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NUTRIENT UPTAKE AND SOIL AVAILABLE NUTRIENTS IN MACHINE TRANSPLANTED RICE (*ORYZA SATIVA* L.) AS INFLUENCED BY DIFFERENT WEED MANAGEMENT PRACTICES

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ABSTRACT
Field experiment on "Studies on efficiency of different weed management practices in machine transplanted rice (*Oryza sativa* L.)" was conducted at Agricultural Research Station, Gangavati, University of Agricultural Sciences, Raichur, Karnataka during *kharif,* 2012 and 2013 under irrigated condition in clay soil. Pooled mean indicated that, among the different weed management practices, weed free check recorded significantly higher nitrogen uptake by the grain straw and total uptake (73.14, 52.95 and 126.09 kg ha^{-1}, respectively), higher phosphorous uptake by the grain straw and total uptake (26.28, 14.09 and 40.37 kg ha^{-1}, respectively) and higher potassium uptake by the grain straw and total uptake (22.48, 59.14 and 81.62 kg ha^{-1}, respectively) as compared to unweeded control which recorded lower nitrogen uptake by the grain straw and total uptake (41.40, 30.04 and 71.44 kg ha^{-1}, respectively), phosphorous uptake by the grain straw and total uptake (17.63, 10.46 and 28.08 kg ha^{-1}, respectively) and potassium uptake by the grain straw and total uptake (15.98, 43.74 and 59.72 kg ha^{-1}, respectively) and higher available nitrogen, phosphorous and potassium was recorded with use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (253.8, 53.47 and 361.2 ha^{-1}, respectively) when compared to unweeded control (217.3, 38.94 and 320.6 ha^{-1}, respectively).

KEY WORDS: Conoweeder, hand weeding low land power operated paddy weeder, post emergent, pre-emergent, weed management, nutrient uptake and nutrient availability.

INTRODUCTION
Rice continues to hold the key to sustained food production by contributing 20-25 per cent to agriculture and assures food security for more than half of the total population in India. Rice accounts for 55 per cent of total cereal production in the country. Out of 2234 calories per day per capita food intake, rice accounts for 30 per cent in Indian diet. There is ever increasing demand for rice with increasing population which is expected to reach 140 million tonnes by 2025 and 528 million tonnes by the year 2050 (Paroda, 1998).In India, rice is cultivated in a wide range of ecosystems *viz.,* irrigated (21.0m ha), rainfed lowlands (14.0 m ha), rainfed uplands (6.0 m ha) and flood prone (3.0 m ha). The most common method that is being followed by the farmers is generally transplanting and some have adopted dry seeding or wet seeding method for cultivation of rice depending upon the situation. Weeds grow faster and absorb the available nutrients earlier and faster resulting in deprivation of nutrients for the rice. Hence, weed management during the early period of rice is one of the most critical factor for successful production of rice. Manual weeding is widely practiced as effective method of weed control. But, it is not advantageous as it is costlier, time consuming. Manually it is difficult to differentiate between grasses and rice due to phenotypical similarities between weeds and rice seedlings in early stages. In such a situation, the chemical weed control becomes an alternative method for weed control. Preferably, the application of pre-emergent chemical herbicide for weeding is a vital tool for effective and cost efficient weed control in rice, which encounters weed competition from the day of germination. Adjusting the time of application, reducing the dose of the herbicide or use of herbicides in sequence can improve selectivity, time and adequate weed control in transplanted rice. Various Universities in India showed that the manually operated cono weeder implement reduced drudgery due to less time taken (50-55 %) compared to hand weeding. The use of equipment also resulted in saving of cost of operation by 45 per cent. Farmers are of the opinion that cono weeder operation in standing position of operator allowed weeding without fatigue (Dixit and Khan, 2009).

