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Weed Dynamics of Semi-Dry Rice (*Oryza sativa*) under different Nutrient and Weed Management Practices in Central Telangana Zone

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ABSTRACT: A field study was carried out in the *Kharif* seasons of 2016 and 2017 in Aswaraopet, Telangana State, to assess the appropriate methods for management of nutrients and controlling weeds among different weed management practices under semi-dry system of rice cultivation. The experiment was designed in a split-plot format, implementing various approaches for nutrient and weed management on sandy clay loam soil. It was found that the combination of 75% of the recommended dose of fertilizer (RDF) and 25% of nitrogen from vermicompost resulted in the lowest weed density and weed dry matter production, while simultaneously achieving the highest rice grain yield. In addition, the application of Bispyribac sodium 10 SC (25 g ha^{-1}) as a pre-emergence treatment, followed by Pyrazosulfuron-ethyl 10 WP (25 g ha^{-1}) and 2,4-D 80 WP (0.5 kg ha^{-1}), in combination with hand weeding at 50 days after sowing (DAS), significantly reduced weed density and dry weight, ultimately leading to a higher yield of rice. Nevertheless, the most effective weed control efficiency was observed with the application of Bispyribac sodium 10 SC (25 g ha^{-1}) as pre-emergence treatment, followed by Pyrazosulfuron-ethyl 10 WP (25 g ha^{-1}) and 2,4-D 80 WP (0.5 kg ha^{-1}), along with hand weeding at 50 DAS.

Keywords: Herbicides, Nutrients, Semi-dry rice, Weed, Yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is a fundamental staple food cultivated extensively in more than 100 countries across the globe. On a global scale, rice is grown on land area of 162.06 M. ha approximately with a total production of 755.47 million metric tons and a productivity of 4661 kgha^{-1}. In India, rice cultivation covers an area of about 43.66 M. ha, yielding a total production of 118.87 million metric tons with a productivity of 2723 kgha^{-1}. In Telangana, it is cultivated on 3.19 M. ha, producing 11.12 million metric tons with a productivity of 3483 kg ha^{-1} (CMIE, 2019–20).

In the Indian economy, rice holds a distinct and crucial position, especially when compared to other South Asian nations. The majority of rice production in India occurs during the *Kharif* season. However, transplanted puddled rice cultivation faces various challenges, including substantial water requirements (ranging from 1000 to 2000 mm), a high energy demand of 5630–8448 MJha^{-1}, and a 15–20% higher demand for labor inputs, in contrast to direct-seeded rice. These factors have made transplanted rice cultivation economically non-viable for small and marginal farmers in Southeast Asia (Saharawat *et al*., 2010; Bhatt *et al*., 2016).

To address these challenges associated with transplanted rice, a promising solution is the adoption of semi-dry rice cultivation, often referred to as "Dry converted wet." In this approach, rice is initially treated as a rainfed crop for a period of 40–45 days before transitioning to wet cultivation when there is a sufficient supply of water availability(Chatterjee and Maiti 1985). Semi-dry system is an alternative source for increasing productivity under command areas (Ajmal *et al*., 2023).

Integrated nutrient management is considered a valuable tool for enhancing crop yield and long-term profitability for small and marginal farmers (Choudhary and Suri 2014). Soil fertility influences both crop and weed growth, and it's beneficial to delay the initial application of nitrogen fertilizer. The use of organic manures will suppress weed growth at the outset, and fertilizer should be applied after effective weed control under suitable soil moisture conditions (Nagargade *et al*., 2018). To achieve high rice yields, it is crucial to implement integrated nutrient and weed management practices. Effective nutrient management in semi-dry rice cultivation can reduce competition from weeds and should be tailored to the specific crop requirements.

In the absence of standing water during the initial crop establishment phase, weed infestation can worsen due to the simultaneous growth of both crops and weeds. Weed control can be efficiently achieved through certain methods such as manual weeding, herbicide application, or a combination of both during the critical period of weed competition (typically between 15 and 60 days after seeding), leading to minimal yield losses. Therefore, it is widely recognized that effective weed management is a key factor for success in semi-dry rice cultivation (Shekhawat *et al*., 2020).

