al.,* 2013). A weed free period for the first 30-45 days after transplanting is required to avoid any loss in yield, because the dry weight of weeds increases greatly from 30 DAT in transplanted rice. Therefore the major challenges for farmers are an effective weed management, as failure to eliminate weeds may result in low or no yield. Manual removal of weed is labour intensive, tedious and does not ensure weed removal at critical stages of crop-weed competition. The choice of chemical herbicides depends upon weed type and degree of weed infestation in rice field. Herbicides are effective against weed species but most of them are specific and are effective against narrow range of weed species (Mukherjee and Singh 2005). Thus effective weed control often requires a combination of cultural, mechanical and chemical control such as an integrated weed management approach to delay herbicide resistance and reduce the herbicide load in the agro-ecosystem (Rao *et al.,* 2007).Therefore, considering the above, experiment on integrated nutrient and weed management in rice-groundnut cropping system was taken. Here weed density, weed dynamics, dry matter accumulation in weeds and weed index in rice crop has been discussed.

Materials and Methods

The field experiment was conducted at instructional farm of Krishi Vigyan Kendra Kendrapara, Odisha in rice-groundnut cropping system during *kharif* and *rabi* seasons of 2013-14 and 2014-15 under irrigated medium land situation where rice was grown as *kharif* crop and groundnut as *rabi* crop. The experimental site was situated at 20^0 $53^/$ N latitude and 86^0 $46^/$ E longitude at an altitude of 11.9 m above the mean sea level. The soil of the experimental site was sandy loam in texture with pH of 5.7, organic carbon of 0.52 % having available soil nitrogen, phosphorus and potassium of 390.9 kg/ha, 10.1 kg/ha and 190.1 kg/ha respectively.

The green manure crop *dhaincha* followed by rice were grown from 22nd standard meteorological week (SMW) (28 May -3 June) to 44th SMW (29-04 November) during kharif 2013 as well as in 2014. Total rainfall amounting to 1731.5 mm in 91 rainy days and 1266.0 mm in 83 rainy days were received during kharif 2013 and 2014 respectively. During *kharif* season three levels each of nutrient and weed management practices in rice were tried in randomized block design

(RBD) with three replications. The treatments were randomly allotted to the plots such as (1) N_1W_1– RDF (60-30-30 N-P_2O_5-K_2O kg/ha.)+Weedy check, (2) N_1W_2– RDF +Pre emergence herbicide (oxadiargyl 80% WP) @ 90g /ha at 3 DAT (Day after transplanting) + Hand Weeding (HW) at 25 DAT,(3) N_1W_3- RDF+ Pre em. (oxadiargyl 80% WP) @ 90g /ha at 3 DAT +Post em.(bispyribac sodium 10%SL) @ 200ml /ha at 15 DAT, (4) N_2W_1– RDF (75%N) +GM(Green manuring) dhaincha (*Sesbania aculeata*) +Weedy check,(5) N_2W_2- RDF (75%N) +GM dhaincha + Pre em. (oxadiargyl 80% WP) @ 90g /ha at 3 DAT + HW at 25 DAT, (6) N_2W_3- RDF (75%N) +GM dhaincha + Pre em. (oxadiargyl 80% WP) @ 90g /ha at 3 DAT +Post em.(bispyribac sodium 10%SL) @ 200ml /ha at 15 DAT,(7) N_3W_1 – RDF (50%N) + GM *dhaincha*+ Weedy check,(8) N_3W_2- RDF (50%N) +GM *dhaincha* + Pre em. (oxadiargyl 80% WP) @ 90g /ha at 3 DAT + HW at 25 DAT, (9) N_3W_3- RDF (50%N) +GM *dhaincha* + Pre em.(oxadiargyl 80% WP) @ 90g /ha at 3 DAT +Post em. (bispyribac sodium 10%SL) @ 200 ml /ha at 15 DAT in randomized block design.

Each main plot was divided into two sub-plots during *rabi* season. The residual effects of three levels each of nutrient and weed management practices imposed in rice and two levels of weed management practices in groundnut were tried with split plot design (SPD) with three replications. The same layout was maintained during the second year of experimentation.

