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Effect of integrated weed and nutrient management practices on the growth and yield of pre-kharif rice under rainfed condition

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Abstract
A field experiment entitled, "Studies on effect of integrated weed and nutrient management practices on the growth and yield of pre-kharif rice under rainfed condition" was conducted at the experiment was carried out at the Research Farm of College of Agriculture, Central Agriculture University, Imphal during two consecutive years i.e. pre-kharif of 2017-18 and 2018-19. The experiment was laid out in split plot design with replicated thrice. The treatments comprised with five weed management practices in the main plot *viz.*, (W_1) pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1}, (W_2) post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}, (W_3) pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1} + post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}, (W_4) 2 Hand weeding at 25 & 45 DAS and (W_5) Weedy check and four nutrient management in the sub plot *viz.*, (N_1) 100% RDF Nitrogen as urea, (N_2) 75% RDF Nitrogen as urea + 25% RDF Nitrogen as Loktak phumdi compost, (N_3) 50% RDF Nitrogen as urea + 50% RDF Nitrogen as Loktak phumdi compost and (N_4) 100% RDF Nitrogen as Loktak phumdi compost. The pooled data revealed that all the weed management practices, application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_3) gave the highest plant growth attributes like plant height, number of tillers m^{-2}, plant population and leaf area index at all the growth stages of pre-kharif rice and highest grain and straw yield. Among the nutrient management practices, highest yield attributes was observed in the application of 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost (N_2). The interaction between the integrated weed and nutrient management practices had significantly effect on the growth and yield attributes.

Keywords: Weed and nutrient, pre-kharif rice, rainfed condition

Introduction
Rice (*Oryza sativa* L.) is the most important cereal crop of the world as it forms the staple diet of 70% of the world's population. Globally, it is grown on approximately 163 m ha out of which 145 m ha is in Asia (Anonymous, 2013a) [1]. 90% of the world's rice is produced as well as consumed in Asia (Solunke *et al.*, 2006) [25]. India has the largest area under rice cultivation in the world and is the second largest producer of rice after China, contributing about 20% of the world rice production (Singh *et al.*, 2012) [23]. In India, the area under rice is 45 m ha with annual production of 104 million tonnes next to china among rice growing countries of the world with productivity of 2.24 t ha^{-1} (Anonymous, 2013b) [2].
Direct seeding of rice (DSR) offers certain advantages such as low labour costs, low soil degradation, less drudgery, early crop maturity by 7 -10 days, high tolerance to water deficit, saving of water, energy, seed and fuel, lower production costs and more profit and less methane emissions. It allows more effective growth period to the paddy crop within the same duration. A physiological shock to the crop due to uprooting and harmonizing during re-establishment after transplanting is clearly avoided. Simplified, mechanized operations render this alternate crop cultivation technology more acceptable and popular. So, in order to protect natural resources especially water, there is a need to replace puddled transplanted rice with the direct seeded rice. Direct seeding of rice is possible provided there is a good crop establishment as well as adequate weed control methods are available to keep the crop free from weeds (Rao *et al.*, 2007; Rao and Nagamani, 2007) [17, 18].
Rice-Rice cropping sequence is practiced in irrigated lowlands to take advantage of high and well distributed rainfall received in north-eastern India. Also, the clayey soils in lowlands are suitable for rice crop due to low seepage and percolation loss of the water (Tsubo *et al.*, 2007) [27].

Use of pre and post emergence application of herbicides would make herbicidal weed control more acceptable to farmers which will not change the existing agronomic practices but will allow for complete control of weeds. Chemical weed management by using pre emergence and post emergence herbicides can lead to the efficient and cost effective control of weeds during critical period of crop weed competition, which may not be possible in manual or mechanical weeding due to its high cost of cultivation (Triveni *et al.* 2017).

Integrated use of organic and mineral fertilizers has been found to be more effective in maintaining higher productivity and stability through correction of deficiencies of secondary and micronutrients in the course of mineralization on one hand and favourable physical and soil ecological conditions on the other (Mallikarjun and Maity, 2017) [10]. Integrated nutrient management system can bring about equilibrium between degenerative and restorative activities in the soil eco-system (Upadhyay *et al*., 2011) [28].