MATERIALS AND METHODS

Semi-dry rice was planted during the *Kharif* seasons of 2016 and 2017 at the College Farm of the Agricultural College in Aswaraopet, located in the Bhadradri Kothagudem District of Professor Jayashankar Telangana State Agricultural University, Telangana State, India. The experimental site is situated in the Central Telangana Zone, positioned at an altitude of 162 m above mean sea level, with coordinates of 17°24’54″ N latitude and 81°10’34″ E longitude. The weather conditions during both *Kharif* seasons of the experiment were favorable for crop growth.

The soil at this location has been analyzed and identified as sandy clay loam, with a pH level of 6.72. It has low levels of available nitrogen but moderate levels of available phosphorus and potassium.

The experiment was set up using a split-plot design, where the primary plots were assigned to nutrient management (M_1 - 100% recommended dose of fertilizer (RDF), M_2 - 75% RDF with 25% nitrogen sourced from vermicompost, and M_3 - 75% RDF with 25% nitrogen sourced from farmyard manure (FYM)). The subplots, on the other hand, consisted of four different weed management practices: S_1 - Control, S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} followed by hand weeding at 20 and 40 days after sowing (DAS), S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} followed by Fenoxaprop-p-ethyl 62.5 g ha^{-1} along with 2,4-D 80 WP at 35–40 DAS, and S_4 - Bispyribac sodium 10 SC @ 25 g ha^{-1} followed by Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} with 2,4-D 80 WP at 0.5 kg ha^{-1}, in addition to hand weeding at 50 DAS. This experiment was conducted during the *Kharif* season with semi-dry rice, and the chosen rice variety was KNM-118.

The recommended fertilizer application included 100 kg of nitrogen (N), 50 kg of phosphorus (P_2O_5), and 40 kg of potassium (K_2O) per hectare, using urea, single superphosphate, and muriate of potash as their respective sources. Nitrogen was applied in three equal portions at sowing, during maximum tillering, and at the panicle initiation stage. Phosphorus was applied as a basal dose at sowing, while potassium was applied in two splits at sowing and during the panicle initiation stage.

In both the years 2016 and 2017, measures were taken to address deficiencies in zinc and iron for effective crop management. To combat zinc deficiency (*khaira*), 5 kg of zinc sulphate and 20 kg of urea was dissolved in 500 l ha^{-1} of water and sprayed at 25 and 40 days after sowing (DAS). For ameliorating iron deficiency, ferrous sulphate 5 g l^{-1} was sprayed, along with 1 g of citric acid at 15 DAS.

Herbicides were applied in accordance with the specific treatment regimes. They were sprayed as pre-emergence one day after sowing, early-post emergence at 12 and 14 DAS, and as post-emergence at 25 and 26 DAS during the *Kharif* 2016 and 2017, respectively. The spray solution for each plot was prepared separately, based on the treatment protocol.

In the rice fields, the common weed species were categorized into grasses, sedges, and broadleaved weeds, and their presence was recorded at 30 and 60 DAS. Weeds were randomly sampled in each plot using a 50 cm×50 cm (0.25 m²) quadrat from two random locations within each plot. Weeds within the quadrat were counted, and the total weed density was expressed as the number per square meter (No. m^{-2}).

To analyze the data statistically, the values were subjected to square root transformation using the formula $X = \sqrt{x + 0.5}$, where X represents the transformed value, and x represents the original value.

Additionally, all weed species were cut near ground level at 30 and 60 DAS within the 0.25 m² quadrat at two locations in each plot. The collected weeds were air-dried for 4-5 days and then further dried in a hot air oven at a constant temperature of 60 ± 1°C and recorded until a constant dry weight was achieved. The total dry matter of the weeds was determined by adding the dry weights of all weed species.

