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Effect of new post emergence herbicides on yield and yield attributes and energy in transplanted rice (*Oryza sativa* L.)

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ABSTRACT : The present investigation was carried out at research cum instructional farm, IGKV, Raipur, Chhattisgarh during *Rabi* season of 2011-12. There were twelve treatments comprised of pre and post- emergence application of different herbicide molecules either alone or in combination along with two hand weeding and unweeded check. Treatments comprised of AE 1887196 – 20 per cent + AEF 095404- 10 per cent – 30 per cent WG, AE 1887196 – 20 per cent + AEF 095404 - 10 per cent – 30 per cent WG, AE 1887196 – 20 per cent + AEF 095404- 10 per cent -30 per cent WG, AE 1887196 -20 per cent SC, AEF 095404 -15 per cent WG, Butachlor 50 per cent EC, Pyrazosulfuran-ethyl 10 per cent WP, Pretilachlor 50 per cent EC, Fenoxaprop p-ethyl + Chlorimuron ethyl + Metsulfuron-methyl 20 per cent WP, Bispyribac-sodium 10 per cent SL, Two hand weeding, Unweeded check. Effective tillers per hill, panicle length, panicle weight, test weight, number of filled grains, grain yield and straw yield were highest under two hand weedings, whereas unweeded check recorded highest number of unfilled grains per panicle and sterility percentage.

KEY WORDS : Rice, Bio efficacy, Yield, Herbicides, Yield attributes

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INTRODUCTION

Rice (*Oryza sativa* L.) is the most important major cereal food crop in agriculture and economy of India. In world, rice is the second most widely consumed cereal next to wheat and it has occupied an area of 161.4 million hectares, with a total production of 678.7 million tonne in 2009-10 (FAO, 2010). Chhattisgarh state is popularly known as “Rice bowl” because of maximum area covered during *Kharif* under rice contributing major share in national rice production. However, the production and productivity of rice per unit area is very low due to limited irrigation, lack of improved varieties suitable to different eco systems, low and imbalance use of fertilizer and improper weed management. The area, production and productivity of rice in Chhattisgarh is 3.57 million ha, 5.85 million tonne and 1.52 t ha^{-1}, respectively (Anonymous, 2010). The productivity of rice per unit area is poor, despite of suitable environmental conditions. One of major problem in rice cultivation for low productivity is weed infestation. Infestation of weeds in transplanted rice not only results in yield reduction but quality of produce is also impaired. Yield reduction in transplanted rice due tounchecked weed growth is 47 per cent (Mukharjee and Maity, 2011). Rice crop isinfested by heterogeneous type of weed flora consisting of grassy, broad leaf weeds and sedges weeds causing yield reduction up to 70 per cent (Singh and Singh, 2006).About 100 weed species are

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known to be associated with this crop in India. Among them *Echinocloacolona* is the most troublesome and widely distributed. Based on research findings it was estimated that extent of yield reduction in rice due to weeds alone is about 15-20 per cent for transplanted rice, 30-35 per cent for direct seeded puddled rice and 5-95 per cent or even more in direct seeded rice under severe weed infestation (Choubey *et al*., 2001). Weeds not only cause quantitative but also hamper the quality of produce due to competition for nutrient, moisture, light and to some extent for space. They harbor many insect, pest and pathogen resulting in poor crop growth. Distribution of weeds is greatly influenced by soil and the prevailing climatic condition and hence, they differ at different place. Weed problem is generally of lower magnitude in transplanted system if puddling and water management is good. But still in the tail end areas of canal irrigated system and other specific areas where there is restricted water availability timely weed control becomes important. In transplanted rice, weeds germinate few days after transplanting of seedling. In early stage of the crop grasses are predominant as compared to others, but at later stage, sedges and broad leaf weeds create interference in crop growth. No doubt that hand weeding is the established effective method of weed control. But now a day's, high cost involved and unavailability of labours makes weed management more difficult. In Chhattisgarh state, farmers generally control weeds manually. The physical methods are costly, labour consuming and the advantage of manual weeding could only be achieved when it is performed timely. Chemical weed control is regarded to be better than hand weeding due to drudgery of weeding and meager availability of labour at peak period of weed infestation. In this respect, application of new and wide spectrum herbicides alone or in combination may give satisfactory weed control. Most of the herbicides are narrow spectrum and control some species, whilemsome remain unaffected. Selective mixture of post emergence herbicides control broad spectrum of weeds. Second flush emerged after application of early post emergence herbicides. In order to manage the second flush or subsequent flush of weeds, sequential application of post emergence herbicides may prove promising. In Chhattisgarh state, consumption of new herbicides (molecules) is very meager. Keeping these points in view a field experiment was carried out at Instructional Farm cum Research, I.G.K.V., Raipur (C.G.) during *Kharif*, 2011 on bio-efficacy of new post emergence herbicides in transplanted rice (*Oryza sativa* L.).