MATERIALS & METHODS
A field experiment was conducted at Agricultural Research Station, Gangavathi, University of Agricultural Sciences, Raichur, Karnataka, during *kharif,* 2012 and 2013. The experiment was laid in strip-plot design. The soil of the experimental site was medium deep black clay with soil reaction (8.2), electrical conductivity (2.1) determined following the procedure given by Jackson (1973), available N (247.2 kg ha^{-1}) Subbaiah and Asija (1956), available P_2O_5 (50.2 kg ha^{-1}) Olsen *et al.* (1954) and available K_2O (357.6 kg ha^{-1}) Jackson (1973) at surface 0-20 cm soil depth. Agricultural Research Station, Gangavathi is situated in the Northen Dry Zone of Karnataka between 15º 15' 40" North latitude and 76º 31' 40" East longitude at an altitude of 419 m above mean sea level and represents irrigated transplanted rice belt of Tungabhadra command area. The experiment consisted

twelve different weed management practices viz., pre-emergent application of butachlor 50 EC fb hand weeding at 30 DAT (T_1), Bensulfuron methyl 0.6% + Pretilachlor 6% fb hand weeding at 30 DAT (T_2), Butachlor 50 EC fb 2, 4-D Sodium salt 80 WP at 25 DAT (T_3), Butachlor 50 EC fb Bispyribac sodium 10 SC at 25 DAT (T_4), Bensulfuron methyl 06% + Pretilachlor 6% fb 2, 4 - D fb Sodium salt 80 WP at 25 DAT (T_5), Bensulfuron methyl 0.6% + Pretilachlor 6% fb Bispyribac sodium 10 SC 25 DAT (T_6), Butachlor 50 EC fb power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (T_7), passing of power operated low land rice weeder at 20 and 30 DAT with hand weeding in intra row space (T_8), passing of Conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (T_9) and two hand weedings at 20 and 40 days after transplanting (T_{10}) were compared with unweeded control (T_{11}) and weed free check (T_{12}). The land was prepared using tractor drawn cultivator twice, followed by puddling twice with disc puddler and finally levelled using tractor drawn spike tooth harrow and kept ready for planting. Weed control treatments were imposed as per the combination of pre, post emergent herbicides and use of weeders, time and dosage of the chemicals. From the day of transplanting upto 10 days, a thin film of water was maintained and thereafter 5 cm standing water was maintained upto 10 days before harvesting. Water was drained during fertilizer application and spraying of weedicides and chemicals. Recommended dose of fertilizers were applied as per the recommendation and time. Nitrogen, phosphorus and potassium content in plant sample of rice at harvest was estimated by modified micro-kjeldhal method, vanadomolybdate yellow colour method and flame photometer method, respectively as outlined by Jackson, (1967). Nutrient uptake was calculated by using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)}}{100} \text{ X dry weight (kg ha}^{-1})$$

RESULTS AND DISCUSSION

1. Nutrient uptake

1.1 Nitrogen uptake

Uptake of nitrogen by the grain varied significantly due to various weed control treatments. Pooled mean indicated that, significantly higher nitrogen uptake by the grain was recorded in the pooled mean with weed free check (73.14 kg ha^{-1}) as compared to unweeded control (41.40 kg ha^{-1}) and it was found to be on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (69.44 kg ha^{-1}). Among the different herbicides applied either in single or in sequence, application of bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (67.20 kg ha^{-1}) recorded higher nitrogen uptake by the grain. Unweeded control recorded the lowest nitrogen uptake by the grain (41.40 kg ha^{-1}).

TABLE 1. Nitrogen uptake by the grain, straw and total nitrogen uptake by the machine transplanted rice as influenced by weed Control treatments