Weed control efficiency was calculated for the two years at 30 and 60 DAS by comparing the reduction in weed dry weight in the treated plots to that in the weedy check or unweeded control plots. This efficiency was expressed as a percentage and calculated using a formula based on Umarani and Boi (1982).

$$WCE (\%) = \frac{WDC-WDT}{WDC} \times 100 \qquad (2)$$

Where, WDC = Dry matter of weeds in control (g m^{-2})

WDT = Dry matter of weeds in treated plot (g m^{-2})

The grain yields were individually measured within each treatment's net plot area and then converted to yield per hectare, which was expressed in kg ha^{-1}. The data obtained from the experiment were subjected to statistical analysis using the analysis of variance method, following a split-plot design as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A. Weed parameters

(i) Weed Flora. The weed species documented in the experimental field during the *kharif* seasons of 2016 and 2017 are outlined in Table 1, specifically at 30 and 60 days after sowing (DAS). The prevalent weed flora observed in the semi-dry rice field comprised grasses such as *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, *Echinocloa colona*, *Eleusine indica*, *Brachiara mutica*, and *Panicum repens*. Among the sedges, *Cyperus rotundus* and *Cyperus iria* were notable, while broad-leaved weeds included *Alternanthera sessilis*, *Trianthema portulacastrum*, *Euphorbia geniculata*, *Eclipta alba*, *Commelina benghalensis*, *Ludwigia perennis*, *Spilanthes acmella*, *Sphaeranthus indicus*, *Malvastratum coramandelianum*, *Oldenlandia corymbosa*, and *Mollugo nudicaulis*. Similar observations highlighting the prevalence of broad-leaved weeds were reported by Soujanya (2020) in semi-dry rice cultivation.

Table 1: Weed flora observed in semi dry rice at different growth intervals during *kharif*, 2016 & 2017.

30 DAS	60 DAS
Malvastratum coramandelianum	*Cyperus rotundus*
Brachiara mutica	*Echinocloa colona*
Mollugo nudicaulis	*Brachiara mutica*
Oldenlandia corymbosa	*Mollugo nudicaulis*
Dactyloctenium aegyptium	*Oldenlandia corymbosa*
	Dactyloctenium aegyptium
	Cynodon dactylon
	Eleusine coracana
	Digitaria sanguinalis

(ii) Total weed density (g m^{-2}). The total weed density exhibited a significant influence from both nutrient and weed management practices, showing an increase from 30 to 60 days after sowing (DAS) in both experimental years, as depicted in Tables 2 and 3.

In terms of nutrient management practices during the *kharif* seasons of 2016 and 2017, the application of 75% RDF + 25% N through vermicompost resulted in the lowest total weed density at 30 DAS (41.78 & 24.64) and 60 DAS (55.57 & 39.57). This was statistically similar to the performance of 75% RDF + 25% N through farmyard manure (FYM) at 30 DAS (47.64 & 27.71) and 60 DAS (60.61 & 45.27). The highest total weed density was associated with 100% RDF.

Among the weed management practices over two consecutive years, the use of S_4 [Bispyribac sodium 10 SC 25 g ha^{-1} (pre-emergence) followed by (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4-D 80 WP 0.5 kg ha^{-1} + hand weeding (HW) at 50 DAS] resulted in lower total weed density at 30 DAS (27.65 & 15.12) and 60 DAS (37.65 & 26.11). This was statistically similar to the performance of S_2 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by hand weeding @ 20, 40 DAS] at 30 DAS (30.37 & 18.01) and 60 DAS (41.18 & 27.84). The control treatment in semi-dry rice exhibited a significantly higher total weed density.

The interaction effect between nutrient and weed management practices was significant in both experimental years. The lowest total weed density was observed with the combined application of 75% RDF + 25% N through vermicompost and S_4 at 30 DAS (20.79 & 8.61) and 60 DAS (29.87 & 21.67). This was statistically comparable to the performance of other treatments (M_2S_2, M_3S_2, M_3S_4) and was superior to all other treatments. The highest total weed density was associated with 100% RDF and the control treatment (M_1S_1).