Integrated weed and nutrient management may provide a more sustainable approach to rice production. The residual nutrients of integrated nitrogen management may be utilized for production of zero tillage rapeseed. Rapeseed or yellow sarson is a major oilseed crop belonging to the family cruciferae. The oil content varies from 37- 49% and 23% protein. Used as edible oil, seed as condiment, young plants and leaves as green vegetable, the oilcakes as cattle feed and manures, as superior quality grease for industrial purposes.

Materials and Methods

A field experiment was conducted during (pre-kharif) season of 2017 and 2018 at the Agriculture Research Farm, Department of Agronomy, College of Agriculture, Central Agriculture University, Imphal. The soil of experimental site was clay soil in texture having pH 5.4, available organic carbon 1.4%, available nitrogen 310.03 kg ha^{-1}, available phosphorus 20.78 kg ha^{-1} and available potassium 248.12 kg ha^{-1}. The experiment was laid out in split plot design with three replications. The weed management subjected to main plots while nutrient management in sub plots. A combination of 60 treatments consisting of five weed management practices, *viz*., (W_1) pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1}, (W_2) post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}, (W_3) pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1} + post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}, (W_4) 2 Hand weeding at 25 & 45 DAS and (W_5) Weedy check and four nutrient management, *viz*., (N_1) 100% RDF Nitrogen as urea, (N_2) 75% RDF Nitrogen as urea + 25% RDF Nitrogen as Loktak phumdi compost, (N_3) 50% RDF Nitrogen as urea + 50% RDF Nitrogen as Loktak phumdi compost and (N_4) 100% RDF Nitrogen as Loktak phumdi compost. The experimental field was ploughed with the help of tractor drawn plough followed by harrowing and planking followed by flooding and puddling operations done manually. Direct seeding rice were sown in the experimental plot. Loktak phumdi compost were applied 20 days before direct seeding as per treatment and well incorporated to the soil. For recommended dose of fertilizer half dose of nitrogen was applied through urea, full dose of phosphorus through SSP and potassium through MOP were applied as basal. The remaining 50% Nitrogen was top dressed through urea at active tillering stage and panicle initiation stage. The required quantity of pre-emergence and post-emergence herbicides was sprayed as per treatment using spray volume of 600 litres of water ha-1 with the help of knap sack sprayer fitted with flat fan nozzle. Weed management practices were given during the critical crop weed competition period. Growth parameters were recorded at 30 days interval and yield was recorded at the time of harvest. The leaf area index was calculated by using the formula (Watson, 1952) [30].

$$\text{LAI} = \frac{\text{Area of total number of leaves}}{\text{Ground area from which leaves sample are collected}}$$

All data obtained were subjected to analysis of variance (ANOVA) and significant differences between the means were determined using Split plot design at 5% probability level. (Gomez and Gomoz, 1976) [5].

Result and Discussion

Growth attributes

Plant height (cm)

Different weed and nutrient management practices significantly influenced the plant height of pre- kharif rice in both the seasons at all the growth stages i.e. 60, 90 DAS and harvest but not significantly affect the plant height at 30 DAS. It is evident from (Table 1) that plant height kept on increasing from 30 DAS till harvest. Among the different wed management practices highest plant height was observed in the application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_3) which was followed by the application of post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_2) and lowest plant height was observed in the unweeded control plot (W_5). This might be due to effective weed control and minimum crop weed competition leading to more nutrient availability resulting in better plant height. Similar finding was also reported by Meghana *et al*. (2020) [12]. Pooled data revealed that among nutrient management practices, application of 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost (N_2) was recorded significantly highest plant height followed by the application of 100% RDF nitrogen as urea (N_1). This might be attributed due to higher doses of nutrients resulted in higher availability of nutrients in the soil for plant nourishment and further, organic source which slow release and continuous availability of nutrients enhanced cell division, elongation as well as various metabolic processes which ultimately increased the plant height. The results were in close conformity with the findings of Krishna *et al*. (2008) [6], Dutt and Chauhan (2010) [4] and Murthy (2012) [14]. Integration of organic nutrients with inorganic fertilizer release nutrients slowly and continuously to the plant and improved soil environment for better root penetration leading to better absorption of moisture and nutrients and produced better plant height and growth.

Number of tillers per m^{-2}

Integrated weed and nutrient management practices significantly influenced the number of tillers per m^{-2} of pre-kharif rice in both the seasons at all the growth stages i.e. 30, 60, 90 DAS and harvest. The number of tillers per m^{-2} gradually increases up to 60 DAS and therefore followed a decreasing trend till harvest.

