Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 378-382
Received: 25-07-2019
Accepted: 27-08-2019

Kabita Mishra
Scientist (Agronomy), Krishi Vigyan Kendra, Ganjam-II, Berhampur, Odisha, India

Corresponding Author:
Kabita Mishra
Scientist (Agronomy), Krishi Vigyan Kendra, Ganjam-II, Berhampur, Odisha, India

Effect of herbicide bensulfuron methyl plus pretilachlor in weed management of transplanted *kharif* rice (*Oryza sativa* L.)

Kabita Mishra

Abstract
Field study were carried out through front line demonstrations during *Kharif* season of 2017& 2018 in villages of Ganjam district i.e., Gudiapalli, Jharapadar, Putipadar in Odisha on farmers field with the active participation of farmers with an objective to evaluate the effect of herbicide Bensulfuron methyl plus pretilachlor in weed management of transplanted kharif rice. The results revealed that rice was infested with three categories of weeds *viz* grasses, broadleaved and sedges. Bensulfuron methyl at 60g /ha + Pretilachlor at 600 g/ha at 3 DAT completely controlled the grasses, broadleaved and sedges. The pre emergence application of bensulfuron methyl at 60g /ha + Pretilachlor at 600 g/ha at 3 DAT recorded weed dry weight (8.13, 21.3, 26.9 g m-2) and the weed control efficiency (74, 49.4 & 42.9%) at 30, 60 & 90 DAT respectively, which were higher than farmers practices of one hand weeding. The improved technology also produced grain yield (45.64 q ha-1) which was 11.9% higher than local check with harvest index. The same also recorded higher gross return of Rs. 72320.8 ha-1 with a benefit cost ratio of 1.74 as compared to local check. Thus, pre-emergence application of bensulfuron methyl 60g /ha + pretilachlor 600 g/ha at 3 DAT was very effective in reducing the weed biomass in transplanting rice with higher grain yield.

Keywords: Bensulfuron methyl, pre-emergence herbicide, pretilachlor, transplanted rice, weed management, yield

Introduction
Rice (*Oryza sativa* L.) is one of the most important food crops of India, contributing to about 40% of total food grain production. It plays a vital role in food security and livelihood for almost every household. The rice production in India in 2015-16 was 104.32 MT (Directorate of Economics and Statistics 2016-17). Out of the total 44 Mha area under rice cultivation, puddled rice culture occupies 56% (Anonymous, 2005) [1]. Rice (*Oryza sativa* L.) is the predominant crop of Odisha with a total coverage of 4.0 million hectare which is about 65% of the total cultivable area of the state.

In India rice is grown over 42.4 million ha area with the production of 104.4 million tons and a productivity of 2.46 tons ha-1. Low productivity of rice in India is a major concern for food and nutritional security of more than 60% population that is dependent on rice (Ram *et al*. 2014).

Weeds become detrimental to crops by changing the pH of soil, decreasing the nutrient availability, which inturn reduces straw yield by 13-38% and grain yield by 25-47% (Manandhar *et al*., 2007) [4]. Weeds pose a major threat for increasing productivity (Shilpa Sree *et al.* 2014). The average yield of rice in India is low due to several constraints. Among them weeds pose a major threat for increasing productivity. Uncontrolled weed growth caused 33-45% reduction in grain yield of rice. The weed flora of rice under transplanted condition is very much diverse and consists of sedges, grasses and broad leaf weeds causing yield reduction up to 76 percent. In wet seeded rice, the weed flora consisting of grasses such as *Echinochloa colona* L., *E. crus-galli* L. and *Cynodon dactylon; sedges* such as *Cyperus rotundus* L., *C. differmis* L. *and C. iria* and broad-leaved weeds such as *Eclipta prostrata* L., *Ammania baccifera* L., *Phyllanthus niruri* L. and *Ludwigia parviflora* were found *(*Subramanian *et al*., 2006). In lowland transplanted rice field, *Echinochloa colona and E. crus-galli* among grasses, *Cyperus rotundus, Cyperus differmis* among sedges and *Eclipta prostrata, Ammania baccifera* among broad-leaved weeds were observed by Narayanaswamy *et al*. (2006) [6]. Weeds become detrimental to crops by changing the pH of soil, decreasing the nutrient availability, which in turn reduces straw yield by 13-38% and grain yield by 25-47% (Manandhar *et al*., 2007) [4].