EXPERIMENTAL METHODS

The present investigation was carried out at research cum instructional farm, IGKV, Raipur, Chhattisgarh during *Rabi* season of 2011-12 in an elevation of 298.56 m above mean sea level, 21^0 $16'$ North latitude and 81^0 $36'$ East longitude. Soil of the experimental field was clayey in texture and belonged to vertisol which was low in available nitrogen with 200.70 kg/ha, medium in available phosphorus with 12.99 kg/ha and medium in available potassium with 256.01 kg/ha, low in organic carbon with 0.44 per cent, neutral in pH and EC . The experiment was laid out in Randomized Block Design with three replications. There were twelve treatments comprised of pre and post-emergence application of different herbicide molecules either alone or in combination along with two hand weeding and unweeded check. Treatments comprised of AE 1887196 – 20 per cent + AEF 095404- 10 per cent - 30 per cent WG, AE 1887196 - 20 per cent + AEF 095404- 10 per cent - 30 per cent WG, AE 1887196 - 20 per cent + AEF 095404- 10 per cent -30 per cent WG, AE 1887196 -20 per cent SC, AEF 095404 -15 per cent WG, Butachlor 50 per cent EC, Pyrazosulfuran-ethyl 10 per cent WP, Pretilachlor 50 per cent EC, Fenoxaprop p-ethyl + Chlorimuronethyl + Metsulfuron-methyl 20 per cent WP, Bispyribac-sodium 10 per cent SL, Two hand weeding, Unweeded check. Rice seeds were treated with 10 per cent salt solution in order to select the healthy seeds. The seeds settled at the bottom were thoroughly rinsed with water twice and used for nursery raising. In order to prevent the crop from seed borne diseases, the seeds were treated with carbendazim @ 2 g kg^{-1} seed. The field was prepared by ploughing and cross ploughing with the help of cultivator. The field was puddled by tractor drawn puddler in presence of 8-10 cm standing water and leveled by planker. The application of herbicides vizbutachlor, pretilachlor (each 3 DAT), AE 1887196+AEF 095404, AE 1887196, AEF 095404 (each 10 DAT), pyrazosulfuranethyl (15 DAT), fenoxaprop-p-ethyl +chlorimuron-ethyl+ metsulfuron-methyl (Almix) and bispyribac-sodium (each 20 DAT) was performed as per the treatment. The first herbicide application was done on 18th July, 2011 and second was on 24rd Sept, 2011. As per the treatments, the exact required quantity of herbicides was taken and mixed in water to prepare stock solution, which was equally distributed. Application of herbicides was carried out in the morning time with the help of Knapsack sprayer manually. All the growth parameters like plant height, plant population, leaf stem ratio, number of tillers per m row length, number of leaves $plant^{-1}$ were taken and yield attributes like effective tillers per hill, panicle length (cm), panicle weight (g), number of filled and unfilled grains per panicle, test weight and grain yield and straw yield were recorded and economics was calculated and computations were done.