Among the different weed management practices, the treatment pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_3) gave the highest number of tillers m^{-2} at 30, 60, 90 DAS and harvest closely followed by two hand weeding at 25 and 45 DAS i.e. (W_4) at 30, 90 DAS and harvest. At 60 DAS, significantly followed by (W_2) i.e. post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS, (W_1) i.e. pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS and (W_4) i.e. two hand weeding at 25 and 45 DAS. The lowest number of tillers m^{-2} was observed with the unweeded control plot (W_5) at all the growth stages i.e., 30, 60, 90 and harvest. Similar trend of variation was observed in both the years of study. This may be attributed to initial vigorous crop growth restricted the growth of weeds that has indirectly boosted the plants to record higher growth parameters and also characteristics of better utilization of solar energy and nutrients during plant growth which has contributed for an increased growth of crop and also weed control by different treatments which resulted into less or nearly no crop weed competition for nutrients, light, moisture and space which leads to higher accumulation of photosynthates. Linganagouda *et al*. (2019) [9] also recorded similar results. Among nutrient management practices, pooled data revealed that the treatment of 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost (N_2) was recorded significantly highest number of tillers m^{-2} but it was found to be at par with application of 50% RDF nitrogen as urea + 50% RDF nitrogen as loktak phumdi compost (N_3) at 30 DAS and 100% RDF nitrogen as urea (N_1) at 60, 90 DAS and harvest. This might be attributed due to the fact that tillering is the product of the expansion of auxiliary buds which is closely associated with the nutritional conditions of the culm because a tiller receives carbohydrate and nutrient from the culm during its early growth period which improved by the application of nitrogen (Tisdale and Nelson, 1975) [26]. Similarly, Bellakki *et al*. (1998) reported the superior performance of organic N as FYM and GM might be owing to reduced loss of N by fixation of NH_4^+ ion with humus present in FYM and increased availability of N to crop which ultimately increased the tillers.

Plant population

Different integrated weed and nutrient management practices had significant effect on the plant population of pre-kharif rice at different growth stages. The results revealed that the plant population kept on increasing from 30 DAS to 90 DAS. Among the weed management the highest plant population was observed in the application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_3) at 30 and 90 DAS which was followed by post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_2). The lowest plant population was observed in the unweeded control plot i.e. (W_5). This might be due to weeds were controlled effectively under these treatments during both the years of experimentation. This could be attributed to higher weed control efficiency under these treatments. These findings are reported by Bhurer *et al*. (2013) [3]. Among nutrient management practices maximum plant population was observed in the application of 100% RDF nitrogen as urea (N_1) followed by the application of 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost (N_2). It was probably due to better availability of nitrogen at critical growth stages and also low weed infestation during these stage, resulting in favorable conditions for growth and development of crop. These results were in conformity with the findings of Kumar *et al* (2015) [7].

Leaf area index

Leaf area index of pre-kharif rice was significantly influenced by the different weed and nutrient management practices at all the growth stages. The results in (Table 4) revealed that the leaf area index values increased progressively and reached their maximum value at 90 DAS and thereafter declined.

Among the integrated weed management practices, maximum leaf area index was observed in the application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS (W_3) followed by (W_4) the two hand weeding at 25 and 45 DAS. The unweeded control plot i.e. (W_5) gave the lowest leaf area index at all the growth stages of pre-kharif rice of 30, 60, 90, and harvest. This might be attributed to the persistence of the assimilatory surface area is pre requisite for a prolonged photosynthetic activity and productivity. Leaf area being the photosynthetic surface plays a vital role in production and availability of photosynthates.

Among the nutrient management practices 75% RDF nitrogen as urea + 25% RDF nitrogen as Loktak phumdi compost (N_2) was recorded significantly highest leaf area index at 30, 90 and harvest. At 60 DAS, (N_2) and (N_1) i.e. application of 75% RDF nitrogen as urea + 25% RDF nitrogen as Loktak phumdi compost and application of 100% RDF nitrogen as urea gave the highest leaf area index which was followed by (N_3) i.e. 50% RDF nitrogen as urea + 50% RDF nitrogen as loktak phumdi compost. This was due to adequate supply of nutrient to the plant and potential of plant for its absorption (Masoni *et al*. 1993) [11]. Singh *et al.* (2018) [24] reported that superior performance of organic N as FYM and GM might be owing to reduced loss of N by fixation of NH_4^+ ion with humus present in FYM and increased availability of N to crop which ultimately increased the tillers.