Herbicides like Pretilachlor applied alone are more effective against grasses, but less effective against sedges. While Bensulfuron methyl is found more effective against sedges than other weeds (Masthana Reddy *et al*. 2012) [5]. Any delay in weeding will lead to increased weed biomass which has a negative correlation with yield. Hand weeding is the traditional weed control measure in rice cultivation practices. However, due to high labour cost, non-availability of labour and time taken for manual removal, farmers are forced to decide for cheaper alternative of chemical weed control. New herbicides are now coming in the market and the use of herbicides of different chemical composition is desirable to reduce the problem of residue buildup, shift in weed flora and development of herbicide resistance in weeds. Therefore, there is a necessity that these herbicides are supplemented with hand weeding to widen weed control spectrum (Sathyapriya *et al*. 2017) [9]. Although a number of pre-emergence herbicides provide good control of grassy weeds but due to continuous use of such herbicides a shift in weed flora and evolution of herbicide resistant weeds has been observed (Rajkhowa *et al*, 2006) [8]. Hence the evaluation of new herbicide molecules for the control of wide spectrum of weed flora is imperative. Recent trend of herbicide use is to find out the effective weed control measures using low dose high efficiency herbicides which not only reduce the total volume of herbicide but also the application becomes easier and economical. In this context, herbicide Bensulfuron methyl in combination with pretilachlor were evaluated.

Bensulfuron methyl + pretilachlor is a new herbicide combination reported to provide effective control of broad-leaved weeds, sedges and grasses in rice when applied at 3 DAT. It has been found effective for complex weed flora in rice without any phytotoxic symptoms in the crop (Sunil *et al*. 2010) [13]. Use of single herbicide might be effective for only sedges or only grass or broad leaf weeds'. Bensulfuron methyl whose chemical name is "Methyl-2[[[[(4, 6-dimethoxy-pyrimidin-2-yl) amino]carbonyl] amino]sulfonyl] methyl] benzoate" has been developed for selective pre- and post-emergence control of annual and perennial weeds and sedges' Bensulfuron methyl has a unique effect on broadleaf weeds and sedges but also has adverse effect on. *Echinochloa crusgalli.*

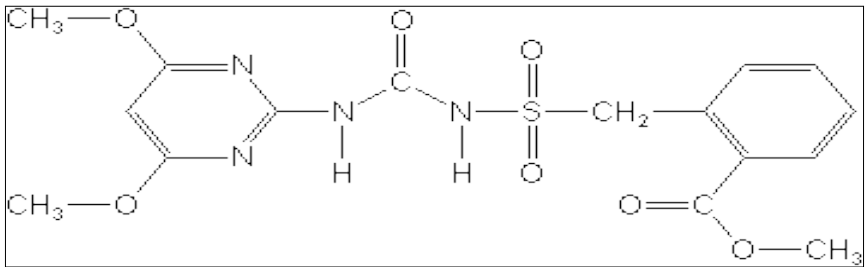

Fig 1: Bensulfuron methyl (C16H18N4O7S)

Pretilachlor ((2-chloro-N-(2, 6-diethylphenyl)-N-(2-propoxyethyl) acetamide)) has been developed recently for pre-emergence control of graminaceous weed having a high efficacy on *Echinochloa crusgalli*, but also has adverse effect on broadleaf weeds.

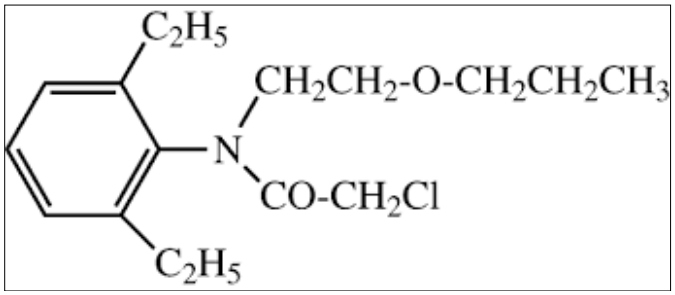

Fig 2: Pretilachlor (2-chloro-N -2', 6' -diethyl-N (2-propoxy ethyl)aceta nilide)

