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Nutrient uptake by direct seeded rice (*Oryza sativa* L.) and removal by dominant weeds species in Chhattisgarh plains

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Abstract
The present investigation entitled "Nutrient uptake by direct seeded rice (*Oryza sativa* L.) and removal by dominant weeds species in Chhattisgarh plains " was carried out at Research cum Instructional Farm Farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G.) during *Kharif* season of 2016. Rice variety Rajeshwari was direct seeded on June 27th 2016 with a spacing of 20 x 10 cm and harvesting was done on November 3rd, 2016. The results of experiment indicated that maximum uptake of nutrient in grain and straw was recorded in weed free (3 Hand weeding) (T_9) 56.14 and 17.52 kg ha^{-1} of N, 15.26 and 5.07 kg ha^{-1} of P and 14.16 and 85.03 kg ha^{-1} of K, respectively. Minimum uptake of 6.70 kg ha^{-1} of N, 0.91 kg ha^{-1} of P and 13.32 kg ha^{-1} of K was observed in control (Mixed flora) (T_8) taking the total values of grain and straw. The nutrient removal by weeds was recorded maximum under control (Mixed flora) (T_8) at 80 DAS 61.73, 8.72, 169.95 and at harvest 73.79, 10.44, 203.46 N, P, K kg ha^{-1}. The lowest nutrient removal of N, P and K kg ha^{-1} was 0.36, 0.12, 0.93 and 0.82, 0.28, 2.13 at 80 DAS and harvest respectively under weed free (3 Hand weeding) (T_9).

Keywords: Nutrient uptake, rice, *Oryza sativa* L., dominant weeds

Introduction
Rice (*Oryza sativa* L.) is the most important and widely cultivated crop in the world. Asia is the home of rice as more than two billion people are getting 60 70% of their energy requirement from rice and its derived products. About 90% of total rice is grown and consumed in Asia. It occupies an important place in the economy of India. Rice crop is the biggest user of fresh water. Rice as a submerged crop is a prime target for water conservation because it is the most widely grown of all crops under irrigation. Rapidly depleting water resources threaten the sustainability of the irrigated rice and hence the food security and livelihood of rice producers and consumers (Tuong *et al*., 2005). Due to resource constraints, especially water and labourers, direct seeding under dry condition is now emerging new trend in rice cultivation. Weeds compete for moisture, nutrients, light and space and a consequence, weeds infestation in direct seeded rice results in yield losses in the range of 30 to 90%, reduces grain quality and enhances the cost of production (Singh *et al.*, 2009 [8] The DSR seems to have retained significantly more nitrogen as compared to transplanted rice in straw, more plant population per unit area might have encouraged DSR for more uptake and retention of nitrogen in straw (Dingkuhn *et al.*1990). Roy and Mishra (1999) experiences that more weeds present in the field suppressed the crop due to nutrient removal and reduced the yield which might be attributed to vigorous growth and development of weeds.
Weeds in direct seeded rice systems are mainly managed by using herbicides and manual weeding. Major weeds found in Chhattisgarh plains are *Echinochloa colona, Echinochloa crus-galli, Ischaemum rugosum, Oryza sativa* (weedy rice), *Leptochloa chinensis, Paspalum distichum* among the grasses. *Cyperus iria, Cyperus difformis, Cyperus rotundus, Fimbristylis miliacea* among the sedges and *Monochoria veginalis, Eclipta prostrate, Commelina benghalensis, Cynotis axillaris, Ceasulia axillaris, Alternanthera triandra* among the broad leaved weeds.

Material and method
A field experiment was conducted at Research cum instructional farm Indira Gandhi Krishi vishwavidyalay Raipur with objective to find out the Nutrient uptake by direct seeded rice (*Oryza sativa* L.) and removal by dominant weeds species in Chhattisgarh plains under medium land situation. The experimental field was sandy loam in texture, poor in organic carbon (0.45%), available nitrogen (205.4 kg ha^{-1}) and medium in available phosphorus (16.2kgha^{-1}) and potash (321 kg ha^{-1}).