Effect of integrated weed and nutrient management on the yield of pre-kharif rice

Grain yield (q ha^{-1})

The pooled data revealed that among the different weed management practices, highest grain yield was observed with the application of (W_3) i.e. pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS which was comparable with the plot receiving (W_4) i.e. two hand weeding at 25 and 45 DAS and (W_2) i.e. application of post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS. The lowest grain yield was observed from the unweeded control plot i.e. (W_5) during both the seasons and pooled data of pre-kharif rice. This might be attributed due to improved availability of natural resources and critical inputs for establishment of rice crop by reduced the maximum germination of weeds as well as suppressing the weed growth with proper efficient mode of action at initial days of critical crop weed competition. In direct seeded rice grain yield was tremendously increased due to timely control of weeds in critical period of crop weed competition has enhanced the availability of nutrients, light and moisture to the crop. Similar, results were revealed by Rao *et al*. (2019) [19]. Among the nutrient management practices, it was evident from the pooled data that the highest grain yield was recorded with the application of (N_2) i.e. 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost which was at par with the treatment of (N_1 and N_3). The lowest grain yield was observed in the treatment of (N_4) i.e. 100% RDF nitrogen as loktak phumdi compost.

Straw yield (q ha^{-1})

The data on straw yield of direct seeded rice was significantly influenced by the different weed management practices in both the years of experiment as well as pooled data.

Application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS + post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS i.e. (W_3) was recorded maximum straw yield closely followed by the application of post-emergence (Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i/ha) at 20 DAS i.e. (W_2), two hand weeding at 25 and 45 DAS i.e. (W_4) and application of pre-emergence (Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i/ha) at 5 DAS i.e. (W_1). The lowest straw yield was observed in unweeded control plot i.e. (W_5). This might be due to more availability of nutrients and moisture as there was less competition between weeds and crop. Similar results were also found by Shantveerayya and Agasimani, (2012) [21], Sharma (2007) [22] and Walia *et al*. (2009) [29]. The enhanced yields under these treatments was because of elimination of weeds which helped in enhancing the availability of nutrients, space, sunlight and water resulting in better growth and development of crop plants. This caused better yield attributing characters. These results of yield parameters are in conformity with the finding of Mukherjee and Singh (2005) [13], Patra *et al*. (2011) [16] and Saha and Rao (2009) [20].

Among the nutrient management maximum straw yield was obtained in the application of 100% RDF nitrogen as urea i.e. (N_1) closely followed by (N_2, N_3 and N_4) but with no significant different between them. This might be attributed due to FYM being store-house of both macro and micro nutrients which might have enhanced the metabolic process vis-à-vis enlarged source and sink capacity, which ultimately enhanced the straw yields. Similar results was suggested by Parihar (2004) [15].

Harvest index (%)

Harvest index of pre-kharif rice was not significant effect by the different integrated weed management practices during both the seasons of study. However, the pooled data had significantly highest the harvest index in the application of two hand weeding at 25 and 45 DAS i.e. (W_4) which was significantly at par with the treatment of (W_1 and W_2) closely followed by (W_3 and W_5). This might be due to better vegetative growth and more dry matter accumulation. Similar results were reported by Kumar *et al*. (2017) [8].

Among the different nutrient management practices, during the first year i.e. 2017, the harvest index of pre-kharif rice had no significant difference as evident from the data in (Table 5). However, during the second year i.e. 2018 and pooled data maximum harvest index was obtained in the application of 75% RDF nitrogen as urea + 25% RDF nitrogen as loktak phumdi compost i.e. (N_2) followed by (N_3, N_1 and N_4) but no significant difference between them.