Table 2: Interaction of nutrient and weed management practices on total weed density (no. m^{-2}) in semi dry rice at 30 DAS during *kharif*, 2016 & 2017.

Weed / Nutrient management	2016				2017			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	12.07 (145.45)	8.98 (80.24)	9.90 (97.52)	10.32 (107.74)	11.36 (129.60)	7.39 (54.21)	7.61 (57.50)	8.79 (80.43)
S_2	6.47 (41.51)	4.86 (23.31)	5.17 (26.29)	5.50 (30.37)	5.48 (30.22)	3.27 (10.30)	3.73 (13.51)	4.16 (18.01)
S_3	8.06 (64.62)	6.54 (42.76)	6.54 (42.69)	7.05 (50.03)	7.28 (52.86)	5.09 (25.43)	5.32 (27.82)	5.90 (3537)
S_4	6.20 (38.11)	4.60 (20.79)	4.94 (24.04)	5.25 (27.65)	4.99 (24.70)	3.00 (8.61)	3.53 (12.04)	3.84 (15.12)
Mean	8.20 (72.43)	6.25 (41.78)	6.64 (47.64)		7.28 (59.34)	4.69 (24.64)	5.05 (27.71)	
Interaction	M × S		S × M		M × S		S × M	
SEm±	0.24		0.42		0.34		0.42	
CD (*P* =*0.05*)	0.70		1.30		1.00		1.21	

Table 3: Interaction of nutrient and weed management practices on total weed density (no. m^{-2}) in semi dry rice at 60 DAS during *kharif*, 2016 & 2017.

Weed / Nutrient management	2016				2017			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	14.22 (199.73)	10.37 (105.43)	10.86 (123.87)	11.82 (143.01)	12.72 (161.34)	8.60 (73.87)	9.35 (87.98)	10.22 (107.73)
S_2	7.57 (57.05)	5.74 (32.57)	5.90 (33.91)	6.40 (41.18)	5.86 (33.90)	4.84 (22.96)	5.20 (26.65)	5.30 (27.84)
S_3	8.85 (78.01)	7.40 (54.42)	7.46 (54.45)	7.90 (62.29)	7.11 (50.15)	6.33 (39.79)	6.46 (41.48)	6.63 (43.81)
S_4	7.28 (52.87)	5.50 (29.87)	5.60 (30.21)	6.13 (37.65)	5.67 (31.67)	4.66 (21.67)	5.05 (24.99)	5.12 (26.11)
Mean	9.48 (96.92)	7.25 (55.57)	7.45 (60.61)		7.84 (69.27)	6.11 (39.57)	6.51 (45.27)	
Interaction	M × S		S × M		M × S		S × M	
SEm±	0.36		0.49		0.29		0.35	
CD (P =0.05)	1.06		1.44		0.87		0.97	

Figures in parenthesis are original values. The data was square root transformed ($\sqrt{X+0.5}$).

Nutrient Management
M_1 – 100% RDF
M_2 – 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 - Control
S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* HW @ 20, 40 DAS
S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl @ 62.5 g ha^{-1} + 2,4 – D 80 WP 0.5 kg ha^{-1}) at 35-40 DAS
S_4 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4 –D 80 WP 0.5 kg ha^{-1}) + HW at 50 DAS

(iii) Total dry matter production (g m^{-2}). The total dry matter production of weeds, evaluated at different intervals (30 and 60 days after sowing - DAS), exhibited significant variations influenced by both nutrient and weed management practices during both experimental years. The total dry matter of weeds showed a progressive increase from 30 to 60 DAS, and the interaction effects were also found to be significant, as outlined in Tables 4 and 5.

In terms of nutrient management practices, the lowest total weed dry matter was observed with 75% RDF + 25% N through vermicompost at 30 DAS (42.20 & 39.83) and 60 DAS (57.44 & 48.24). This was statistically similar to the performance of 75% RDF + 25% N through farmyard manure at 30 DAS (48.61 & 43.79) and 60 DAS (62.43 & 51.60). Conversely, the application of 100% RDF resulted in the highest weed dry matter during both years.

