The Pharma Innovation Journal 2022; 11(7): 555-559

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 555-559

www.thepharmajournal.com
Received: 29-05-2022
Accepted: 07-07-2022

KC Ahirwar
1. ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India
2. RMD College of Agriculture and Research Station, Ambikapur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

VK Choudhary
ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India

MP Sahu
ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India

Akhilesh Patel
ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India

VK Singh
RMD College of Agriculture and Research Station, Ambikapur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Vivek Kumar Dubey
1. ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India
2. RMD College of Agriculture and Research Station, Ambikapur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
KC Ahirwar
1. ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh, India
2. RMD College of Agriculture and Research Station, Ambikapur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Seed rate and weed management practices influences weed severity, and productivity in direct-seeded rice

KC Ahirwar, VK Choudhary, MP Sahu, Akhilesh Patel, VK Singh and Vivek Kumar Dubey

Abstract
A field experiment was conducted during *Kharif* 2021 at ICAR- Directorate of Weed Research, Jabalpur on different seed rate and weed management practices on weed severity and productivity in direct-seeded rice. The experiment was laid out in spilt plot design and replicated thrice, where main plots were assigned with four seed rate *viz,* 30, 40, 50 and 100 kg ha^{-1} and sub-plots with four weed management practices *viz*. pendimethalin 678 g ha^{-1} (2 days after sowing, DAS) followed by *(fb)* bispyribac-sodium 25 g ha^{-1} (20 DAS), pretilachlor + pyrazosulfuron 615 g ha^{-1} (2 DAS) *fb* cyhalofop + penoxsulam 135 g ha^{-1} (20 DAS), pretilachlor + pyrazosulfuron 615 g ha^{-1} (2 DAS) *fb* hand weeding (30 DAS) and weedy check. Result revealed that higher seed rate (100 kg ha^{-1}) has fewer weeds and lesser biomass hence obtained better weed suppression and it gradually decreased with lower seed rate and lowest at 30 kg ha^{-1}. Whereas grain yield was significantly ($p<0.05$) higher with, 40 kg ha^{-1} over 30 kg ha^{-1} but was comparable with 50 and 100 kg ha^{-1}. Among weed management practices, application of pretilachlor + pyrazosulfuron 615 g ha^{-1}*fb* cyhalofop+penoxsulam 135 g ha^{-1} provide broad-spectrum weed control at 30 DAS which was comparable to application of pretilachlor + pyrazosulfuron 615 g ha^{-1}*fb* hand weeding at 30 DAS and next best was pendimethalin 678 g ha^{-1}*fb* bispyribac- sodium 25 g ha^{-1}. On contrary, higher weed density and biomass with lowest grain yield was obtained under weedy check treatment. Therefore, 40 kg ha^{-1} with pretilachlor + pyrazosulfuron 615 g ha^{-1}*fb* cyhalofop+penoxsulam 135 g ha^{-1} can be adopted for better weed control and higher productivity in DSR.

Keywords: Direct seeded rice, Grain yield, Herbicide, Seed rate, Weed management

Introduction
Rice (*Oryza sativa* L.) is the main source of food, globally approximately 60% population depends on rice as a staple food, and more than 90% of cultivation and consumption of the world is in the Asia with about 162.9 million hectares (Mha) and produce about 742.4 million tonnes (Mt) of paddy rice (FAO 2017)[5]. The area for rice cultivation is insufficient; therefore, the rising demand may be fulfilled only with an enhancement in productivity with 3% annual increment (Oerke 2006; Chauhan and Johnson 2011) [7, 2]. Transplanting of rice seedlings and direct seeding are two important rice establishment methods. Transplanting has numerous advantages i.e. retention of water, fewer weeds, more yields etc but is also associated with some constraints such as formations of hardpan, damages soil structures, longer duration, more water, labourers, energy etc (Choudhary *et al.,* 2021) [13]. Keeping all the constraints in view, direct- seeded rice is being emerged as a potential alternative to avoid over-exploitation of water from the ground and maintain ecological and environmental balance (Tripathi *et al*. 2004) [11]. Although, direct-seeded rice (DSR) also has some constraints like higher seed rate and heavy weed infestation that cause severe loss in yield (Choudhary and Dixit 2021) [13].

Seed rate is the key input for any crop and has a significance on the plant geometry, competitiveness, grain and straw yield. Poor plant stand and inappropriate sowing methods are the principle agronomical constraints for obtaining higher yields (Sivaesarajah *et al.,* 1995) [10]. As plant geometry increases resulted in lesser plant population and per unit plant biomass that leads to lesser accumulation of photosynthates causes declined in yield. This was mainly due to higher competition for the resources (Choudhary *et al.,* 2021) [13].