Table 1: Effect of integrated weed and nutrient management practices on plant height (cm) of pre-kharif rice

	30 DAS			60 DAS			90 DAS			Harvest		
Treatment	2017	2018	pool	2017	2018	pool	2017	2018	pool	2017	2018	pool
W1	40.08	40.33	40.20	80.00	76.56	78.28	106.01	108.53	107.27	116.35	114.81	115.58
W2	41.98	43.08	42.53	85.54	79.53	82.53	112.86	111.33	112.08	121.06	121.40	121.22
W3	43.81	44.11	43.93	99.21	84.25	91.71	115.54	113.85	114.68	134.63	127.64	131.11
W4	38.08	45.15	41.61	71.41	103.83	87.61	102.93	118.19	110.55	111.95	129.33	120.64
W5	34.33	34.68	34.50	64.23	64.86	64.53	96.69	100.98	98.83	106.61	109.83	108.20
SE.d(±)	0.97	1.00	0.93	0.89	1.41	0.95	1.34	0.97	1.12	1.42	1.19	1.28
C.D(p=0.05)	N.S	N.S	N.S	2.05	3.24	2.18	3.08	2.24	2.58	3.27	2.73	2.93
N1	41.44	40.44	40.94	86.51	80.66	83.59	114.51	110.45	112.48	127.31	119.8	123.57
N2	40.37	44.04	42.21	82.65	85.66	84.16	108.65	116.29	109.55	122.75	127	124.85
N3	39.25	41.67	40.46	78.77	82.95	80.86	104.75	113.25	109.00	118.69	123.3	120.99
N4	37.56	39.73	38.65	72.38	77.95	75.17	99.33	102.32	104.89	103.73	112.2	107.95
SE.d(±)	0.36	0.41	0.31	0.36	0.30	0.25	0.32	0.35	0.30	0.39	0.37	0.27
C.D(p=0.05)	N.S	N.S	N.S	0.74	0.61	0.52	0.66	0.71	0.61	0.80	0.75	0.56

W_1: pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1}
W_2: post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}
W_3: pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1} + post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}
W_4: 2 Hand weeding at 25 & 45 DAS and
W_5: Weedy check
N_1: 100% RDF Nitrogen as urea
N_2: 75% RDF Nitrogen as urea + 25% RDF Nitrogen as Loktak phumdi compost
N_3: 50% RDF Nitrogen as urea + 50% RDF Nitrogen as Loktak phumdi compost and
N_4: 100% RDF Nitrogen as Loktak phumdi compost

Table 2: Effect of integrated weed and nutrient management practices on No. of tillers m^{-2} of pre-kharif rice

	30 DAS			60 DAS			90 DAS			Harvest		
Treatment	2017	2018	pool	2017	2018	pool	2017	2018	pool	2017	2018	pool
W1	366.83	346.66	356.72	800.07	809.12	804.57	424.14	402.05	413.08	416.93	390.31	403.60
W2	379.93	368.34	374.11	871.37	868.35	869.83	512.17	412.63	462.38	504.45	408.66	456.53
W3	411.71	380.25	395.96	895.43	881.67	888.53	534.66	514.22	524.42	526.53	507.82	517.16
W4	350.16	410.28	380.21	685.66	895.55	790.60	403.08	533.40	468.22	399.43	526.53	462.96
W5	216.58	208.38	212.47	320.45	340.06	330.24	234.12	243.37	238.73	225.82	226.68	226.24
SE.d(±)	6.88	1.95	4.03	7.42	3.00	4.13	2.99	1.83	1.90	3.80	3.13	2.35
C.D(p=0.05)	15.81	4.49	9.28	17.07	6.91	9.51	6.87	4.21	4.37	8.74	7.19	5.40
N1	366.78	328.2	347.5	748.75	745.2	747.0	450.93	407.6	429.3	444.72	398.6	421.7
N2	354.79	381.9	368.4	729.31	802.1	765.7	436.62	461.1	448.9	426.61	453.2	439.9
N3	337.85	359.7	348.8	696.56	776.2	736.4	410.69	439.7	425.2	406.18	425.7	415.9
N4	320.73	301.3	311.0	683.75	712.3	698.0	388.29	376.2	382.3	381.01	370.5	375.8
SE.d(±)	2.19	0.76	1.05	2.25	0.73	1.33	1.18	0.74	0.64	1.22	0.74	0.64
C.D(p=0.05)	4.46	1.54	2.15	4.59	1.50	2.71	2.40	1.50	1.30	2.50	1.52	1.31

Table 3: Effect of integrated weed and nutrient management practices on plant population m^{-2} of pre-kharif rice