Bensulfuron methyl + Pretilachlor 6.60 GR (Commercial name- Londax Power) is a pre-emergence weed control product for rice. It effectively controls most important perennial and annual species Jf broad leaf weeds, grasses and sedges in transplanted and direct seeded rice'. Granular formulation of Londax power is an additional benefit to rice growers for easy dispersal in the rice puddles along with sand mix or fertilizers. So herbicide combination can make up the deficiency of single use.' Furthermore such type of herbicide mixture is almost new' perception in Odisha So to give farmers a wider choice of effective herbicide there is a need to develop environmental eco-friendly molecules of newer chemistries with different mode of action. The present study has been undertaken to evaluate the usefulness of Bensulfuron methyl + Pretilachlor 6.6oh GR for broad spectrum control of weeds for the use of farmers as and effective weed control option in rice

Materials and Methods

The study was conducted out through front line demonstration during *kharif* season of 2017 and 2018 by Krishi Vigyan Kendra, Ganjam-II in *v*illage Giria, Gudiapalli, Jharapadar, Putipadar, of Ganjam district in Odisha on farmers field with an objective to evaluate the efficacy of Bensulfuron methyl plus pretilachlor for weed management in transplanted *kharif* rice. The district of Ganjam lies in two agro climatic zones i.e. East & South Eastern coastal plain zone and North Eastern Ghat Zone of Odisha extending from $18^0$13'N to $19^0$10' North latitude to $82^0$5' to $83^0$23' East longitude. The Average Normal Rainfall of this district is 1276.2 mm and more than 75% of the precipitation is received over five months i.e. June- October. Agriculture is the primary occupation of inhabitants of this district. The maximum and minimum temperature of this district is 39^0C and 18.9^0C respectively. The soil of the study area was sandy loam in texture with slightly acidic in reaction (pH-5.2 -5.5), low in organic carbon content (0.42-0.45)%), low in available nitrogen (153.6-173.8 kg ha-1), low in phosphorus (7.15-13.6 kg ha-1) and medium in potassium (185-204 kg ha-1) content. Ten different farmers each having 0.1 hectare of land cultivated the HYV rice *cv*. Pooja with recommended package of practices. Twenty five days old seedlings of rice were transplanted in second week of July at a spacing of 20 cm x 15 cm during both the seasons of demonstration. They were supplied with herbicide (Bensulfuron methyl at 60g /ha + Pretilachlor at 600 g/ha) for

application at 3 DAT. Besides farmers practice of one hand weeding at 40 DAT was selected as local check. A weedy check plot was selected for comparison of weed control efficiencies. Rice variety (*Pooja*) was transplanted during 2nd week of July and harvested during 3rd week of November. The required quantities of herbicide were broadcasted 10 kg per hectare. Need based plant protection measures were taken up. Weed counts per m-2 was sampled randomly at ten places with the help of one square meter quadrates at 30, 60 & 90 DAT and weed dry weight per m-2 were recorded. The weeds falling in the quadrat randomly at two points from field were identified, grouped and separately counted as grasses, sedges and broad leaf weeds

The weed control efficiency was worked out through following formula:

$$WCE\ (\%) = \frac{(DWC - DWT)}{DWC} \times 100$$

Where: DWC = Dry weight of weeds under control plot; DWT = Dry weight of weeds under treated plot.

Observations on different yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Final crop yield (grain & straw) were recorded and the gross return were calculated on the basis of prevailing market price of the produce. Harvest index is the relationship between economic yield and biological yield (Gardener *et al*. 1985)

$$Harvest\ index\ (\%) = \frac{Economic\ yield}{Biological\ yield} \times 100$$

Tabular analysis involving simple statistical tools like mean was done by standard formula to analyze the data and draw conclusions and implications.

Details of Technology

Bensulfuron methyl 0.6% + Pretilachlor 6% GR) herbicide, is a pre-emergent herbicide for weed control in rice. It contains Bensulfuron methyl as an active ingredient and pretilachlor.