	Uptake by grain (kg ha^{-1})			Uptake by straw (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T_1	45.70	47.70	46.70	32.20	34.30	33.25	77.90	82.00	79.95
T_2	48.50	50.50	49.50	34.80	35.80	35.30	83.30	86.30	84.80
T_3	51.60	53.27	52.44	36.40	37.40	36.90	88.00	90.67	89.34
T_4	54.10	56.10	55.10	37.70	38.90	38.30	91.80	95.00	93.40
T_5	64.10	66.10	65.10	44.60	45.60	45.10	108.70	111.70	110.20
T_6	66.20	68.20	67.20	46.40	48.00	47.20	112.60	116.20	114.40
T_7	68.77	70.10	69.44	48.20	49.81	49.01	116.97	119.91	118.44
T_8	60.20	62.20	61.20	41.60	42.60	42.10	101.80	104.80	103.30
T_9	62.00	64.00	63.00	43.30	44.60	43.95	105.30	108.60	106.95
T_{10}	57.60	58.93	58.27	39.50	40.20	39.85	97.10	99.13	98.12
T_{11}	40.40	42.40	41.40	29.80	30.28	30.04	70.20	72.68	71.44
T_{12}	72.30	73.97	73.14	52.10	53.80	52.95	124.40	127.77	126.09
S.Em±	1.69	1.74	1.75	1.30	1.32	1.26	2.85	2.94	2.91
C.D. (P=0.05)	4.91	5.12	5.15	3.81	3.90	3.73	8.37	8.65	8.57

Weed free check recorded significantly higher nitrogen uptake by the straw (52.95 kg ha^{-1}) against all the treatments under the study followed by the application of butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (49.01 kg ha^{-1}). Application of bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (47.20 kg ha^{-1}) and bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4 - D sodium salt 80 WP (45.10 kg ha^{-1}) recorded on par nitrogen uptake by straw. Significantly lower nitrogen uptake by the straw was recorded with unweeded control (30.04 kg ha^{-1}). Similar trend persisted in the individual years also.

The lowest total nitrogen uptake by the rice crop was noticed in unweeded control (70.20 and 72.68 kg ha^{-1}, respectively) during both the years of the experiment and was significant compared to all the treatments of investigation. Whereas weed free check recorded significantly higher total nitrogen uptake by the rice crop (124.40 and 127.77 kg ha^{-1}, respectively) but was found to be on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder twice at

20 and 30 DAT with hand weeding in intra row space (116.97 and 119.91 kg ha^{-1}, respectively) during both the years.

1.2 Phosphorous uptake

Phosphorous uptake by the grain varied significantly due to various weed control treatments. Pooled mean indicated that, significantly higher phosphorous uptake by the grain with weed free check (26.28 kg ha^{-1}) when compared to unweeded control (17.63 kg ha^{-1}) and it was found to be on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder (twice at 20 and 30 DAT) with hand weeding in intra row space (25.08 kg ha^{-1}) and bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (24.69 kg ha^{-1}). Similar response was noticed in individual years too. Significantly higher phosphorous uptake by the straw was recorded with weed free check (13.10 and 15.08 kg ha^{-1}, respectively) as compared to unweeded control (9.80 and 11.11 kg ha^{-1}, respectively) and it remained on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (12.90 and 14.55 kg ha^{-1}, respectively) and bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (12.75 and 14.73 kg ha^{-1}, respectively) during both the years of study.

Pooled mean indicated that weed free check recorded significantly higher (40.37 kg ha^{-1}) total phosphorous uptake by the rice crop as compared to unweeded control (28.08 kg ha^{-1}) and it was found to be on par with the application of bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (38.43 kg ha^{-1}) and butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (38.80 kg ha^{-1}).

TABLE 2. Phosphorous uptake by the grain, straw and total phosphorous uptake by machine transplanted rice as influenced by weed control treatments

	Uptake by grain (kg ha^{-1})			Uptake by straw (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T_1	45.70	47.70	46.70	32.20	34.30	33.25	77.90	82.00	79.95
T_2	48.50	50.50	49.50	34.80	35.80	35.30	83.30	86.30	84.80
T_3	51.60	53.27	52.44	36.40	37.40	36.90	88.00	90.67	89.34
T_4	54.10	56.10	55.10	37.70	38.90	38.30	91.80	95.00	93.40
T_5	64.10	66.10	65.10	44.60	45.60	45.10	108.70	111.70	110.20
T_6	66.20	68.20	67.20	46.40	48.00	47.20	112.60	116.20	114.40
T_7	68.77	70.10	69.44	48.20	49.81	49.01	116.97	119.91	118.44
T_8	60.20	62.20	61.20	41.60	42.60	42.10	101.80	104.80	103.30
T_9	62.00	64.00	63.00	43.30	44.60	43.95	105.30	108.60	106.95
T_{10}	57.60	58.93	58.27	39.50	40.20	39.85	97.10	99.13	98.12
T_{11}	40.40	42.40	41.40	29.80	30.28	30.04	70.20	72.68	71.44
T_{12}	72.30	73.97	73.14	52.10	53.80	52.95	124.40	127.77	126.09
S.Em±	1.69	1.74	1.75	1.30	1.32	1.26	2.85	2.94	2.91
C.D. (P=0.05)	4.91	5.12	5.15	3.81	3.90	3.73	8.37	8.65	8.57