	30 DAS			90 DAS		
Treatment	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**
W1	45.00	46.33	45.67	46.00	45.75	45.88
W2	47.33	47.00	47.17	48.25	47.00	47.63
W3	48.58	47.33	47.96	49.00	47.17	48.08
W4	43.42	48.17	45.79	44.83	47.75	46.29
W5	40.25	43.42	41.83	41.25	42.92	42.08
SE.d(±)	0.22	0.21	0.17	0.16	0.27	0.19
C.D(p=0.05)	0.50	0.49	0.40	0.37	0.63	0.43
N1	47.53	46.4	47.0	47.80	46.13	47.0
N2	46.07	47.6	46.8	46.67	47.33	47.0
N3	44.20	47.07	45.6	45.07	46.6	45.8
N4	41.87	44.73	43.3	43.93	44.4	44.2
SE.d(±)	0.08	0.09	0.07	0.06	0.09	0.06
C.D(p=0.05)	0.15	0.17	0.14	0.11	0.19	0.13

Table 4: Effect of integrated weed and nutrient management practices on leaf area index of pre-kharif rice

	30 DAS			60 DAS			90 DAS			Harvest		
Treatment	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**
W1	1.12	1.18	1.15	3.61	3.76	3.68	7.18	6.83	7.00	5.47	5.46	5.46
W2	1.19	1.28	1.23	3.83	3.90	3.86	7.52	7.32	7.42	6.58	6.62	6.60
W3	1.45	1.32	1.38	4.19	4.07	4.13	8.01	8.05	8.03	7.07	6.98	7.03
W4	1.05	1.54	1.29	3.54	4.28	3.91	6.27	8.13	7.20	4.33	7.18	5.76
W5	0.77	0.83	0.80	2.98	3.26	3.12	5.38	5.40	5.39	3.95	4.24	4.10
SE.d(±)	0.04	0.04	0.04	0.09	0.07	0.08	0.10	0.12	0.10	0.11	0.10	0.10
C.D(p=0.05)	0.09	0.09	0.08	0.21	0.17	0.19	0.23	0.29	0.24	0.26	0.24	0.23
N1	1.23	1.19	1.2	4.15	3.75	4.0	7.59	7.23	7.4	6.09	5.99	6.0
N2	1.14	1.38	1.3	3.73	4.17	4.0	7.24	7.66	7.5	5.69	6.59	6.1
N3	1.08	1.29	1.2	3.45	4.09	3.8	6.78	7.38	7.1	5.35	6.3	5.8
N4	1.00	1.04	1.0	3.18	3.4	3.3	5.87	6.31	6.1	4.77	5.51	5.1
SE.d(±)	0.01	0.01	0.01	0.03	0.03	0.02	0.04	0.05	0.04	0.04	0.04	0.03
C.D(p=0.05)	0.03	0.03	0.02	0.05	0.06	0.04	0.08	0.10	0.08	0.08	0.08	0.07

Table 5: Effect of integrated weed and nutrient management practices on yield of pre-kharif rice

	Grain yield q ha^{-1}			Straw yield q ha^{-1}			Harvest index %		
Treatment	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**	**2017**	**2018**	**pool**
W1	39.33	36.35	37.85	61.63	66.91	64.27	38.97	38.93	39.0
W2	40.49	37.92	39.21	64.86	69.53	67.20	38.44	39.62	39.0
W3	42.31	42.78	42.54	70.04	74.02	72.03	37.61	39.95	38.8
W4	37.56	41.20	39.38	58.21	69.95	64.08	39.20	40.59	39.9
W5	32.83	31.86	32.34	55.51	60.66	58.09	37.04	37.63	37.3
SE.d(±)	0.60	0.63	0.49	0.77	1.08	0.76	0.37	0.35	0.24
C.D(p=0.05)	1.37	1.46	1.13	1.77	N.S	1.75	N.S	N.S	0.56
N1	40.80	36.16	38.48	64.79	70.83	67.81	38.67	38.99	38.8
N2	39.42	41.83	40.62	62.55	70.59	66.57	38.72	40.51	39.6
N3	37.75	38.98	38.37	61.01	68.56	64.79	38.16	39.57	38.9
N4	36.04	35.11	35.58	59.84	62.88	61.36	37.46	38.30	37.9
SE.d(±)	0.19	0.14	0.12	0.19	0.31	0.16	0.15	0.13	0.10
C.D(p=0.05)	0.39	0.28	0.25	0.39	N.S	0.33	N.S	0.26	0.20