The treatments consist of Infestation of *Echinochloa colona* (T_1), Infestation of *Cyperus iria* (T_2), Infestation of *Alternanthera triandra* (T_3), Infestation of *Spilanthes acmella* (T_4), Infestation of *Cyanotis axilaris* (T_5), Infestation of grasses (T_6), Infestation of broad leaved weeds (T_7), control (Mixed flora) (T_8) and weed free (3 Hand weeding) (T_9). The experiment was laid out in a randomized block design with three replications. The crop was sown on 27.06.16 and harvested on 03.11.16. The rice variety "Rajeshwari" with a seed rate of 40 kg ha^{-1} was used for sowing and fertilized with NPK @ 100: 50: 30 kg ha^{-1}. Half of nitrogen and full dose of phosphorus and potash was applied at the time of sowing. The rest half of nitrogen was applied at 25 and 50 days after sowing. The crop was sown in rows at 20 centimeters apart under sufficient moisture condition. From sowing to emergence the soil was kept near moist but not saturated to avoid seed rotting. Weed management was done by only manual hand weeding at 20, 40 and 60 DAS to check the flush of undesirable weeds and to maintain the desirable weed population into the respective plots.

The observations on weed and crop was recorded at 20 40, 60 80 and at harvest from three randomly selected places in each plot. Species-wise and total weed count was made in randomly selected three quadrates of 50 cm x 50 cm (0.25 m^2) from each plot. Weeds present in quadrate (0.25 m^2) were uprooted carefully along with roots. The root portion was detached and shoot portion of the weed plants were oven dried at 60℃ for 36 to 48 hours. After complete oven drying, species wise and total dry matter production of weeds was recorded for different treatments and converted to m^{-2}. Weeds density and weed dry weight data was subjected to square root of transformation i.e. x + 0.5 for statistical analysis.

Result and Discussion

Yield and yield attributes

Grain yield

Among different treatments, the treatment of weed free (3 Hand weeding) (T_9) proved to be significantly superior over the other treatments in producing higher seed yield. However, the treatment of *Cyperus iria* (T_2) was next, in order and performed significantly better than the treatment of control (Mixed flora) (T_8). Mamun *et al*. (2013) [6] also reported that grain yield losses due to interference increased with weed population density increase. Patel *et al.* (1998) [7] at Raigarh (C.G.) observed that when the weeds were allowed to grow with the crop, grain yield was reduced by about 48.6%. Abdullah *et al*., (2014) [1] reported that the rice plants produced the highest grain yield m^{-2} when grown in the absences of weeds. Kapoor and Ramkrishna (1975) [4] reported that *Echinochloa colona* causes substantial yield reductions because of its severe infestations, rapid growth and great competitive ability.

Straw yield

The data on straw yield are given in Table 4. Data shows that the straw yield significantly affected by the various dominant weed species.

Among various treatments the treatment of weed free (3 Hand weeding) (T_9) proved significantly superior over the other treatments in producing higher straw yield. However, the treatment of *Cyperus iria* (T_2) also proved significantly better than the treatment of control (Mixed flora) (T_8). The minimum straw yield was recorded under the treatment of control (Mixed flora) (T_8), due to the more dry matter of weed and its density, or due to the higher crop weed competition which does not allow crop to grow with their genetic potential.

Nutrient uptake and removal by weeds kg ha^{-1}

Nutrient uptake by grain (kg ha^{-1})

The data on the nutrient uptake by grain as affected by various dominant weed species are presented in Table 1 and cleared indicated that maximum nutrient uptake by grain were observed in weed free (3 Hand weeding) 56.14, 15.26, and 14.16 N,P and K kg ha^{-1}. While the minimum uptake recorded in control (Mixed flora) plot 5.21, 0.64, and 1.26 N, P and K kg ha^{-1}.

Nutrient uptake by straw (Kg ha^{-1})

The data in respect of nutrient uptake by straw are presented in Table 1. It was noted that significantly higher N, P and K uptake was recorded under weed free (3 Hand weeding) 17.52, 5.07, 85.03 N,P and K kg ha^{-1}.And the lowest uptake of nutrient was observed under control (Mixed flora) 1.49, 0.27, 12.06 N, P and K Kg ha^{-1}.

Total nutrient uptake by crop (kg ha^{-1})

The data in respect of total nutrient uptake by crop are presented in Table 2 It was recorded that, Weed free (3 Hand weeding) plot recorded highest N, P and K kg ha^{-1} uptake by crop 73.65, 20.33 and 99.19 kg ha^{-1}. None of the treatments were comparable to weed free (3 Hand weeding) in increasing nutrient uptake in grain and straw. And the minimum N, P and K kg ha^{-1} were recorded in control (Mixed flora) plot 6.70, 0.91 and 13.32 kg ha^{-1}

Table 1: Nutrient uptake by grain and straw at harvest in direct seeded rice as affected by various dominant weed species *kharif* 2016.