1.3 Potassium uptake

Pooled data revealed that, weed free check recorded significantly higher potassium uptake by the grain (22.48 kg ha^{-1}) compared to unweeded control (15.98 kg ha^{-1}) but was found to be on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (21.48 kg ha^{-1}). On par potassium uptake by the grain was noticed with the application of bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (20.70 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb 2,4-D sodium salt 80 WP (20.56 kg ha^{-1}), use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (19.91 kg ha^{-1}) and power operated low land rice weeder (20 and 30 DAT) with hand weeding in intra row space (19.25 kg ha^{-1}) but were superior over unweeded control (15.98 kg ha^{-1}). Significantly higher potassium uptake by the straw was recorded with weed free check (59.14 kg ha^{-1}) compared to unweeded check (43.74 kg ha^{-1}) and it was found to be on par with the application of butachlor 50 EC fb passing of power operated low land rice weeder (twice at 20 and 30 DAT) with hand weeding in intra row space (57.94 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (57.14 kg ha^{-1}), both bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4 - D sodium salt 80 WP and use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (56.34 kg ha^{-1}) and power operated low land rice weeder at 20 and 30 DAT with hand weeding in intra row space (54.54 kg ha^{-1}). Significantly higher total potassium uptake by the rice crop was recorded with weed free check (81.62 kg ha^{-1}) in contrast to unweeded check (59.72 kg ha^{-1}) and it remained on par with butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (79.42 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (77.84 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4 - D sodium salt 80 WP (76.90 kg ha^{-1}) and use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (76.25 kg ha^{-1}).

Higher nutrient uptake by crop in these treatments was due to lower weed population and their dry weight, which helped the crop to grow in weed free environment and absorb more nutrients from the soil and due to active and massive root system which might have caused increased uptake of nutrients. Greater availability of plant nutrients in weed free condition provides a better environment for root growth and proliferation, thereby creating more absorptive surface for uptake of nutrients. Whereas, unweeded control registered significantly lower total nutrient uptake due to higher crop weed competition for growth factors. The similar results were reported by Bhanu Rekha *et al*. (2002), Deka and Gogai (1995), Jadhav *et al.* (1997), Jaydeva, (2007) and Sadhana *et al*. (2012). The higher uptake of nutrients in case of passing of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT and passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space may be attributed to the deeper and proliferate root system enabling them to uptake more nutrients as reported by the Revathi *et al*. (2012).

TABLE 3. Potassium uptake by the grain, straw and total potassium uptake by machine transplanted rice as influenced by weed control treatments

	Uptake by grain ($kg\ ha^{-1}$)			Uptake by straw ($kg\ ha^{-1}$)			Total uptake ($kg\ ha^{-1}$)		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T_1	15.70	17.09	16.40	47.20	48.68	47.94	62.90	65.77	64.34
T_2	16.10	17.52	16.81	48.30	49.78	49.04	64.40	67.30	65.85
T_3	16.60	18.02	17.31	49.80	51.28	50.54	66.40	69.30	67.85
T_4	17.20	18.52	17.86	50.33	51.81	51.07	67.53	70.33	68.93
T_5	19.90	21.22	20.56	55.60	57.08	56.34	75.50	78.30	76.90
T_6	20.00	21.39	20.70	56.40	57.88	57.14	76.40	79.27	77.84
T_7	20.80	22.15	21.48	57.20	58.68	57.94	78.00	80.83	79.42
T_8	18.60	19.89	19.25	53.80	55.28	54.54	72.40	75.17	73.79
T_9	19.20	20.62	19.91	55.60	57.08	56.34	74.80	77.70	76.25
T_{10}	18.00	19.39	18.70	52.10	53.55	52.83	70.10	72.94	71.52
T_{11}	15.30	16.65	15.98	43.00	44.48	43.74	58.30	61.13	59.72
T_{12}	21.80	23.15	22.48	58.40	59.88	59.14	80.20	83.03	81.62
S.Em±	0.54	0.55	0.54	1.56	1.56	1.57	2.07	2.08	2.12
C.D. (P=0.05)	1.58	1.61	1.59	4.61	4.59	4.61	6.09	6.11	6.24