	Grain yield q ha^{-1}			Straw yield q ha^{-1}			Harvest index %		
Treatment	2017	2018	pool	2017	2018	pool	2017	2018	pool
W1	39.33	36.35	37.85	61.63	66.91	64.27	38.97	38.93	39.0
W2	40.49	37.92	39.21	64.86	69.53	67.20	38.44	39.62	39.0
W3	42.31	42.78	42.54	70.04	74.02	72.03	37.61	39.95	38.8
W4	37.56	41.20	39.38	58.21	69.95	64.08	39.20	40.59	39.9
W5	32.83	31.86	32.34	55.51	60.66	58.09	37.04	37.63	37.3
SE.d(±)	0.60	0.63	0.49	0.77	1.08	0.76	0.37	0.35	0.24
C.D(p=0.05)	1.37	1.46	1.13	1.77	N.S	1.75	N.S	N.S	0.56
N1	40.80	36.16	38.48	64.79	70.83	67.81	38.67	38.99	38.8
N2	39.42	41.83	40.62	62.55	70.59	66.57	38.72	40.51	39.6
N3	37.75	38.98	38.37	61.01	68.56	64.79	38.16	39.57	38.9
N4	36.04	35.11	35.58	59.84	62.88	61.36	37.46	38.30	37.9
SE.d(±)	0.19	0.14	0.12	0.19	0.31	0.16	0.15	0.13	0.10
C.D(p=0.05)	0.39	0.28	0.25	0.39	N.S	0.33	N.S	0.26	0.20

W_1: pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1}
W_2: post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}
W_3: pre-emergence Pyrazosulfuron ethyl 10% W.P. @ 0.025 kg a.i ha^{-1} + post-emergence Bispyribac-sodium 10SC 9.5% w/w @ 0.025 kg a.i ha^{-1}
W_4: 2 Hand weeding at 25 & 45 DAS and
W_5: Weedy check
N_1: 100% RDF Nitrogen as urea
N_2: 75% RDF Nitrogen as urea + 25% RDF Nitrogen as Loktak phumdi compost

N_3: 50% RDF Nitrogen as urea + 50% RDF Nitrogen as Loktak phumdi compost and
N_4: 100% RDF Nitrogen as Loktak phumdi compost