Direct-seeded rice can saves labour and water (Choudhury *et al.* 2009) [4], early duration, less greenhouse gas emissions etc. However, DSR has constraints like heavy weed infestation and low production. Weeds are considered to be a major constraint and threat to the production and adoption of DSR (Chauhan 2012) [2]. The yield loss due to weeds in DSR has been reported as

50- 91% and some time complete crop failure (Rao *et al*., 2007) [9].

In DSR, weeds could be managed manually, but it is tedious and costlier. Therefore, chemical weed management is considered to be effective and economical. However, in some cases, continuous application of sole herbicides may lead to the development of resistance in weeds and changes in the associated weed flora. Furthermore, due to higher weed infestation in DSR, single weed control approach may be incapable to keep weeds below the economic threshold level. Thus, adoption of integrated approach is essential for weed management in DSR to get targeted yield. Therefore, application of pre-emergence (PE) herbicide prevents the simultaneous emergence of weeds with rice crop, though it has a narrow application window, efficacy also varies with the molecules and environmental conditions (Mahajan and Chauhan 2013). Since area under DSR is rapidly increasing. Rice growers need chemicals having high efficiency and selective to rice. Considering above all constraints and facts, present experiment was conducted hypothesizing seed rate and weed management can influence weed severity and rice productivity in DSR conditions.

Materials and Methods

The experiment was conducted at ICAR-Directorate of Weed Research, Jabalpur (Madhya Pradesh) situated at 23˚13' N latitude and 79˚ 58' E longitudes with an elevation of 412 m above mean sea level. The mean annual rainfall with 1208 mm with lowest monthly mean temperature of 15˚C during winter and maximum temperature of 45˚C during summer. The soil was clay loam medium in organic carbon (0.58%), neutral in reaction (pH 6.9), low in nitrogen (268 kg ha^{-1}), high in phosphorous (25.2 kg ha^{-1}) and medium in available potassium (253.0 kg ha^{-1}). The experiment was executed in split-plot and replicated thrice consisted of four seed rate *viz.* 30, 40, 50 and 100 kg ha^{-1} as main factor and four weed management practices *viz.* pendimethalin 678 g ha^{-1} (2 days after sowing, DAS) followed by (*fb)* bispyribac-sodium 25 g ha^{-1} (20 DAS), pretilachlor+pyrazosulfuron 615 g ha^{-1} (2 DAS) *fb* cyhalofop+penoxsulam 135 g ha^{-1} (20DAS),pretilachlor+Pyrazosulfuron 615 g ha^{-1} (2 DAS) *fb* hand weeding (30 DAS), IWM and weedy checkassigned as sub-factor. The recommended dose of fertilizers 100:60:40 kg N, P_2O_5 and K_2O ha^{-1} has commonly applied in the experiment through urea, (di-ammonium phosphate and murate of potash. Half dose of nitrogen with full dose of di-ammonium phosphate and murate of potash was applied as basal application at the time of sowing and leftover dose of nitrogen was applied in two equal splits i.e. ¼ at maximum tillering stage and remaining ¼ dose was at panicle initiation in all the treatments. The rice variety MTU 1010 was sown using ferti-cum-seed drill on 2nd July 2021 at a row spacing of 20 cm and harvested on 3rd November 2021. During the study, two quadrates of 0.25 m^2 (dimension, 0.5 m × 0.5 m) were placed in observation rows (either side of each plot) to count weeds. Weeds were pulled out then counted and classified into grasses, broadleaf weeds and sedges. Later, roots were cut and subjected to sun drying for three days then oven-dried at 70 ± 2˚C for 72 hrs and after constant biomass determination, and then weighted. Later, weed density and biomass were converted to 1 m^2. Weed control efficiency (WCE, %) and weed control index (WCI, %) was calculated by the formula suggested by Mani *et al.* (1973) [6] and Das (2008) [6], respectively. The grain and straw yield was recorded from 10 m^2 area and converted into hectare. Data was analysed using the OPSTAT software. The weed data was heterogeneous; to normalize them square root transformation ($\sqrt{x+0.5}$) was done, however, for better understanding original values were also given in parenthesis. The interaction between seed rate and weed management practices were found non-significant hence not elaborated.