2. Available nutrients

2.1 Available nitrogen

Pooled mean revealed that, lower soil available nitrogen after harvest of rice was recorded with unweeded control (217.3 kg ha^{-1}) when compared to use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (253.8 kg ha^{-1}). Application of butachlor 50 EC fb hand weeding at 30 DAT (250.5 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6 % fb hand weeding at 30 DAT (247.8 kg ha^{-1}), butachlor 50 EC fb 2, 4 - D sodium salt 80 WP (244.6 kg ha^{-1}) and butachlor 50 EC fb bispyribac sodium 10 SC (242.4 kg ha^{-1}) recorded on par available nitrogen in the soil with each other, but were significantly higher when compared to unweeded control (217.3 kg ha^{-1}).

Application of bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (228.3 kg ha^{-1}) and bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4-D sodium salt 80 WP (229.8 kg ha^{-1}) recorded significantly lower soil available nitrogen next only to unweeded control (217.3 kg ha^{-1}).

2.2 Available phosphorus

Significant variations were noticed with respect to available phosphorous in the soil after harvest due to various weed control treatments. Significantly higher available phosphorous in the soil after harvest was recorded with use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (53.47 kg ha^{-1}) when compared to unweeded control (38.94 kg ha^{-1}) and it was found to be on par with application of butachlor 50 EC fb hand weeding at 30 DAT (52.50 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb hand weeding at 30 DAT (51.20 kg ha^{-1}) , butachlor 50 EC fb 2, 4 - D sodium salt 80 WP (50.80 kg ha^{-1}), butachlor 50 EC fb bispyribac sodium 10 SC (50.07 kg ha^{-1}) and hand weeding twice at 20 and 40 DAT (48.54 kg ha^{-1}). Passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (47.74 kg ha^{-1}), application of butachlor 50 EC fb passing of power operated low land rice weeder twice at 20 and 30 DAT with hand weeding in intra row space (46.94 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4-D sodium salt 80 WP (45.64 kg ha^{-1}) and bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (45.30 kg ha^{-1}) recorded lower available phosphorous in the soil next only to unweeded control (38.94 kg ha^{-1}).

2.3 Available potassium

Significant variations were noticed with respect to available potassium in the soil after harvest due to various weed control treatments. The higher available potassium in the soil after harvest was recorded with use of conoweeder twice at 10 and 20 DAT fb hand weeding at 30 DAT (361.2 kg ha^{-1}) as compared to unweeded control (320.6 kg ha^{-1}) and it was found to be on par with almost all the treatments except application of butachlor 50 EC fb bispyribac sodium 10 SC (344.0 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb 2, 4 - D sodium salt 80 WP (343.9 kg ha^{-1}), bensulfuron methyl 0.6% + pretilachlor 6% fb bispyribac sodium 10 SC (343.2 kg ha^{-1}) and weed free check (341.9 kg ha^{-1}).

Due to lower weed population throughout the crop growth period and incorporation of weeds into the soil seems to be resulted in lower loss of soil applied nutrients which otherwise was depleted by the more competitive weeds leading to lower availability in the soil. Similar findings were reported by Sangeetha *et al.* (2011).