Effective tillers (no.$hill^{-1}$) :

The number of effective tillers from 10 randomly selected hills wascounted at harvest from each plot and the mean was worked out.

Panicle length (cm) :

Ten panicles from the tagged hills were randomly selected and harvested separately and the length of panicle was measured in cm from base ring to tip with the help of scale. After this, average length of panicle was determined by dividing summation by ten.

Panicle weight (g) :

Selected ten panicles from the tagged hills were weighed on an electric weighing balance and the mean was worked out.

Filled grains (no. panicle^{-1}) :

Selected ten panicles were harvested separately and grains were manually removed from the panicle. The number of filled grains panicle^{-1} was counted and the mean was calculated.

Unfilled grains (no. panicle^{-1}) :

From the ten selected panicles, from which the no. of filled grains was counted, the number of unfilled grains was also counted and calculated panicle^{-1}.

Test weight (g) :

Grain samples were taken from the produce of each net plot. Out of the samples, 1000 grains were counted from each net plot and the same were dried inan oven at 60^{0}C to get constant weight, thereafter, obtained weight was noted as1000-grain weight (test weight).

Grain yield (t ha^{-1}) :

The crop from each net plot was harvested separately. The grains were separated from straw by threshing. After threshing winnowing was done. The weight of grains was recorded and expressed in t ha^{-1} by multiplying the factor(0.595). The number of hills uprooted for dry matter accumulation were also included in the calculation of yield.

Straw yield (t ha^{-1}) :

The straw yield was worked out by subtracting the weight of grains from the bundle weight of the produce it was expressed in t ha^{-1} by multiplying the factor (0.595).

Sterility percentage :

The number of filled and unfilled grains panicle^{-1} was counted separately from each plot and sterility percentage was computed with the help of following formula :

$$\text{Sterility percentage Z} \frac{\text{Number of unfilled grains / panicle}}{\text{Total mumber of grains / panicle}} \text{x100}$$

EXPERIMENTAL RESULTS AND ANALYSIS

The findings of the present study as well as relevant discussion have been presented under following heads :

Effective tillers (number hill^{-1}) :

All the treatments produced significantly higher number

Table 1 : Yield attributing characters of transplanted rice as affected by weed management practices

Treatments		Dose (g/ha)	Effective Tillers/hill	Panicle length (cm)	Panicle weight (g)	No. of filled grains/ panicle	No. of unfilled grains/ panicle	Sterility Percentage	Test weight (g)
T_1	AE 1887196-20% +AE F 095404-10%-30%WG	35+17.5	7.27	24.35	2.48	98.70	9.1	10.07	25.11
T_2	AE 1887196-20% +AE F 095404-105-30%WG	40+20	7.33	24.48	2.65	101.67	8.8	9.27	25.23
T_3	AE 1887196-20% +AE F 095404-10%-30%WG	45+22.5	7.83	25.59	2.70	108.17	8.0	7.77	25.50
T_4	AE 1887196-20% SC	45	7.07	24.34	2.47	97.8	9.3	10.47	25.06
T_5	AE F 095404-15% WG	22.5	7.07	24.30	2.43	94.93	9.4	1.57	25.03
T_6	Butachlor 50% EC	1250	6.80	23.03	2.20	91.60	10.1	12.77	24.78
T_7	Pyrazosulfuran ethyl 10% WP	15	7.07	23.64	2.36	93.57	10.5	11.07	25.0
T_8	Pretilachlor 50% EC	625	6.80	23.31	2.32	98.33	10.7	11.43	24.93
T_9	Fenoxaprop p-ethyl 9.3% EC + (chlorimuron-ethyl + metsulfuronmethyl 20% WP	60+4	7.27	24.45	2.62	98.83	8.9	970	25.13
T_{10}	Bispyribac sodium 10%SL	20	7.40	24.58	2.65	105.77	8.5	9.11	25.25
T_{11}	Two hand weeding	-	8.20	27.08	2.75	110.67	7.7	7.73	25.60
T_{12}	Unweeded check	-	5.47	20.47	1.14	83.33	13.2	10.67	23.57
	S.E. ±		0.31	0.79	0.13	3.55	0.85	0.72	0.19
	C.D. (P=0.05)		0.90	2.31	0.38	10.42	2.48	2.11	0.55