All the herbicides were sprayed by knapsack sprayer using a spray volume of 500 litres/ha. Data on weed count and weed biomass from an area enclosed in a quadrate of 1 m^2 under different herbicide treatments.

The total number of weeds falling within the quadrate was counted species wise. All the weeds inside the quadrate were cut closer to ground level and collected for dry matter accumulation. Weed Index was calculated in relation to the seed yield in weed free treatment and expressed in percentage. Data on individual and total weed density and weed dry weight were subjected to square root transformation

Results and Discussion

Weed flora and its composition in rice

Observations on weeds were recorded during crop growing period. Weed flora of *kharif* rice for 2013 and 2014 are presented under Table 1. The results revealed that there were sixteen weed species *in toto*, out of which grasses were 4, sedges 4 and broad leaved weeds were 8. The dominant weed flora under grasses were *Echinochloa colona*, *Digitaria sanguinalis*, *Eleusine indica*, *Leptochloa chinensis*, among sedges *Cyperus rotundus*, *Cyperus difformis*, *Cyperus iria*, and *Fimbristylis miliaceae* and among the broadleaf weeds *Ludwigia parviflora*, *Alternanthera philoxeroids*, *Marsilia quadrifolia* and *Eclipta lba.* The weed flora examined during both the years in *kharif* season were more or less same but their composition varied from year to year presented under same table.

As regards to composition of weeds, It was interesting to indicate that grassy weeds were 42.85 % followed by sedges (32.84 %) and broad leaved weeds were minimum (20.31 %) during *kharif* 2013. In the second year of *kharif* 2014, there was slight decrease in grassy weed and estimated at 27.97 % and sedges were little higher than grasses (32.87 %), whereas the broad leaved weeds were comparatively higher (39.16 %) as compared to grasses and sedges. Similar findings have been observed by Bhanu Rekha *et al.*, (2004), Saha(2005) and Singh *et al.*, (2009).

Effect of INM and weed control practices on weed density (number/m^2) of *kharif* rice

Grasses

The weed density in *kharif* rice (2013) was recorded at 25, 40 and 55 DAT. The grassy weeds influenced due to effect of fertility levels indicated that there was significant increase in weed density of grasses at 100% RDF at 25 DAT. The weed density was reduced with increasing date of observations at 40 and 55 DAT. However, the trend was more or less similar to that of 25 DAT.As regards to weed management practices there was significant reduction in grassy weed population due to application of pre em. herbicide oxadiargyl followed by post em. bispyribac sodium. Second in order was oxadiargyl + one hand weeding. Weedy check recorded significantly higher weed density at all stages of observations.

During *kharif* 2014, the impact of N_1, N_2 and N_3 on grassy weed population were more or less similar to that of 2013, when observed at 25, 40 and 55 DAT. However, when weed control methods were assessed, the grassy weed population were higher at 25 DAT and then slowly reduced at 40 and 55 DAT. Pre emergence application of oxadiargyl followed by post emergence application of bispyribac sodium recorded minimum weed population.

Sedges

During *kharif* 2013, the density of sedges recorded at 25 DAT indicated that N_1 (100 % RDF) recorded significantly higher weed density (8.8 /m^2), whereas N_3 recorded the lowest. While examining the impact of weed control practices, application of pre emergence oxadiargyl followed by post emergence bispyribac sodium had great impact in reducing the weed density as compared to weedy check. In all cases weedy check treatment recorded significantly higher sedges per square metre.

During *kharif* 2014, N_1 recorded significantly higher sedges as compared to N_2 and N_3. However, in all stages of observations, the numbers of sedges recorded at 25, 40 and 55 DAT were higher.

Broad leaved weeds

During *kharif* 2013 the broad leaved weeds density was examined at 25, 40 and 55 DAT. The results revealed that N_1 recorded minimum weed density as compared to N_2 and N_3. Whereas N_3 recorded significantly higher weed density at 25 DAT. It decreased with increase in date of observation. On examining the impact of weed management practices W_3 recorded minimum weed density as compared to W_2 and W_1.The density of broad leaf weeds decreased with increase in date of observation.