Treatment		Crop dry weight at harvest gm	Nutrient uptake by crop (kg ha^{-1})					
			Grain			Straw		
			N	P	K	N	P	K
T_1	Infestation of *Echinochloa colona*	6.74	19.96	5.04	5.78	5.94	0.96	23.56
T_2	Infestation of *Cyperus iria*	10.43	36.74	9.35	9.65	12.36	2.88	48.36
T_3	Infestation of *Alternanthera triandra*	7.08	20.70	5.59	6.02	7.00	1.49	36.35
T_4	Infestation of *Spilanthes acmella*	9.34	26.54	6.33	6.15	8.02	1.84	33.54
T_5	Infestation of *Cyanotis axillaris*	8.43	24.44	5.88	6.13	7.87	2.14	32.60
T_6	Infestation of grasses	4.08	10.33	2.58	2.25	3.06	0.55	16.37
T_7	Infestation of broad leaved weeds	5.36	11.66	2.73	2.80	3.73	0.89	17.23
T_8	Control (Mixed flora)	3.32	5.21	0.64	1.26	1.49	0.27	12.06
T_9	weed free (3 Handweeding)	14.35	56.14	15.26	14.16	17.52	5.07	85.03
	Sem±	6.74	1.82	0.38	0.53	0.78	0.33	3.26
	CD 5%	10.43	5.47	1.19	0.59	2.35	1.01	9.7

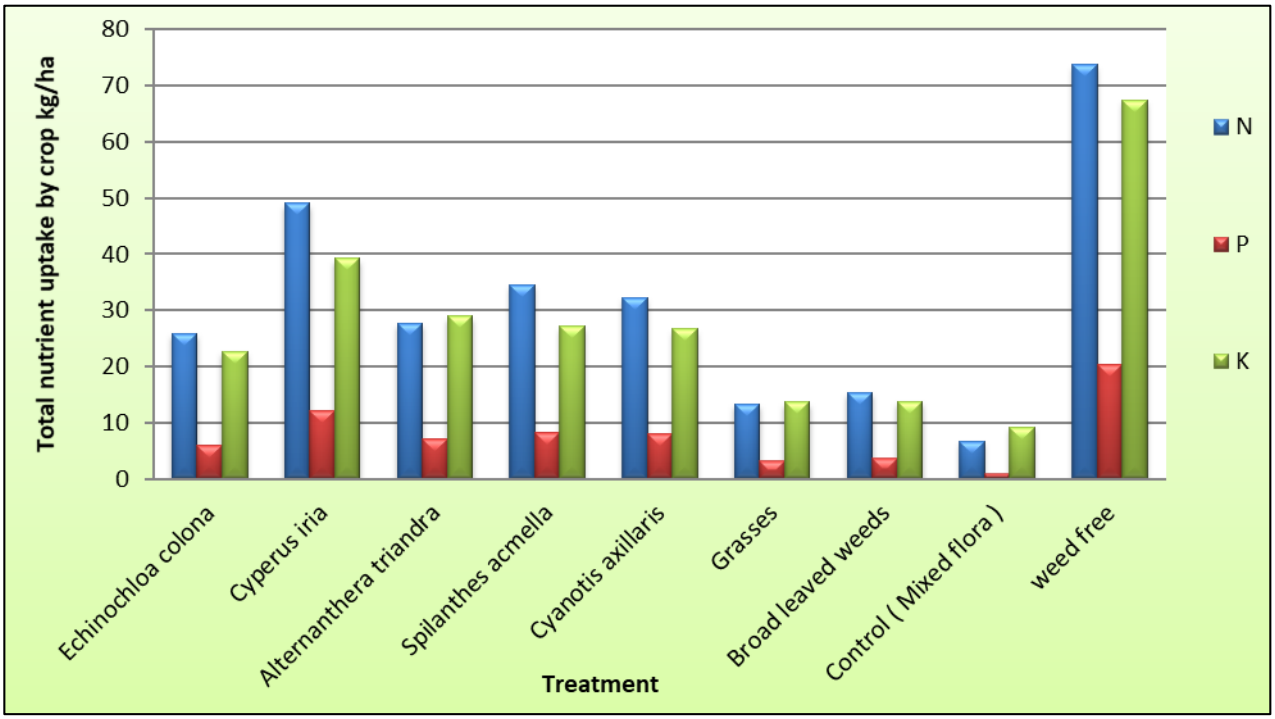

Fig 1: Total nutrient uptake by crop as affected by various dominant weeds

Table 2: Total nutrient uptake by crop at harvest in direct seeded rice as affected by various dominant weed species *kharif* 2016.