Bensulfuron-methyl, a member of sulfonylurea herbicides, is a broad-spectrum herbicide for the control of broadleaf-weeds and sedges in the rice fields. As a selective herbicide for direct seeding and mechanical transplanting rice fields, Bensulfuron is active at a rate as low as 30 - 70 g ai/ha and has a good herbicidal activity on most annual and perennial weeds in the rice fields. This is used as a mixture with pretilachlor, butachlor, mefenacet and other grass-killing herbicides for the effective control of grassy weeds. The mode of action by Bensulfuron-methyl is similar to other sulfonylurea herbicides. The primary site of Bensulfuron-methyl is the inhibition of ALS (acetolactate synthase) which is an important acid biosynthesis

It provides effective solution for weed control in rice by inhibiting the growth of the most important perennial, annual species of weeds namely *Echinochloa crusgalli, Echinochloa colonum* in grasses, *Cyperus iria, Cyperus difformis, Cyperus rotundus, Fimbristylis miliacea* in sedges, and *Ludwigia palviflora, Marsilea quadrifolia, Sphenoclea zeylancia, Eclipta alba, Ammania baccifera* in broad leaf weeds. The herbicide is highly selective to most varieties of Indian rice. It exhibits safety margins of 5-30 folds at recommended use rates. It gives farmers an additional benefit of easy hand dispersal in the rice puddle and enables them to protect their crop. Shekhra *et al.*, (2011) [10] found that application of Bensulfuron methyl + pretilachlor (6.6%) @ 0.06 +0.60 kg a.i/ha + one intercultivation at 40 DAT recorded significantly lower weed population and weed dry weight and higher grain yield. This was at par with Bensulfuron methyl+ pretilachlor (6.6%) @ 0.06%+0.60 kg a.i/ha

Results and Discussion

Effect on weeds

Identified weed species

The predominant weed flora observed during the study was *Digitaria sanguinalis, Cynodon dactylon;,Echinochloa colonum* among the grasses *Cyperus difformis, Cyperus iria, Cyperus rotundus* among the sedges; and *Ludwigia parviflora, Ageratum conyzoides, Cleome viscose, Ammania baccifera, Eclipta alba* among the broadleaved weeds were present as major weeds throughout the cropping period.. Similar weed species under transplanted rice were also reported by Purusottam Singh et al (2007) and Singh Mandhata and Singh (2010) [11].

Table 1: Effect of herbicide (Bensulfuron methyl plus pretilachlor) on weed density and dry weight of weeds and Weed control efficiency on transplanted rice (pooled over two years)

Practices	Weed density at			Dry weight of weeds (gm-2)			Weed control efficiency (%)		
	30 DAT	60DAT	90DAT	30 DAT	60DAT	90DAT	30 DAT	60DAT	90DAT
Bensulfuron plus pretilachlor	14.2	27.3	37.4	8.13	21.3	26.9	74	49.4	42.9
Hand weeding	22.1	34.6	61.2	10.6	24.1	36.3	66.1	42.75	33.14
Weedy check	73.4	104.2	128.6	31.3	42.1	54.3			

Table 2: Effect of herbicide (Bensulfuron methyl plus pretilachlor) on growth attributes and yield parameters of transplanted rice

Treatments	Plant height(cm)	Tillers plant^{-1}	Effective tillers plant^{-1}	No of grains/panicle
Bensulfuron plus pretilachlor	104.3	12.8	9.2	102.8
Hand weeding	98.6	10.8	7.9	96.78
Weedy check	91.4	8	5.2	93.8

Table 3: Effect of herbicide (Bensulfuron methyl plus pretilachlor) on yield of transplanted rice

Treatmenmts	Grain yield	Straw yield	HI
Bensulfuron plus pretilachlor	45.64	52.30	46.57
Hand weeding	40.8	49.68	45
Weedy check	29.32	40.61	41.92

Table 4: Effect of herbicide (Bensulfuron methyl plus pretilachlor on economics of transplanted rice

Treatmenmts	Cost of cultivation	Gross Return(Rs/ha)	Net Return(Rs/ha)	BC ratio
Bensulfuron plus pretilachlor	41632.6	72320.8	30688.2	1.74
Hand weeding	45312.2	64944	19631.8	1.43
Weedy check	38284	47161.4	8877.4	1.23

*Sale price of paddy seed Rs.1470 q-1and paddy straw Rs.100q-1 for the year 2016

Weed density

Pre-emergence application of Bensulfuron methyl 60g /ha + Pretilachlor 600 g/ha at 3 DAT recorded better weed control than hand weeding with weed density 14.2, 27.3 and 37.4 m-2 at 30, 60 and 90 DAT respectively (Table 1). This was due to application of herbicide which might have prevented the germination of susceptible weed *spp* and also reduced the growth of germinated weeds by inhibiting the process of photosynthesis (Musik, 1970]. Weedy check recorded the maximum weed density 73.4, 104.2 and 128.6 m-2 at 30, 60 and 90 DAT respectively