During 2014, the density of BLWs was significantly higher at N_1, second in order was N_3, N_2 recorded the minimum BLWs.

Total weeds

In analysing the total weed density during 2013, N_1 recorded significantly higher total weed due to 100 % RDF and second in order was N_2 and minimum weed density was recorded in N_3. In case of weed control methods W_1 recorded significantly higher weed density followed by W_2 and W_3. The trend continued at 40 and 55 DAT. However, the density decreased with increase in date of operation during 2014. N_1 recorded significantly higher density and it was followed by N_3.

Minimum weed density was recorded in N_2.. As regards to weed management practices; W_1 recorded significantly higher weed

density. It was followed by W_2.Minimum weed density was recorded in W_3.

The weed density was higher at initial phase and got reduced at aging of plant with 50% N + green manure was advantageous to reduce the weed density during its incorporation in soil. This result corroborated the findings of Yadav *et al.*, (2009),Haldar and Patra (2007) Kiran *et al.*, (2010).

Table.1 Weed flora and its composition in rice during kharif 2013 and 2014

Weeds	**Botanical name**	**English name**	**Family**	**Ontogeny**	**Composition (%) at 25 DAT**	
					2013	**2014**
Grasses	*Echinochloa colona* (L.) Link	Barnyard grass	Poaceae	Annual	42.85	27.97
	Digitaria sanguinalis (L.) Scop	Hairy crab grass	Poaceae	Annual		
	Eleusine indica (L.) Gaertn	Indian goose grass	Poaceae	Annual		
	Leptochloa chinensis	Red sprangle top	Poaceae	Annual		
Sedges	*Cyperus iria Linn*	Umbrella sedge	Cyperaceae	Annual	36.84	32.87
	Cyperus difformis Linn	Flat sedge	Cyperaceae	Annual		
	Fimbristylis miliacea L. Vahl	Hoorah grass	Cyperaceae	Annual		
	Cyperus rotundus Linn.	Purple Nut sedge	Cyperaceae	Annual		
Broad leaved weeds	*Ludwigia parviflora* Linn	Creeping Water Primrose	Onagraceae	Annual	20.31	39.16
	Sphenoclea zeylanica Gaertn.	Goose weed	Sphenocleaceae	Annual		
	Eclipta alba (L.) Hassk	False daisy	Asteraceae	Annual		
	Alternanthera philoxeroides(Mart.)	Alligator weed	Amaranthaceae	Perennial		
	Cynotis cuculata	Cradle plant	commelinaceae	Annual		
	Marsilea quadrifolia	Pepperwort, water fern	Marsiliaceae	Perennial		
	Melochia corchorifolia	Red weed	Sterculiaceae	Annual		
	Ammania baccifera	Monarch red stem	Lythraceae	Annual		

Table.2 Effect of INM and weed control practices on weed density (number/m^2) of *kharif* rice during 2013 and 2014