Among the weed management practices, the lowest weed dry matter production was recorded with S_4 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4-D 80 WP 0.5 kg ha^{-1} + hand weeding (HW) at 50 DAS] {(22.00 & 16.72) and (23.29 & 16.69) at 30 & 60 DAS}. This was statistically similar to the performance of S_2 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by hand weeding at 20, 40 DAS (23.78 & 19.03) and (25.47 & 18.26) at 30 & 60 DAS. The control treatment recorded significantly higher weed dry weight in both years.

The interaction effect of nutrient and weed management practices on total weed dry matter production was significant during both study years. Weed dry matter was lower with the interaction of 75% RDF + 25% N through vermicompost and S_4 at 30 DAS (17.82, 14.93) and 60 DAS (15.00, 10.70). This was statistically similar to the performance of other treatments (M_2S_2, M_3S_2, M_3S_4).

Total weed density (broad-leaved, grasses, and sedges) and weed dry matter recorded were lowest with 75% RDF + 25% N through vermicompost. This result may be attributed to increased crop competitiveness facilitated by the availability of slow-release nutrients. These findings align with previous studies by Thirumal (2012); Patel *et al*. (2018).

The use of broad-spectrum herbicides with different modes of action, such as Pyrazosulfuron ethyl and Bispyribac sodium, which belong to ALS inhibitors preventing amino acid biosynthesis in chloroplasts, effectively controlled diverse weed cohorts. These results are consistent with findings by Arya (2015); Pooja (2018); Pooja and Saravanane (2021).

Table 4: Interaction of nutrient and weed management practices on total dry matter production of weeds (g m^{-2}) in semi dry rice at 30 DAS during *kharif*, 2016 & 2017.

Weed / Nutrient management	2016				2017			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	11.62 (135.17)	10.29 (105.54)	10.99 (120.20)	10.97 (120.30)	11.53 (132.45)	10.09 (101.68)	10.46 (109.03)	10.69 (114.38)
S_2	5.37 (28.50)	4.50 (19.80)	4.85 (23.04)	4.91 (23.78)	4.36 (18.57)	4.32 (18.28)	4.55 (20.26)	4.41 (19.03)
S_3	6.84 (46.55)	5.11 (25.65)	5.50 (29.81)	5.82 (34.00)	6.20 (38.04)	4.98 (24.43)	5.31 (27.88)	5.49 (30.11)
S_4	5.20 (26.79)	4.28 (17.82)	4.68 (21.39)	4.72 (22.00)	4.20 (17.22)	3.92 (14.93)	4.29 (18.00)	4.14 (16.72)
Mean	7.26 (59.25)	6.97 (42.20)	6.50 (48.61)		6.57 (51.57)	5.83 (39.83)	6.15 (43.79)	
Interaction	M × S		S × M		M × S		S × M	
SEm±	0.15		0.24		0.22		0.27	
CD (*P =0.05*)	0.43		0.76		0.65		0.78	

Figures in parenthesis are original values. The data was square root transformed (√X+0.5).

Nutrient Management
M_1 – 100% RDF
M_2 – 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 - Control
S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* HW @ 20, 40 DAS
S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl 62.5 g ha^{-1} + 2,4 – D 80 WP 0.5 kg ha^{-1}) at 35-40 DAS
S_4 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4 –D 80 WP 0.5 kg ha^{-1}) + HW at 50 DAS

Table 5: Interaction of nutrient and weed management practices on total dry matter production of weeds (g m^{-2}) in semi dry rice at 60 DAS during *kharif*, 2016 & 2017.