of effective tillers hill^{-1} over unweeded check.Two hand weedings (20 and 40 DAT) recorded significantly highest number of effective tillers hill^{-1}, which was comparable to AE 1887196 + AEF 095404 @40 +20 g ha $^{-1}$, AE 1887196 + AE F 095404 @ 45 + 22.5 g ha $^{-1}$ andbispyribac sodium @ 20 g ha^{-1}. The reason for more no. of effective tillers hill^{-1} in different treatments may due to the fact that there was more space to the crop to show their potential and lower weed- crop competition in terms of dry matter production of weeds aswell as good source sink relationship which allow crop to absorb required amount of nutrient, water and sunlight for its growth and tillering behaviour. These results are in accordance with the findings of Tiwari (2002), Hasazzaman and Karim (2007) and Yadav *et al.* (2009).

Panicle length (cm) :

With regards to weed management practices, two hand weedings (20 and 40 DAT) gave significantly maximum length of panicle, which was comparable to AE 1887196+AE F 095404 @ 45 + 22.5 g ha^{-1} and significantly superior over others. The shortest panicle was obtained under unweeded check. This result also found by Tiwari (2002).

Panicle weight (g) :

Most of the herbicidal treatments were showed significant impact on panicle weight as compared to unweeded check. As regards to weed management practices, maximum panicle weight was recorded under two hand weedings (20 and 40 DAT). However, treatments AE 1887196 + AEF 095404 @ 35+17.5 g ha $^{-1}$, AE 1887196 + AEF 095404 @ 40 +20 g ha $^{-1}$, AE 1887196+AE F 095404 @ 45 + 22.5 g ha^{-1}, AE 1887196 @ 45 g ha $^{-1}$, AEF 095404 @ 22.5 g ha $^{-1}$, fenoxaprop p-ethyl + (chlorimuron-ethyl+ metsulfuron-methyl) @ 60+4 g ha^{-1} and bispyribac sodium @ 20 g ha^{-1} were performed equally effective to two hand weedings (20 and 40 DAT) (T_{11}) and significantly superior to unweeded check. Higher panicle length of the above treatment could be responsible for higher panicle weight; this might be due to better transfer of photosynthates to the sink which contributes to increase the weight of panicles. These findings are in accordance with those of Tiwari (2002).

Filled grains (number panicle^{-1}) :

Two hand weedings (20 and 40 DAT) gave significantly maximum number of filled grains panicle^{-1}, which was comparable to AE 1887196 + AEF 095404 @ 40 +20 g ha^{-1}, AE 1887196+AE F 095404 @ 45 + 22.5 g ha $^{-1}$ and bispyribac sodium @ 20 g ha^{-1}. Possible reason to obtain maximum number of filled grains panicle^{-1} might be due to effective weed control and highest weed control efficiency in herbicidal treated plot. They found that application of herbicides responded well with respect to production of higher number of grains panicle^{-1} as compared to others treatments. The minimum number of filled grains panicle^{-1} was recorded under unweeded check. The similar result was also found by Tiwari (2002).