Weed dry weight and Weed control efficiency

The lowest weed dry weight was recorded with application of Bensulfuron methyl 60g /ha + pretilachlor 600 g/ha at 3 DAT with 8.13, 21.3 and 26.9 g m-2 at 30, 60 and 90 DAT respectively might be due to effective control of weeds during early stages of crop growth by herbicide (Table 1). Weedy check produced the maximum weed dry weight at all the crop growth stages (31.3 to 54.3g m-2) because of higher weed intensity and its dominance in utilizing the sunlight, nutrients, moisture *etc*. Similar observation was also recorded by Singh *et al* (2007).

The weed control efficiency was higher with application of Bensulfuron methyl 60g /ha + Pretilachlor 600 g/ha at 3 DAT than hand weeding which varies from 74% at 30 DAT to 42.9% at 90 DAT. This might be due to effect of weed during initial stages of crop growth with herbicide application. Singh (2012) also reported similar results.

Weed dry weight and Weed control efficiency

Effect on crop

Growth attributes and yield parameters

Minimum number of panicles m-2 was recorded in weedy check (control plots) as compared to other weed control treatments due to severe weed competition. Results of front line demonstration indicated that the improved technology of application with Bensulfuron methyl 60g /ha + Pretilachlor 600 g/ha at 3 DAT recorded maximum plant height (104.3 cm), tillers plant-1(12.8), effective tillers plant-1 (9.2) grains panicle-1(102.8) than hand weeding. Yadav *et al* (2008) also recorded similar results showing the effectiveness of herbicide for improving the yield attributing characters of rice with respect to the recommended herbicide.

Yield

Pre-emergence application of Bensulfuron methyl 60g /ha + Pretilachlor 600 g/ha at 3 DAT produced grain yield 45.64 q ha-1 which is 14.3% higher as compared to the farmers practices of one hand weeding(Table 3). This might be due to the production of higher growth and yield parameters owing to effective control of weeds in early stage which was in conformity with Earlier Reddy mastana *et al* (2012) [3] reported better performance of Bensulfuron methyl plus pretilachlor combination in controlling weeds and increasing yield in transplanted rice.

The improved practices also produced the higher straw yield (52.30 q ha-1) with harvest index (46.57%) as compared to hand weeding where straw yield was 49.68 q ha-1 and harvest index was 45%. Weedy check recorded the least grain yield (29.8 q ha-1) straw yield (49.68 q ha-1) and harvest index (41.92 q ha-1).

Economics

The pre-emergence application of Bensulfuron methyl 60g /ha + pretilachlor 600 g/ha at 3 DAT recorded the higher gross return of Rs.72320.8 ha-1 withl net return of Rs. 30688.2 ha-1 over farmers practice where in one hand weeding at 40 DAT observed the gross return of Rs 64944 ha-1 with net return of Rs 19631.8 qha-1 (Table 4). Higher B:C ratio(1.74) was found in improved technology due to higher net return as compared to farmers practice(1.43).The weedy check showed the lowest net return this was due to higher yield with use of herbicide in the early growth stage. These finding are similar with the findings of Teja *et al* (2015).