Weed / Nutrient management	2016				2017			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	16.55 (273.38)	12.49 (155.66)	12.87 (165.35)	13.97 (198.13)	14.40 (207.01)	11.84 (139.86)	12.09 (145.88)	12.78 (164.25)
S_2	6.31 (39.39)	4.19 (17.08)	4.52 (19.93)	5.01 (25.47)	5.37 (28.32)	3.56 (12.20)	3.84 (14.26)	4.26 (18.26)
S_3	9.58 (91.27)	6.52 (42.00)	6.81 (45.87)	7.63 (59.71)	8.14 (65.80)	5.54 (30.21)	5.78 (33.00)	6.49 (43.00)
S_4	6.06 (36.31)	3.94 (15.00)	4.36 (18.56)	4.79 (23.29)	5.15 (26.09)	3.35 (10.70)	3.71 (13.27)	4.07 (16.69)
Mean	9.63 (110.09)	6.78 (57.44)	7.14 (62.43)		8.26 (81.81)	6.07 (48.24)	6.36 (51.60)	
Interaction	M × S		S × M		M × S		S × M	
SEm±	0.33		0.37		0.17		0.25	
CD (*P =0.05*)	0.97		1.02		0.49		0.75	

Figures in parenthesis are original values. The data was square root transformed (√X+0.5).

Nutrient Management
M_1 – 100% RDF
M_2 – 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 - Control
S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* HW 20, 40 DAS
S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl 62.5 g ha^{-1} + 2,4 – D 80 WP 0.5 kg ha^{-1}) at 35-40 DAS
S_4 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4 –D 80 WP 0.5 kg ha^{-1}) + HW at 50 DAS

(iv) Weed control efficiency (%). In both study years (Table 6), the most effective weed control was achieved with the application of Bispyribac sodium 10 SC 25 g ha^{-1} followed by (Pyrazosulfuron ethyl 10 WP @ 25 g ha^{-1} + 2, 4-D 80 WP @ 0.5 kg ha^{-1}) + hand weeding (HW) at 50 DAS. At 30 DAS, this treatment exhibited a weed control efficiency of 81.83% and 85.27%, and at 60 DAS, it demonstrated 88.62% and 90.22%. Following closely behind was the performance of S_2 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by hand weeding @ 20, 40 DAS], with weed control efficiencies of 80.33% and 83.14% at 30 DAS, and 87.52% and 89.27% at 60 DAS.

The treatment involving Bispyribac sodium 10 SC 25 g ha^{-1} (Early post-emergence) followed by (Fenoxaprop-p-ethyl 62.5 g a.i ha^{-1} + 2,4 – D 80 WP 0.5 kg a.i ha^{-1}) at 35-40 DAS recorded the lowest weed control efficiency, with weed control efficiency of 72.15% and 73.90% and 70.63% and 74.66% of weed index during both the years.

These findings are in line with the observations of Patel *et al*. (2018), who emphasized that pre-emergence herbicides effectively target the initial weed flush, while post-emergence herbicides, when combined with hand weeding, prove to be a suitable strategy. This integrated approach provides rice with a competitive advantage over weeds, resulting in reduced weed density, dry weight, and consequently, achieving higher weed control efficiency compared to the application of herbicides alone.

Table 6: Weed control efficiency (%) and weed index (%) in semi dry rice as influenced by weed management practices during *kharif*, 2016 & 2017.

Treatments	Weed control efficiency (%)		Weed index (%)	
	2016	2017	2016	2017
Sub plots: Weed Management (S)				
S_1	0	0	0	0
S_2	80.33	83.14	87.52	89.27
S_3	72.15	73.90	70.63	74.66
S_4	81.83	85.27	88.62	90.22

S_1 - Control
S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* HW @ 20, 40 DAS
S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl 62.5 g a.i ha^{-1} + 2,4 – D 80 WP 0.5 kg ha^{-1}) at 35-40 DAS
S_4 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4 –D 80 WP 0.5 kg ha^{-1}) + HW at 50 DAS

B. Yield

(i) Grain Yield (kg ha^{-1}). Among the various nutrient management practices, the application of 75% RDF + 25% N through vermicompost (M_2) resulted in the highest grain yield, producing 4060 and 4436 kg ha^{-1}, which was comparable to the yield obtained with 75% RDF + 25% N through farmyard manure (FYM) (M_3) at 3702 and 4270 kg ha^{-1}. The treatment with 100% RDF (M_1) yielded the lowest grain yield of 3198 and 3467 kg ha^{-1} during the *kharif* seasons of 2016 and 2017.