Treatments	Grasses at different DAT			Sedges at different DAT			BLWs at different DAT			Total weeds at different DAT		
	25	40	55	25	40	55	25	40	55	25	40	55
2013												
Fertility levels												
N_1	9.2 (84.6)	5.7 (32.2)	5.1 (26.01)	8.8 (76.6)	5.0 (24.5)	4.1 (16.81)	6.9 (46.4)	5.2 (26.6)	4.7 (22.1)	14.4 (207.9)	9.2 (83.4)	8.05 (64.9)
N_2	7.9 (62.2)	5.1 (25.0)	4.2 (17.64)	5.8 (33.2)	3.7 (13.2)	3.1 (9.6)	8.6 (73.3)	4.5 (19.9)	3.9 (15.2)	13.0 (168.9)	7.7 (58.3)	6.51 (42.4)
N_3	7.3 (52.6)	3.6 (12.5)	2.5 (6.25)	4.7 (21.2)	3.4 (10.9)	2.6 (6.7)	8.2 (66.7)	4.0 (15.3)	2.9 (8.4)	11.9 (140.5)	6.3 (38.9)	4.62 (21.4)
SEm±	0.3	0.1	0.1	0.2	0.2	0.1	0.3	0.2	0.1	0.3	0.2	0.1
CD(P=0.05)	0.8	0.4	0.4	0.6	0.6	0.4	0.9	0.6	0.4	0.8	0.7	0.4
Weed Control practices												
W_1	10.3 (105.6)	9.7 (95.4)	7.3 (53.3)	8.7 (75.5)	8.1 (65.8)	7.4 (54.8)	8.1 (65.3)	7.1 (50.4)	6.3 (39.7)	15.7 (246.4)	14.5 (211.6)	12.16 (147.8)
W_2	6.6 (42.5)	2.4 (5.2)	2.1 (4.4)	5.1 (25.6)	3.5 (12.1)	3.0 (9.0)	7.1 (50.5)	3.9 (14.4)	3.2 (10.2)	10.9 (119.0)	5.7 (31.7)	4.6 (23.6)
W_3	6.2 (38.5)	1.9 (3.2)	1.7 (2.9)	4.6 (20.5)	3.2 (9.5)	2.6 (6.8)	6.6 (42.5)	3.4 (11.1)	2.9 (8.4)	10.0 (101.5)	4.9 (23.8)	4.3 (18.1)
SEm±	0.3	0.1	0.1	0.2	0.2	0.1	0.3	0.2	0.1	0.3	0.2	0.1
CD(P=0.05)	0.8	0.4	0.4	0.6	0.6	0.4	0.9	0.6	0.4	0.8	0.7	0.4
Treatments	**Grasses at different DAT**			**Sedges at different DAT**			**BLWs at different DAT**			**Total weeds at different DAT**		
	25	**40**	**55**	**25**	**40**	**25**	**40**	**55**	**25**	**25**	**40**	**55**
2014												
Fertility levels												
N_1	8.6 (73.3)	4.9 (23.7)	4.0 (23.7)	9.5 (90.2)	7.2 (51.1)	6.9 (47.6)	10.3 (106.5)	6.9 (47.0)	5.9 (34.8)	16.4 (270.0)	11.1 (121.8)	9.9 (98.4)
N_2	6.6 (42.5)	2.4 (5.2)	1.9 (3.4)	5.1 (25.6)	3.5 (12.1)	3.1 (9.6)	7.1 (50.5)	3.9 (14.4)	3.2 (10.2)	10.9 (119.0)	5.7 (31.7)	4.8 (23.2)
N_3	7.5 (55.8)	3.8 (14.2)	3.0 (9.0)	6.2 (37.6)	4.1 (16.5)	3.4 (11.6)	7.8 (60.2)	4.0 (15.5)	2.8 (7.8)	12.4 (153.8)	6.8 (46.2)	5.3 (28.4)
SEm±	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2
CD(P=0.05)	0.6	0.5	0.5	0.7	0.4	0.5	0.6	0.4	0.5	0.5	0.6	0.5
Weed Control practices												
W_1	8.3 (69.1)	4.6 (20.4)	3.9 (15.2)	9.0 (81.2)	5.7 (32.2)	4.8 (23.0)	9.9 (97.0)	6.4 (40.9)	5.3 (28.0)	15.8 (247.7)	9.7 (93.6)	8.14 (66.2)
W_2	4.7 (21.6)	3.3 (10.6)	3.0 (9.0)	8.6 (73.6)	4.6 (20.5)	3.3 (10.9)	5.4 (29.1)	5.1 (25.4)	4.3 (18.5)	11.0 (119.9)	7.4 (54.3)	5.8 (33.8)
W_3	4.2 (17.1)	3.0 (8.3)	2.1 (4.4)	7.9 (61.6)	3.9 (14.3)	2.8 (17.8)	4.6 (20.9)	4.4 (18.8)	3.9 (15.2)	10.2 (104.4)	6.7 (43.8)	5.7 (32.1)
SEm±	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2
CD(P=0.05)	**0.6**	**0.5**	**0.5**	**0.7**	**0.4**	**0.5**	**0.6**	**0.4**	**0.5**	**0.5**	**0.6**	**0.5**