TABLE 4. Available NPK at harvest as influenced by weed control treatments in machine transplanted rice

	Available N (kg ha^{-1})			Available P_2O_5 (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T_1	249.8	251.1	250.5	52.00	53.00	52.50	348.5	354.5	351.5
T_2	247.3	248.3	247.8	51.20	51.20	51.20	350.2	353.0	351.6
T_3	244.1	245.1	244.6	50.30	51.30	50.80	349.3	352.0	350.7
T_4	241.5	243.2	242.4	49.40	50.73	50.07	342.1	345.9	344.0
T_5	229.3	230.3	229.8	45.30	45.97	45.64	341.9	345.8	343.9
T_6	227.6	228.9	228.3	44.80	45.80	45.30	337.8	348.6	343.2
T_7	233.7	235.0	234.4	46.60	47.27	46.94	344.5	347.1	345.8
T_8	235.9	236.6	236.3	47.40	48.07	47.74	342.9	345.1	344.0
T_9	252.6	254.9	253.8	52.80	54.13	53.47	359.2	363.2	361.2
T_{10}	238.8	240.1	239.5	48.20	48.87	48.54	347.5	350.2	348.9
T_{11}	216.8	217.8	217.3	38.60	39.27	38.94	318.8	322.4	320.6
T_{12}	231.2	231.9	231.6	46.00	46.67	46.34	342.9	340.9	341.9
S.Em±	3.06	3.29	3.18	1.89	1.84	1.86	5.43	5.30	5.36
C.D. (P=0.05)	9.01	9.69	9.37	5.55	5.40	5.47	15.97	15.58	15.77

REFERENCES

Bhanu Rekha, K., Raju, M.S. & Reddy, M.D. (2002) Effect of herbicides in transplanted rice. *Indian J. Weed Sci.,* 34(1 & 2): 123-125.

Deka, S.C. & Gogoi, A.K. (1995) Effect of herbicides on N uptake by rice and weeds in low land transplanted situation. *Indian J. Weed Sci.,* 27(1 & 2): 92-93.

Dixit, A. & Khan, J.N. (2009) Improved cost effective implements for small rice farmers. *Agricultural Mechanization in Asia, Africa and Latin America,* **40**(2): 30-35.

Jackson, M.L. (1967) *Soil Chemical Analysis*. Prentice Hall of India Private Limited, New Delhi.

Jackson, M.L. (1973) *Soil Chemical Analysis*, (Ed.). Prentice-Hall of India, Pvt. Ltd., New Delhi, pp. 121-125.

Jadhav, A.B., Talashilkar, S.C. & Power, A.G. (1997) Influence of the conjunctive use of FYM, vermicompost and urea on growth and nutrient uptake in rice. *J. Maharashtra Agric. Univ.,* 22: 249-250.

Jayadeva, H.M. (2007) Studies on nitrogen losses, methane emission and productivity of rice under crop establishment techniques. *Ph.D. Thesis, Univ. Agric. Sci.,* Bangalore: 130-171

Olsen, S.R., Cole, C.L., Watanabe, F.S. & Deaw, D.A. (1954) Estimation of available phosphorous in soils by extraction with sodium bicarbonate. United States Departments of Agriculture circular, p.939.

Paroda, R.S. (1998) ICAR Reporter. *Indian Council of Agric Res.,* New Delhi. pp.1-23.

Revathi, M., Prabhakaran, N.K., Chinnusamu, C. & Meena, S. (2012) Influence of establishment methods and weed management practices on nutrient removal by weeds and uptake by rice in puddled lowland. *Madras Agric. J.,* 99(7-9): 496-499.

Sadhana, R., Babar &Velayutham, A. (2012) Weed management practices on nutrient uptake, yield attributes and yield of rice under system of rice intensification. *adras Agric. J.,* 99(1-3): 51-54.

Sangeetha, S.P., Bhalakrishna, A., Sathyapriya & Maheswari, J. (2011) Nutrient depletion by weeds, yield and economics of drum seeded rice influenced by weed management. *J. Weed Sci.,* 43 (3&4):23-235.

Subbaiah, B.V. & Asija, G.L. (1956) Rapid procedure for determination of available nitrogen in soils. *Current. Sci.,* 31: 196.