Unfilled grains (number panicle^{-1}) :

Two hand weedings (20 and 40 DAT) gave the lowest number of unfilled grains panicle^{-1}, which was comparable to AE 1887196 + AEF 095404 @ 35+17.5 g ha^{-1}, AE 1887196 + AEF 095404 @ 40 +20 g ha^{-1}, AE 1887196+AEF 095404 @ 45+22.5 g ha^{-1}, fenoxaprop p-ethyl + (chlorimuron-ethyl+ metsulfuron-methyl) @ 60+4 g ha^{-1} and bispyribac sodium @ 20 g ha^{-1}. It might to be due to the lower weed competition in terms of dry matter of weeds which create overall agreeable environment for

Table 2 : Effect of post emergence herbicides on yield of rice

Treatments		Rate (g ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1	AE 1887196-20% +AE F 095404-10%- 30%WG	35 + 17.5	34.73	56.21
T_2	AE 1887196-20% +AE F 095404-105- 30%WG	40 + 20	44.80	65.26
T_3	AE 1887196-20% +AE F 095404-10%- 30%WG	45 + 22.5	24.11	45.34
T_4	AE 1887196-20% SC	45	40.26	60.68
T_5	AE F 095404-15% WG	22.5	25.67	47.75
T_6	Butachlor 50% EC	1250	32.06	56.13
T_7	Pyrazosulfuran ethyl 10% WP	15	30.00	51.17
T_8	Pretilachlor 50% EC	625	43.12	63.97
T_9	Fenoxaprop p-ethyl 9.3% EC + (chlorimuron-ethyl + metsulfuronmethyl 20% WP	60+4	22.91	43.87
T_{10}	Bispyribac sodium 10%SL	20	30.87	55.62
T_{11}	Two hand weeding	–	46.3	33.42
T_{12}	Unweeded check	–	7.34	18.47
	S.E. ±		1.68	1.29
	C.D. (P=0.05)		4.80	3.72

growth and development of rice resulted more availability of light moisture, nutrients and space for rice plant leads to produce more number of sound grains panicle^{-1}. The maximum number of unfilled grains panicle^{-1} recorded under unweeded check.

Test weight (g) :

The data showed that weed management practices have significant effect on 1000-seed weight (test weight). Significantly the highest test weight was obtained under two hand weedings (20 and 40 DAT), while AE 1887196 + AEF 095404 @ 35+17.5 g ha^{-1}, AE 1887196 + AEF 095404 @ 40 +20 g ha^{-1}, AE 1887196+AE F 095404 @ 45 + 22.5 g ha $^{-1}$, AE 1887196 @ 45 g ha^{-1} (T_4), fenoxaproppethyl + (chlorimuron-ethyl + metsulfuron-methyl) @ 60+4 g ha $^{-1}$ and bispyribac sodium @ 20 g ha^{-1} were comparable with two hand weedings (20 and 40 DAT) and they were significantly superior to unweeded check. It is mainly due to management of the weeds from early crop growth period. The lowest test weight was recorded under unweeded check due to more crop weed competition. Similar results have been reported by Tiwari (2002).

Grain yield (t ha^{-1}) :

Two hand weedings (20 and 40 DAT) registered significantly highest grain yield (4.63 t ha^{-1}) over rest of the treatments except, treatments AE 1887196 + AEF 095404 @ 35+17.5 g ha^{-1}, AE 1887196 + AEF 095404 @ 40 +20 g ha^{-1}, AE 1887196+AE F 095404 @ 45 + 22.5 g ha^{-1}, fenoxaprop p-ethyl + (chlorimuron-ethyl+ metsulfuron-methyl) @ 60+4 g ha^{-1} and bispyribac sodium @ 20 g ha^{-1} which were at par with two hand weedings (20 and 40 DAT). The lowest grain yield was recorded under unweeded check. Similar results were also reported by Tiwari (2002). Grain production, which is the final product of growth and development, is controlled by growth and yield attributing characters such as effective tillers, dry matter accumulation and test weight etc. Growth and all yield attributing characters are more in two hand weedings (20 and 40 DAT) because of less crop-weed competition, Similarly environmental conditions were favorable for better crop growth resulted in higher photosynthesis and ultimately higher grain yield in this treatment. The lower grain yield under unweeded check may be due to the high weed interference and less yield attributing characters (Behera and Jha, 1992). Unweeded check plot compete with rice plants for light, nutrients and moisture resulting reduction in grain yield.