N_1 - RDF (60-30-30 N-P_2O_5-K_2O kg/ha.), N_2– RDF (75%N) +GM *Dhaincha* , N_3 – RDF(50%N) + GM *Dhaincha*,W_1 – Control (Weedy check), W_2 –Pre em. Oxadiargyl at 3 DAT + HW at 25 DAT, W_3 - PE Oxadiargyl at 3 DAT +Post em. Bispyribac sodium at 15 DAT

Table.3 Effect of INM and weed control practices on weed dry matter accumulation (g/m^2) during 2013 and 2014

Treatments	Grasses at different DAT			Sedges at different DAT			BLWs at different DAT			Total weeds at different DAT		
	25	40	55	25	40	55	25	40	55	25	40	55
2013												
Fertility levels												
N_1	3.4 (11.3)	6.5 (42.3)	7.2 (49.5)	2.4 (5.4)	4.6 (20.3)	5.1 (22.3)	2.6 (6.1)	5.9 (33.8)	6.1 (36.5)	4.8 (22.9)	9.5 (98.5)	10.2 (105.6)
N_2	2.6 (6.5)	5.9 (34.3)	6.1 (36.2)	2.1 (4.1)	3.3 (10.2)	4.3 (16.5)	3.3 (10.1)	5.0 (24.5)	4.1 (16.5)	4.6 (20.7)	8.3 (69.0)	8.9 (81.3)
N_3	2.1 (4.0)	4.6 (20.8)	5.2 (25)	3.7 (12.5)	3.3 (10.4)	4.2 (16.5)	2.5 (5.8)	3.6 (12.4)	3.2 (16.8)	4.8 (22.8)	6.6 (43.6)	7.3 (49.5)
SEm±	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
CD(P=0.05)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5
Weed control practices												
W_1	3.6 (12.5)	6.5 (41.4)	7.1 (49.5)	2.7 (6.9)	4.4 (18.4)	5.2 (25.8)	2.9 (7.9)	5.7 (37.5)	6.3 (37.4)	5.3 (27.4)	9.6 (92.4)	10.2 (100.4)
W_2	2.6 (6.5)	5.9 (34.3)	6.2 (36.0)	2.1 (4.1)	3.3 (10.2)	4.1 (16.5)	3.3 (10.1)	5.1 (25.5)	5.9 (35.3)	4.6 (20.7)	8.3 (69.0)	9.3 (81.3)
W_3	2.1 (4.1)	4.3 (17.6)	5.1 (25)	1.7 (2.4)	3.1 (9.1)	4.0 (16.0)	3.0 (8.3)	4.6 (20.8)	4.8 (23.6)	3.9 (14.8)	6.9 (47.6)	7.2 (49.8)
SEm±	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
CD(P=0.05)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5
Treatments	**Grasses at different DAT**			**Sedges at different DAT**			**BLWs at different DAT**			**Total weeds at different DAT**		

	25	40	55	25	40	55	25	40	55	25	40	55
2014												
Fertility levels												
N_1	3.0 (10.0)	5.0 (24.1)	6.4 (38.1)	2.9 (7.9)	3.9 (15.1)	5.1 (25.1)	2.8 (7.5)	4.3 (18.1)	5.1 (25.1)	5.2 (26.4)	7.6 (57.4)	8.8 (70.2)
N_2	2.8 (7.5)	5.8 (33.2)	5.9 (35.2)	2.5 (5.9)	3.0 (8.2)	3.8 (9.2)	3.4 (11.1)	4.8 (22.4)	5.5 (26.2)	5.0 (24.6)	8.0 (63.9)	8.5 (67.2)
N_3	2.5 (5.8)	4.0 (15.6)	4.2 (16.3)	1.6 (2.1)	2.7 (6.9)	3.4 (10.6)	3.1 (9.1)	4.4 (19.0)	5.1 (25.2)	4.2 (17.1)	6.5 (41.6)	7.0 (49.1)
SEm±	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2
CD(P=0.05)	0.3	0.3	0.3	0.3	0.6	0.6	0.4	0.5	0.6	0.3	0.6	0.6
Weed control practices												
W_1	3.6 (12.5)	6.5 (41.4)	7.2 (49.4)	2.7 (6.9)	4.4 (18.4)	5.1 (26.4)	2.9 (7.9)	5.7 (32.5)	6.3 (36.4)	5.3 (27.4)	9.6 (92.4)	10.8 (101.4)
W_2	2.3 (4.8)	3.9 (14.5)	4.5 (17.5)	2.9 (8.1)	2.8 (7.5)	3.2 (9.5)	2.3 (4.8)	5.8 (33.0)	6.9 (36.9)	4.3 (17.8)	7.4 (54.9)	8.2 (65.5)
W_3	2.1 (4.0)	4.6 (20.8)	5.2 (25.8)	3.7 (12.5)	3.3 (10.4)	3.7 (12.8)	2.5 (5.8)	3.6 (12.4)	4.2 (17.8)	4.8 (22.8)	6.6 (43.6)	7.6 (50.8)
SEm±	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2
CD(P=0.05)	0.3	0.3	0.3	0.3	0.6	0.6	0.4	0.5	0.5	0.3	0.6	0.6