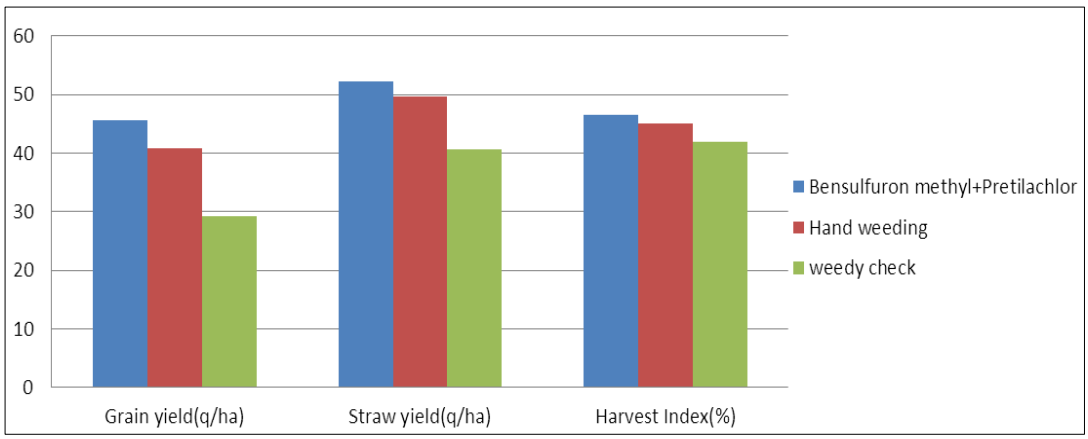

Fig 1: Effect of herbicide (Bensulfuron methyl plus pretilachlor) on yield of transplanted rice

Fig 2: Effect of herbicide (Bensulfuron methyl plus Pretilachlor) on economics of transplanted rice

Conclusion

Based on two years study it can be clearly indicated that the pre-emergence application of Bensulfuron methyl 60g /ha + pretilachlor 600 g/ha at 3 DAT was very effective in reducing the weed biomass in transplanting rice with higher grain yield and net realization. Bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha-1 suppressed all the predominant weeds throughout crop growing season and recorded higher weed control efficiency, higher grain yield. Thus, application of Bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha-1at 3 DAT may be recommended for broad spectrum weed management and higher paddy yield.

Acknowledgement

The author is thankful to the Director, ICAR-Agriculture Technology Application Research Institute (ATARI), Zone-V, KOLKATA and ICAR-Directorate of Weed Research (DWR), Jabalpur for providing support towards conducting the front line demonstration

Reference

1. Anonymous. Atlas of Rice and World. Rice Statistics, 2005. http://www.irri.org/ science/ricestat/index.asp.
2. Directorate of Economics and Statistics 2016- 2017. Directorate of Economics and Statistics DAC&FW, Department of Agriculture, Cooperation and Farmers Welfare Ministry of Agriculture and Farmers welfare, Govt. of India.
3. Gardner FP, Pearce RB, Mistecell RI. Physiology of Crop Plants, Iowa State Universit, Press, Iowa, 1985, 66.
4. Manandhar, Sailaza B, Bharat D, Shrestha and Hair Lekhak. Weeds of paddy fields at Kirtipur, Kathmanndu. Scientific World. 2007; 5(5):100-106.
5. Masthana Reddy BG, Ravishankar G, Balganvi S, Joshi VR, Negalur RK. Efficacy of Bensulfuron methyl plus pretilachlor for controlling weeds in transplanted rice. Oryza. 2012; 49(1):65-67.
6. Narayanaswamy G, S Prathap, C Raghava Reddy. Relative efficacy of herbicides on weed growth and yield of low land rice (*Oryza sativa* L.). Crop Res. 2006; 31(2):202-205.
7. Purusottam Singh, Parmeet Singh, Rekhi singh, Singh KN. Efficacy of new herbicides in transplanted rice (*Oryza sativa* L.) under temperate conditions of Kashmir. Indian J Weed Science. 2007: 39(3&4):167-171.
8. Rajkhowa DJ, Borah N, Barua IC, Deka NC. Effect of pyrazosulfuron ethyl on weeds and productivity of transplanted rice during rainy season. Indian J. Weed Sci. 2006; 38:25-28.
9. Sathyapriya R, Chinnuswamy C, Arthanari Murali P, Janaki P. Pre-emergence herbicide of oxyflorfen on weed control in transplanted rice. International Journal of Chemical studies. 2017; 5(50):271-275.
10. Shekhra *et al*. Growth and yield of Aerobic rice as influenced by integrated weed Management practices. Indian J of Weed Sci. 2011; 42(3&4):180-183.
11. Singh M, Singh RP. Influence of crop establishment methods and weed management practices on yield and economiocs of direct seeded rice (*Oryza sativa*"). Indian J Agron. 2010: 55(3):224-229.
12. Subramanian E, G James Martin, R Balasubramanian. Effect of integrated weed management practices on growth and yield of wet seeded rice (*Oryza sativa*) and their residual effect on succeeding pulse crop. Indian J. Agron. 2006; 51(2):93-96.
13. Sunil CM, Shekara BG, Kalyanamurthy KN, Shankaralingappa BC. Growth and yield of aerobic rice as influenced by integrated weed management practices. Indian Journal of Weed Science. 2010; 42(3/4):180-183.