Straw yield (t ha^{-1}) :

The highest straw yield was produced under two hand weedings (20 and 40 DAT), it was at par with all the treatments except butachlor @ 1250 g ha^{-1} and pretilachlor @ 625 g ha^{-1}. Higher straw yield in these treatments is because of higher plant height, dry matter accumulation. Similar results have been also reported by Tiwari (2002).

Sterility percentage :

Among different treatments, two hand weedings (20 and 40 DAT) registered significantly lowest sterility percentage (7.68 %), which was at par with rest of the treatments, except butachlor @ 1250 g ha^{-1}, pyrazosulfuran-ethyl @ 15 g ha^{-1} and pretilachlor @ 625 g ha^{-1}.The highest sterility percentage was observed under unweeded check. The sterility percentage was reduced significantly due to post emergence herbicides. It is the established fact that weeds compete with rice for the nutrients, space, light and moisture with effective control of weeds with two hand weedings (20 and 40 DAT) and other post emergence herbicides the sterility percentage was less under these treatments. The higher weed competition under unweeded check arrested the nutrients and moisture available to rice crop. This, in turn, reduced the translocation of food material to sink resulted in higher sterility. As we know that weeds leads to imbalance uptake of nutrients, moisture, utilization of light and space, consequently affecting filling of grains adversely (Tiwari, 2002). Similar work related to the present investigation was also carried out by Hasanuzzaman and Karim (2007); Nagappa and Biradar (2002); Narayanan *et al.* (1999); Reddy *et al.* (2000); Singh and Mukherjee (2005); Singh and Singh (2006); Singh *et al.* (2007); Verma and Dave (2005) and Vijayakumar *et al.* (2004).

REFERENCES

Anonymous (2010). Report of Agriculture Department, Chhattisgarh Government.Krishi Diary, Directorate of Extension Services, IGKV, Raipur: 05.

Behera, U.K. and Jha, K.P. (1992). Technology for improving and stabilizing riceyields in drought prone region of Klahnadi. *Indian Farming*, **42**(4) : 9-13.

Choubey, N.K., Kohle, S.S. and Tripathi, R.S. (2001). Relative performance of cyhalofop-butyl for weed control in direct seeded rice. *Indian J. Weed Sci.*, **33**(3&4): 132-135.

FAO (2010). Joint FAO/WHO expert committee on food additives 72nd meeting Rome, Itly, from 16th-25th February.

Hasanuzzaman, K.N.M. and Karim, M.R. (2007). Effectiveness of different weedcontrol methods on the performance of transplanted rice. *Pak J. Weed Sci. Res.*, **13** (1-2) : 17-25.

Mukharjee, P.K. and Maity, S.K. (2011). Weed control in transplanted and wet-seeded rainy season rice. *Indian J. Agril. Sci.*, **81**(2) : 134-139.

Nagappa and Biradar, D.P. (2002). Effect of methods of planting and weed management practices on yield and yield attributes of rice (*Oryza sativa*). Extended summary 2nd International Agronomy Congress, Nov. 26-30, New Delhi, India, **2** : 926-927.

Nandal, D.P. and Singh, C.M. (1994). Effect of weed control on direct seeded paddled rice. *Haryana Agril. UIniv. J. Res.*, **24**(4): 154-157.

Narayanan, A.L., Veerabadram, V. and Poonguzhalan, R. (1999). Performance of low dose high efficacy herbicide for weed control in transplanted rice (*Oryza sativa* L.). *Oryza.,* **36** (3) : 290 - 292.

Rajkhowa D.J., Deka, N.C., Borah, N. and. Barua, I.C. (2007). Effect of herbicides with or without paddy weeder on weeds in transplanted. *Indian J. Agron.,* **52**(2) : 107-110.