* $\sqrt{X + 0.5}$ transformed values of data on dry matter production by weeds and original values are given in parentheses

N_1 - RDF (60-30-30 N-P_2O_5-K_2O kg/ha.), N2 – RDF (75%N) +GM *Dhaincha* , N_3 – RDF(50%N) + GM *Dhaincha*,

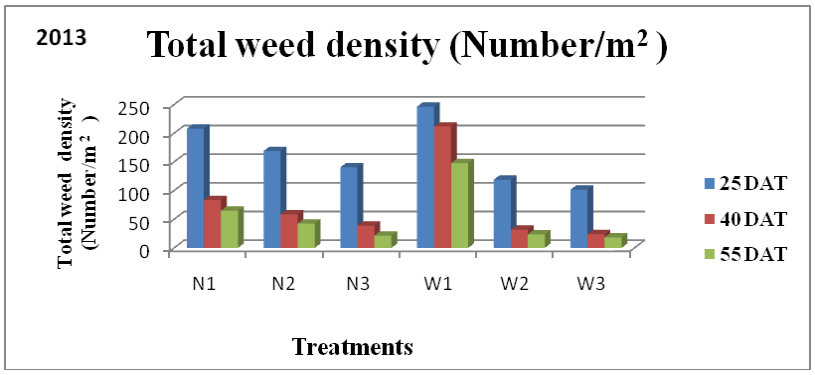
W_1 – Control (Weedy check), W2–Pre em. Oxadiargyl at 3 DAT + HW at 25 DAT, W_3 - PE Oxadiargyl at 3 DAT +Post em. Bispyribac sodium at 15 DAT

Table.4 Effect of INM and weed control practices on weed index (%) of rice

Treatments	2013	2014
N_1W_1	49.1	48.5
N_1W_2	21.9	22.2
N_1W_3	16.4	17.4
N_2W_1	25.5	23.6
N_2W_2	8.5	4.3
N_2W_3	0	0
$N3W_1$	28.7	33.7
N_3W_2	10.0	10.9
N_3W_3	6.0	5.8

N_1 W_1 - RDF (60-30-30 N-P_2O_5-K_2O kg/ha.)+ Control (Weedy check), N_1 W_2 – RDF +Pre em.oxadiargyl at 3 DAT + HWat 25 DAT, N_1 W_3 - RDF+ P E oxadiargyl at 3 DAT +Post em. bispyribac sodium at 15 DAT, N_2 W_1 – RDF (75%N) +GM *dhaincha* +Control (Weedy check), N_2 W_2 - RDF (75%N) +GM *dhaincha* + PE (Oxadiargyl at 3 DAT + HW at 25 DAT, N_2 W_3 - RDF (75%N) +GM *dhaincha* + PE oxadiargyl at 3 DAT +Post em. bispyribac sodium at 15 DAT, N_3 W_1 – RDF(50%N) + GM *dhaincha*+ Control (Weedy check)', N_3 W_2 - RDF (50%N) +GM *dhaincha* + PE Oxadiargyl at 3 DAT + HW at 25 DAT,, N_3 W_3 - RDF (50%N) +GM d*haincha* + PE oxadiargyl 80% WP) at 3 DAT +Post em. bispyribac sodium at 15 DAT