Reference

1. Anonymous. 2013a. FAOSTAT, http:// faostat3.fao.org/ faostatgateway /go/to /download/ Q/QC/E.
2. Anonymous. Department of Agriculture & Cooperation, Fourth Advance Estimates of Production of Oilseeds & Other Commercial Crops for 2012-13, http://eands.dacnet.nic.in/advance_estimate/4th-adv-est-english-16072012.pdf. 2013b.
3. Bhurer KP, Yadav DN, Ladha JK, Thapa RB, Pandey KR. Effecacy of various herbicides to control weeds in dry direct seeded rice (*Oryza sativa* L.), Global Journal of Biology, Agriculture and Health Science. 2013;2(4):205-212.
4. Dutta M, Chauhan BS. Effect of nutrient management practice on the performance of upland rice in a newly developed terraced land Indian Agriculture. 2010;54(1/2):13-21.
5. Gomez KA, Gomez AA. Statistical procedure for Agricultural Research 2nd edition, John Willey and Sons, New York. 1976, 30.
6. Krishna A, Biradarpatil NK, Channappayoundar BB. Influence of system of Rice Intensification (SRI) cultivation on seed yield and quality. Karnataka Journal Agriculture Science. 2008;21(3):369-372.
7. Kumar S, Singh RK, Meena RN, Singh SP. Effect of nitrogen scheduling and weed Management on weed density, growth and yield of direct-seeded rice (*Oryza sativa* L.), Research on crops. 2015;16(4):643-652.
8. Kumar Rakesh, Singh UP, Mahajan Gaurav. Residue and weed management practices in zero-till wheat (*Triticum aestivum* L.) under rice-wheat cropping system. International Journal of Agriculture Sciences. 2017;9(4):3708-3712.
9. Linganagouda N, Ananda BG, Mastanareddy MY, Ajayakumar, Vishwanath J. Boi-efficacy of sequential application of herbicides in direct seeded rice (*Oryza sativa* L.). Journal Farm Science. 2019;32(4):415-419.
10. Mallikarjun M, Maity SK. Energetic Evaluation of Integrated Nutrient Management for Nitrogen in Kharif Rice and its Residual Effect on Yellow Sarson. Research Journal of Agriculture Science. 2017;8(6):1362-1365.
11. Masoni A, Mariotti M, Ercoli L, Massantini F. Chlorophyll concentration and spectoral properties of maize leaves as affected by nitrogen rate. Agricultura Mediterranea. 1993;123(3):209-214.
12. Meghana GK, Sukanya TS, Salmankhan RM, Kiran HP. Effect of weed management practices on weed density, dry weight and growth of kodo millet (*Paspalum scrobiculatum* L.). International Journal of Current Microbiology and Applied Science. 2020;9(11):3377-3384.
13. Mukherjee D, Singh RP. Effect of low doses herbicides on weeds, nutrient uptake and yield of transplanted rice. Indian Journal of Agronomy. 2005;50(3):194-196.
14. Murthy RK. Productivity and economics of rainfed rice as influenced by integrated nutrient management. Madras Agriculture Journal. 2012;99(4/6):266-270.
15. Parihar SS. Effect of integrated sources of nutrient, puddling and irrigation schedule on productivity of rice (*Oryza sativa*) – wheat (*Triticum aestivum*) cropping system. Indian Journal of Agronomy. 2004;49(2):74-79.
16. Patra AK, Halder J, Mishra MM. Chemical weed control in transplanted rice in Hirakud command area of Orissa. Indian Journal of Weed Science. 2011;43(3&4):175-177.
17. Rao AN, Nagamani A. Available technologies and future research challenges for managing weeds in dry-seeded rice in· India. Proc. 2r' Asian Pacific Weed Sci. Soc. Conj, 2-6th October 2007, Colombo, Sri Lanka, 2007.
18. Rao AN, Johnson DE, Sivaprasad B, Ladha JK, Mortimer AM. Weed management in direct seeded rice. Advance Agronomy. 2007;93:153-255.
19. Rao IJ, Sujani Rao CH, Prasad PRK, Pulla Rao CH, Jayalalitha K. Review on effect of conjunctive use of organic manures and inorganic phosphorus on growth, yield attributes, yield and economics of rice. Journal of Pharmacognosy and phytochemistry. 2019;8(3):2637-2640.
20. Saha S, Rao KS. Efficacy of sulfonylurea herbicides for broad-spectrum weed control in wet direct-sown summer rice. *Oryza*-An International Journal on Rice. 2009;46:116-119.
21. Shantveerayya H, Agasimani CA. Effect of herbicides on weed control and productivity of maize (*Zea mays* L.). Karnataka Journal of Agriculture Science. 2012;25(1):137-139.
22. Sharma, Growth and development studies in maize as affected by integrated weed management under rainfed condition. Indian Journal of Agronomy. 2007;52(4):321-324.
23. Singh M, Sairam CV, Hanji MB, Prabhukumar S, Kishor N. Cropweed competition and weed management studies in direct seeded rice (*Oryza sativa*), Indian Journal of Agronomy. 2012;57(1):38-42.
24. Singh NP, Singh MK, Tyagi S, Singh SS. Effect of Integrated Nutrient Management on Growth and Yield of Rice (*Oryza sativa* L.). International Journal of Current Microbiology and Applied Science. 2018;7:3671-368.
25. Solunke PS, Giri DG, Rathod TH. Effect of integrated nutrient management on growth attributes, yield attributes and yield of basmati rice, Crop research. 2006;32(3):279-282.
26. Tisdale SL, Nelson WL. Soil Fertility and Fertilizers, 3rd Edition. The MacMillan Publ. Co. Inc., New York. 1975.
27. Tsubo M, Fukai S, Basnayake J, Toung P, Bouman B, Harnpichitvitya D. Effects of soil clay content on water balance and productivity in rainfed lowland rice ecosystem in north-east Thailand. Plant Pro. Sci. 2007;10(2):232-41.
28. Upadhyay VB, Jain V, Vishwakarma SK, Kumhar AK. Production potential, soil health, water productivity and economics of rice (*Oryza sativa*) – based cropping systems under different nutrient sources. Indian Journal of Agronomy. 2011;56(4):311-316.
29. Walia U, Singh SS, Singh B. Integrated control of hardy weed in maize (*Zea mays* L.), Indian Journal of Weed Science. 2009;39(1&2):17-20.
30. Watson DJ. The physiological basis of variation in yield. Advance Agronomy. 1952;4:101-145.