	Treatment	Total nutrient uptake by crop (kg ha^{-1})		
		N	P	K
T_1	Infestation of *Echinochloa colona*	25.90	5.99	29.34
T_2	Infestation of *Cyperusiria*	49.10	12.23	58.01
T_3	Infestation of *Alternanthera triandra*	27.69	7.07	42.37
T_4	Infestation of *Spilanthes acmella*	34.55	8.17	39.69
T_5	Infestation of *Cyanotis axillaris*	32.31	8.02	38.72
T_6	Infestation of grasses	13.38	3.12	18.62
T_7	Infestation of broad leaved weed	15.38	3.62	20.03
T_8	Control (Mixed flora)	6.70	0.91	13.32
T_9	Weed free (3 Hand weeding)	73.65	20.33	99.19
	Sem±	2.25	0.55	3.07
	CD 5%	6.67	0.55	9.21

Nutrient removal by weeds (kg ha^{-1})

The data in respect of nutrient removal by weeds at 80 days and harvest are presented in Table 3

At 80 DAYS and harvest: It was noted that maximum removal of nutrient at 80 days and harvest 61.73, 8.72, 169.95 and 73.79 10.44, 203.46 N, P and K Kg ha $^{-1}$, respectively were observed under control (Mixed flora) plot and it was significantly higher than the rest of the treatment. While minimum removal of N, P and K at 80 DAS and harvest to tune of 0.36, 0.12, 0.93 and 0.82, 0.28, 2.13 N, P and K kg ha^{-1} respectively were registered under weed free (3 Hand weeding), this was significantly lower than rest of the treatments. Payman and Singh (2008) [3] reported that repeated hand weedings in direct seeded rice recorded minimum nitrogen losses due to weeds. Sanjay *et al*. (2006) observed that unweeded control registered highest N uptake through weeds due to lack of weed control. Among the various dominant weed species maximum nutrient uptake by the *Alternanthera triandra* (T_3) due to maximum dry matter at 80 days and harvest which was followed by *Spilanthes acmella* (T_4), by *cynotis axillaris* (T_5), and minimum by the *cyperus iria* (T_2). More weeds present in the field suppressed the crop due to nutrient removal and reduced the yield which might be attributed to vigorous growth and development of weeds. Similar results were reported by Roy and Mishra (1999)