In both *kharif* seasons, the highest grain yields of 4845 and 5400 kg ha^{-1} were achieved with S_4 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4-D 80 WP 0.5 kg a.i ha^{-1}) + hand weeding (HW) at 50 (DAS)], and this was statistically equivalent to the yield from S_2 [Bispyribac sodium 10 SC 25 g ha^{-1} followed by hand weeding @ 20, 40 DAS] (4619 and 5133 kg ha^{-1}). In contrast, the control treatment yielded the minimum grain output of 1828 and 1983 kg ha^{-1} (Table 7).

The combination of 75% RDF and 25% N through vermicompost or FYM facilitated slow and continuous nutrient release, enhancing the availability and uptake of macro and micro-nutrients. This active participation in various physiological processes, including carbon assimilation, photosynthesis, starch formation, sugar and protein translocation, and water absorption, contributed to increased dry matter, source and sink capacity, ultimately leading to higher yields. These findings align with the studies conducted by Gayatree *et al*. (2017); Rishikesh *et al*. (2020).

Table 7: Interaction of nutrient and weed management practices on grain yield (kg ha^{-1}) of semi dry rice during *kharif*, 2016 & 2017.

Weed / Nutrient management	2016				2017			
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	1671	1923	1890	1828	1825	2018	2106	1983
S_2	3984	5125	4749	4619	4249	5657	5492	5133
S_3	3016	3717	3228	3320	3345	4074	3728	3716
S_4	4120	5473	4941	4845	4449	5996	5754	5400
Mean	3197	4060	3702		3467	4436	4270	
Interaction	M × S		S × M		M × S		S × M	
SEm±	157		196		208		242	
CD (*P=0.05*)	468		560		617		677	

Nutrient Management
M_1 – 100% RDF
M_2 – 75% RDF + 25% N through Vermicompost
M_3 - 75% RDF + 25% N through FYM

Weed Management
S_1 - Control
S_2 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* HW @ 20, 40 DAS
S_3 - Bispyribac sodium 10 SC 25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl 62.5 g ha^{-1} + 2,4 – D 80 WP 0.5 kg ha^{-1}) at 35-40 DAS
S_4 - Bispyribac sodium 10 SC 25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4 –D 80 WP 0.5 kg ha^{-1}) + HW at 50 DAS

The integrated weed management approach, involving the sequential application of pre- and post-emergence herbicides, broad-spectrum herbicides, tank mixture herbicides with different modes of action, and hand weeding, effectively addressed weed challenges in semi-dry rice. This approach prevented changes in weed community structure throughout the crop growth period and likely improved source and sink capacity, including the number of panicles per square meter and the total number of grains per panicle. This, in turn, contributed to higher yield production, as indicated by the studies of Priyanka *et al*. (2019); Singh and Pandey (2019).

CONCLUSIONS

It can be recommended that higher grain yield was observed with 75% RDF + 25% N through vermicompost and Bispyribac sodium 10 SC 25 g ha^{-1} *fb* (Pyrazosulfuron ethyl 10 WP 25 g ha^{-1} + 2, 4-D 80 WP 0.5 kg a.i ha^{-1}) + HW at 50 DAS recorded lower weed density, weed dry matter and depletion of nutrient by weeds (N, P and K) under semi dry rice cultivation in the Central Telangana Zone.

FUTURE SCOPE

More studies need to be conducted on other organic sources of nutrients and different herbicide mixtures under semi-dry method of rice cultivation.

Ethical Statement. All authors have approved the manuscript and agreed with its submission to the Biological Forum – An International Journal. The submitted work is original and has not been submitted or published elsewhere. The manuscript has been prepared following principles of ethical and professional conduct.

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