Fig.1 Effect of INM and weed control practices on weed density (number/m^2) of rice



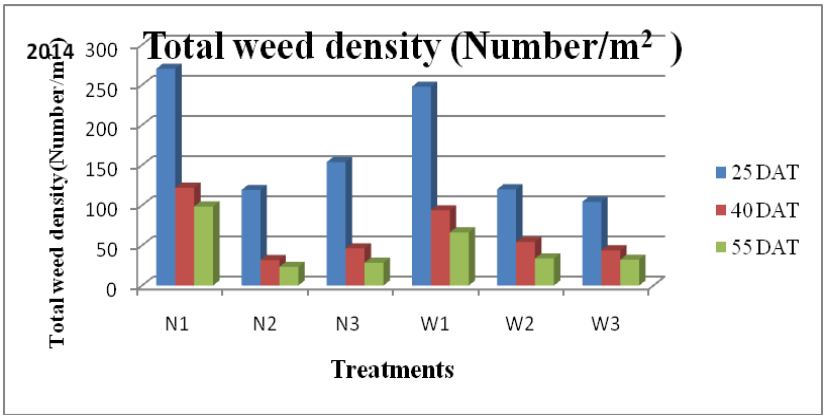
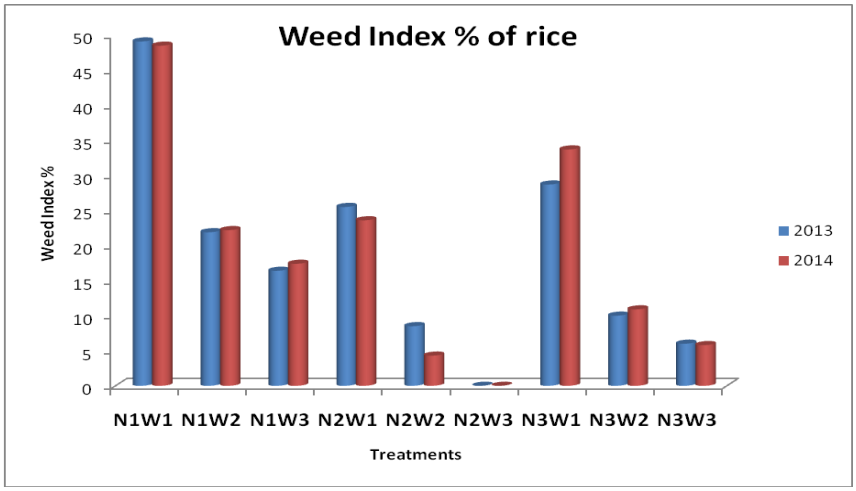


Fig.2 Effect of INM and weed control practices on weed index of rice



Effect of INM and weed control practices on dry matter accumulation of weeds

Grasses

The dry matter production in *kharif* rice (2013) was recorded at 25, 40 and 55 DAT. The effect of fertility levels on grassy weeds indicated that there was significant increase in dry matter production of grasses at 100% RDF at 25 DAT. The dry matter accumulation increased with increasing date of observations at 40 and 55 DAT. As regards to weed management practices there was significant reduction in grassy weed dry matter production due to application of pre em. oxadiargyl followed by post em. bispyribac sodium. Second in order was oxadiargyl + one hand weeding. Weedy check recorded significantly higher dry matter accumulation at all stages of observations. During *kharif* 2014, the impact of N_1, N_2 and N_3 on grassy weed dry matter production were more or less similar to that of 2013, when observed at 25, 40 and 55 DAT. However when weed control methods were assessed, the grassy weed dry matter production were higher at 25 DAT and progressively increased at 40 and 55 DAT. Pre emergence application of oxadiargyl followed by post emergence application of bispyribac sodium recorded minimum weed dry matter production.

Sedges

During *kharif* 2013, the dry matter accumulation of sedges recorded at 25 DAT indicated that 100 % RDF (N_1) recorded significantly higher dry matter production (11.3 g /m^2) whereas N_3 recorded the lowest. While examining the impact of weed control practices, application of pre emergence oxadiargyl followed by post emergence bispyribac sodium had great impact in reducing the weed dry matter production as compared to weedy check. In all cases weedy check treatment recorded significantly higher sedges dry matter production.