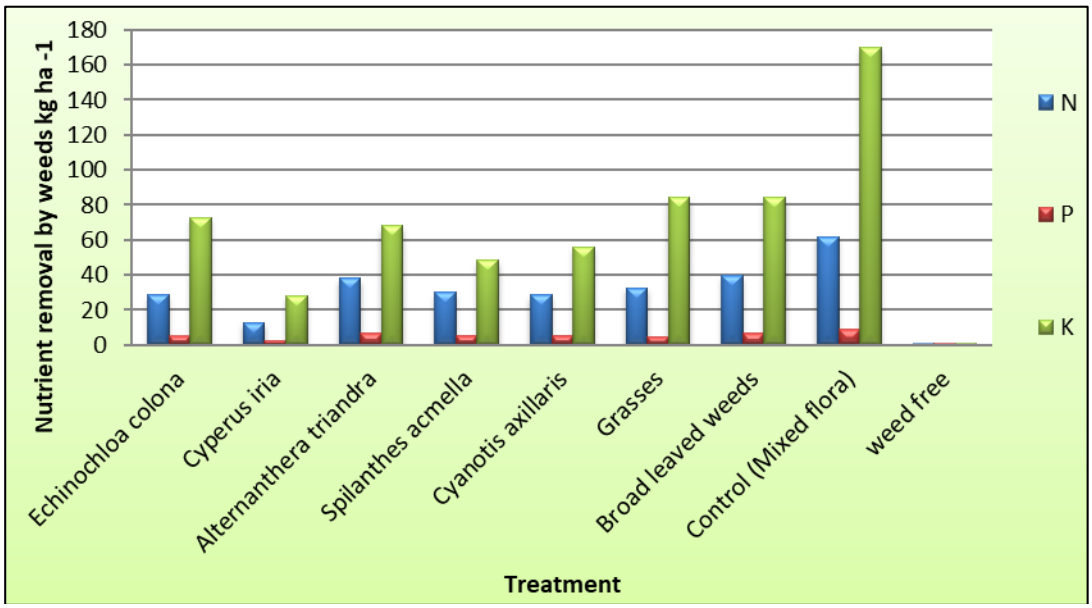

Fig 2: Nutrient removal by weed at 80 days in direct seeded rice

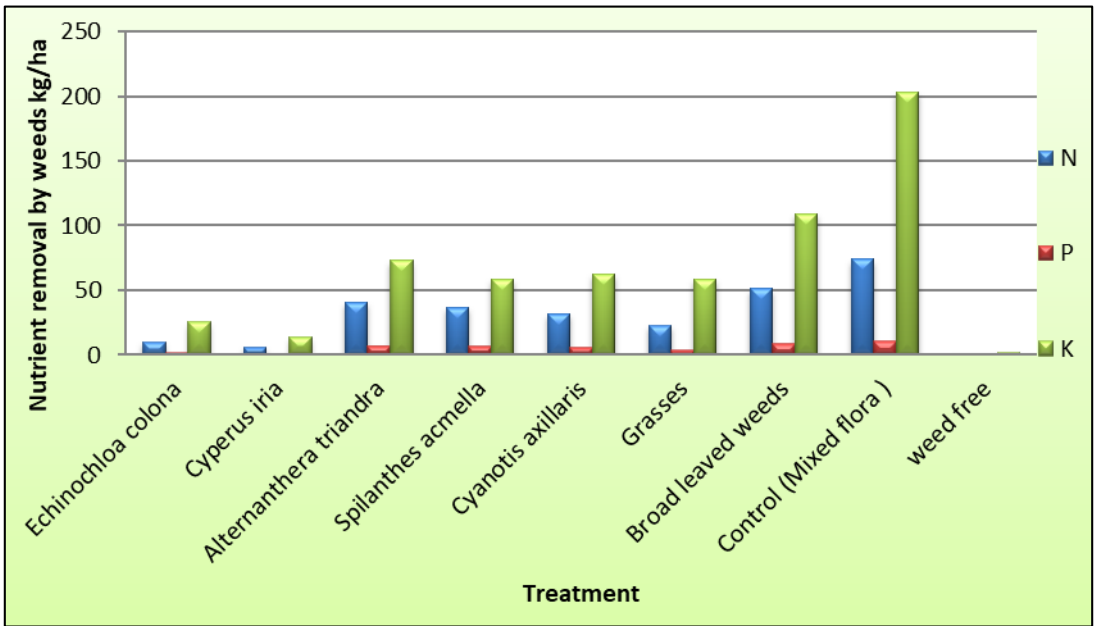

Fig 3: Nutrient removal by weed at harvest days in direct seeded rice

Table 1: Nutrient removal by weeds at 80 DAS and at harvest in Direct seeded rice, *kharif* 2016.

Treatment		Weed dry weight at 80 Days g m^{-2}	Weed dry weight at harvest g m^{-2}	Nutrient removal by weeds (kg ha^{-1})					
				At 80 Days at harvest					
				N	P	K	N	P	K
T_1	Infestation of *Echinochloa colona*	13.62 (207.62)	8.56 (72.76)	28.44	5.01	72.68	9.97	1.76	25.44
T_2	Infestation of *Cyperus iria*	10.78 (115.63)	7.48 (55.38)	12.69	2.57	28.37	6.07	1.28	13.68
T_3	Infestation of *Alternanthera triandra*	16.75 (280.18)	17.35 (300.54)	37.92	6.65	68.20	40.66	7.14	72.73
T_4	Infestation of *Spilanthes acmella*	15.04 (225.78)	16.57 (274.20)	30.10	5.22	48.14	36.56	6.33	58.48
T_5	Infestation of *Cyanotis axillaris*	14.69 (215.35)	15.51 (240.00)	28.50	5.17	55.95	31.76	5.76	62.43
T_6	Infestation of grasses	14.78 (217.84)	12.28 (150.36)	32.53	4.83	84.23	22.71	3.37	58.80
T_7	Infestation of broad leaved weeds	16.40 (268.37)	18.68 (348.30)	39.45	6.47	84.04	51.20	8.39	109.10
T_8	Control (Mixed flora)	18.65 (347.50)	20.39 (415.32)	61.74	8.72	169.95	73.79	10.44	203.46
T_9	weed free (3 Handweeding)	3.26 (10.13)	4.89 (23.39)	0.36	0.12	0.93	0.82	0.28	2.13

	Sem±	0.92	0.76	1.79	0.26	3.26	1.60	0.27	2.51
	CD 5%	2.77	2.30	5.58	0.79	9.79	4.8	0.80	7.54

Figures in the parentheses are original value, data were transformed through √x+0.5 which are given in bold

Conclusion

Studies on nutrient uptake/removal by weeds shows that highest nutrient uptake by crop in weed free (3 Hand weeding) plot and minimum nutrient uptake in control (Mixed flora) plot. Similarly nutrient removal by weeds observed highest under control plot and minimum nutrient removal in weed free plot.

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