Ramamoorthy, K. (1991). Effect of herbicides on weeds and yield of upland rice (*Oryza sativa* L.) and residual effect on cowpea (*Vigna unguiculata*) and green gram (*Phaseolus vigna*). *Indian J. Agron.,* **36**(3) : 304-307.

Rathore, A.L., Singh, A.P. Sharma, M.L. and Shaw, S.S. (2010). Weed management in direct seeded rice for enhancing water productivity under rainfed environment. In: Proceeding of the Biennial Conference of Indian Society of Weed Science, February 25-26, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh p 66.

Ravichandran, V.K. (1993). Weed control in dry-seeded rice (*Oryza sativa*). *Indian J. Agron.,* **38**(3) : 477-480.

Reddy, C.N., Reddy, M.D. and Devi, M.P. (2000). Evaluation of fenoxyprop-p-ethyl and ethoxysulfuron in transplanted rice. *Indian J. Weed Sci.,* **32**(1/2) : 105-107.

Rekha, K.B., Raju, M.S. and Reddy, M.D. (2003). Effect of herbicide on weed growth, grain yield and nutrient uptake in rainfed low land rice. *Indian J. Weed Sci.,* **35**(1&2) : 121-122.

Singh, Parmeet and Singh, S.S. (2006). Effect of establishment method, fertility level and weed management practices on aromatic rice (*Oryza sativa* L.). *Indian J. Agron.,* **51**(4) : 288-292.

Singh, R.P. and Mukherjee, D. (2005). Effect of low doses of herbicides on weeds nutrient uptake and yield of transplanted rice (*Oryza sativa* L.). *Indian J. Agron.,* **50**(3) : 194-196.

Singh, V.P., Singh, G. and Singh, Mahendra (2007). Effect of fenoxaprop-p-ethyl in transplanted rice and associated weeds. *Indian J. Weed Sci.,* **36**(36) : 190-192.

Sori, O. (2008). Efficacy and economics of post emergence herbicides in transplanted rice. M.Sc. (Ag.) Thesis, Indira Gandhi Krishi Vishwavidyalaya, Raipur, C.G. (INDIA).

Srinivasan, E.K., Natrajan, S., Ganpathy, M. and Arivazhagan, K. (2008). Effect of nitrogen levels and weed management in hybrid rice. *Oryza,* **45**(2) : 160-162.

Subramanyam, D., Reddy, R.C. and Reddy, S.D. (2007). Influence of puddling intensity and water-management practices on weed dynamics and yield of transplanted rice (*Oryza sativa* L.). *Indian J. Agron.,* **51**(4) : 225-230.

Tiwari, N. (2002). Effect of herbicide on performance of direct seeded rice, weeddynamic and soil microflora M.Sc. (Ag.) Agronomy Thesis, Indira Gandhi Krishi Vishwavidyalaya Raipur, C.G. (INDIA).

Urkurkar, J.S. and Chandrakar, B.L. (1992). Herbicidal manipulation to improve efficiency of fertilizer nitrogen in direct sown rice. Abstract Annual Weed Science Conference. Hissar, 3-4 March p.33.

Verma, A. and Dave, A. (2005). Efficacy of different weed control methods in direct seeded rainfed rice. *Oryza,* **42**(3) : 197-200.

Vijayakumar, M., Singh, S.D.S., Prabhakaran, N.K. and Thiyagarajan, T.M. (2004). Effect of SRI (System of Rice Intensification) practices on the yield attributes, yield and water productivity of rice (*Oryza sativa* L.). *J. Acta Agron. Hungarica.,* **52**(4) : 399-408.

Yadav, D.B., Ashok, Y. and Punia, S.S. (2009). Evaluton of bispyribac - sodium forweed control in transplanted rice. *Indian J. Weed Sci.,* **41**(1 & 2) : 23-27.