During *kharif* 2014, N_1 recorded significantly higher dry matter production of sedges as compared to N_2 and N_3. However, in all stages of observations, the dry matter production of sedges recorded at 25, 40 and 55 DAT were higher.

Broad leaved weeds

During *kharif* 2013 the broad leaf weeds dry matter production was examined at 25, 40 and 55 DAT. The results revealed that N_1 recorded maximum weed dry matter

accumulation as compared to N_2 and N_3. Whereas N_1 recorded significantly higher weed dry matter production at 25 DAT. It increased with increase in date of observation. On examining the impact of weed management practices W_3 recorded minimum weed dry matter production as compared to W_2 and W_1.The dry matter accumulation of broad leaf weeds increased with increase in date of observation.

During 2014, the density of BLWs was significantly higher at N_1, second in order was N_3. N_2 recorded the minimum dry matter production BLWs.

Total weeds

In analysing the total weed density during 2013, N_1 recorded significantly higher total weed dry matter production due to 100 % RDF and second in order was N_2 and minimum weed dry matter production was recorded in N_3. In case of weed control methods W_1 recorded significantly higher weed dry matter production followed by W_2 and W_3.

The trend continued at 40 and 55 DAT. However, the dry matter production increased with increase in date of operation during 2014. N_1 recorded significantly higher dry matter production and it was followed by N_3.

Minimum weed dry matter production was recorded in N_2.As regards to weed management practices; W_1 recorded significantly higher dry matter production. It was followed by W_2.Minimum weed dry matter production was recorded in W_3.

It was interesting to mention that dry weight of weeds in respect of grasses was increased at 100% RDF but decreased with reducing dose of nitrogen coupled with green manure. At critical stage of crop weed competition the sedges grew up faster and enhanced the dry weight. In case of broadleaf weeds, it started emerging at 45 days onward and its dry weight was enhanced progressively till harvest. Similar results were recorded by Kiran *et al.,* (2010), Khaliq *et al.,* (2012), Walia *et al.,* (2013) and Khare *et al.,* (2014)

Effect of INM and weed control practices on weed index (%) of rice

Enhanced weed index could be ascribed for 75% use of N coupled with green manuring of *dhaincha* in rice in addition to pre emergence application of oxadiargyl followed by post emergence application of bispyribac sodium. This could support suppression of weed at critical stages crop weed competition. Similar findings has been observed by N_1- RDF (60-30-30 N-P_2O_5-K_2O kg/ha.)**,** N_2– RDF (75%N) +GM *dhaincha*, N_3– RDF(50%N) + GM *dhaincha*,W_1 – Control (Weedy check), W_2 – Pre em. Oxadiargyl at 3 DAT + HW at 25 DAT, W_3 - PE oxadiargyl at 3 DAT +Post em. bispyribac sodium at 15 DAT

It is conclude that broad leaved weeds infested the rice crop to the tune of 42 %, followed by sedges (39 %) and grassy weeds (19%).The major broad leaved weeds of rice were *Ludwigia parviflora* and *Sphenoclea zeylanica*, sedges such as *Cyperus iria* and *Cyperus difformis* and grasses like *Echinocloa colona.* Minimum weed density was observed rice crop in treatment of RDF (75% N) with green manuring of *dhaincha (Sesbania aculeata)* coupled with pre emergence application of herbicide oxadiargyl at 3 DAT followed by post emergence bispyribac-sodium at 20 DAT Maximum weed density, weed dry matter accumulation was observed when there is application of RDF without green manuring and weedy check plot. The weed index of 49.1 % and 48.5 % was observed during 2014 and 2015 respectively from weedy check plot.

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How to cite this article:

Lalita Kumar Mohanty, Sankarsan Nanda and Lalita Mohan Garnayak. 2021. Effect of Integrated Nutrient and Various Weed Management Practices on Weed Dynamics in Rice Crop in Rice-groundnut Cropping System under Irrigated Medium Land Situation. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 584-595. doi: https://doi.org/10.20546/ijcmas.2021.1003.076