Results and Discussion

Floristic composition and dominance of weed flora

Fifteen (15) weed species from twelve different families were recognized in weedy check plot comprising broadleaf weed (BLWs), grasses and sedges and other weeds. The major weeds BLWs were *Phyllanthus* spp., *Ageratum conyzoides* (L.), *Ludwigia parviflora* Roxb. and *Alternanthera sessilis* (L.) DC, grasses like *Dinebra retroflexa* (Vahl) Panzer and *Echinochloa* spp., and *Cyperus iria* (L.) was major sedge. Rest of weeds were classified under other weeds. Among different weed classes, the highest BLWs by 44 and 47%, grasses by 21 and 18%, and sedges by 14 and 11%, respectively, whereas other weeds contributed 21% and 24%, respectively (Figure 1 & 2). Direct-seeded rice is highly infested by composite weed flora including various grasses, BLWs and sedges Singh *et al.* (2017).

Effect on weed density and biomass

Seed rate and weed management practices significantly ($p<0.05$) influenced density and biomass of weeds in DSR (Table 1).

Table 1 exhibits that 100 kg ha^{-1} was noticed with a lower density of BLWs, grasses, sedges and total weeds (16.2, 6.3, 3.8 and 32.8 m^{-2}, respectively) and biomass (2.7, 0.9, 0.5 and 5.3 g m^{-2}, respectively). Contrarily, 30 kg ha^{-1} has the highest density (20.9, 9.4, 6.0 and 47.3 no. m^{-2}, respectively), biomass (3.8, 1.5, 0.8 and 8.2 g m^{-2}, respectively), this was followed by 40 and 50 kg ha^{-1}. This exhibits that increase in seed rate from 30 to 100 kg ha^{-1} has considerably reduced the density and biomass of all groups of weeds. Mahajan *et al.* (2006) also reported earlier that higher seed rates provided lesser space for weeds and suppressed them than the lower seed rates.

Absolute control of weeds obtained in pretilachlor+pyrazosulfuron 615 g ha^{-1}*fb* hand weeding followed by pretilachlor+pyrazosulfuron 615 g ha^{-1}*fb* cyhalofop+penoxsulam 135 g ha^{-1} plots had lowest densities of all the group of weeds (10.2, 4.0, 1.2 and 17.1 m^{-2}, respectively) and biomass (1.6, 0.3, 0.1 and 2.4 g m^{-2}, respectively). As imposition of hand weeding at 30 DAS completely eliminated the weeds, whereas sequential application of pretilachlor+pyrazosulfuron 615 g ha^{-1}*fb* cyhalofop+penoxsulam 135 g ha^{-1} and pendimethalin 678 g ha^{-1}*fb* bispyribac-sodium 25 g ha^{-1} also provided better control on all group of weeds, yet their effect was less in relation to IWM, but superior to weedy check. However, weedy check has highest density (47.8, 22.8, 15.3 and 109.0 m^{-2}, respectively) and biomass (9.03, 3.5, 2.2 and 19.4 g m^{-2}, respectively).

Effect on weed control efficiency and weed control index

Seed rate and weed management practices influences the WCE and WCI (Table 1). It was noticed that WCE and WCI gradually increased with increases in seed rate. Seeding at 100 kg ha^{-1} recorded the highest values (70.0 and 72.8%, respectively) and was followed by 40 and 50 kg ha^{-1} over seed rate of 30 kg ha^{-1}. This trend was mainly due to increase in seed rate provided lesser space to the weeds for establishment, resulted lesser density and accumulated lesser biomass. Similarly, weeds at lower seed rate (30 kg ha^{-1}) due to thin plant populations more solar radiation could transmit that might have degraded herbicides rapidly resulted in the lowest WCE and WCI.

Among weed management practices, pretilachlor+pyrazosulfuron 615 g ha^{-1} (PE) *fb* hand weeding at 30 DAS was recorded absolute WCE and WCE, mainly due to imposition of hand weeding at 30 DAS completely removed the weeds. Similarly, pretilachlor+pyrazosulfuron 615 g ha^{-1}*fb* cyhalofop+penoxsulam 135 g ha^{-1} also recorded higher WCE (83.4%) and WCI (87.5%) over weedy check. Sequential application of pre-and post- emergence herbicide provides broad- spectrum weed control resulted in lesser density and biomass. Likewise, pendimethalin 678 g ha^{-1}*fb* bispyribac sodium 25 g ha^{-1} also recorded improved WCE and WCI over weedy check but was less than pretilachlor+pyrazosulfuron 615 g ha^{-1} (PE) *fb* hand weeding at 30 DAS.

Grain and straw yield and harvest index

Grain and straw yield, and harvest index of rice under DSR affected significantly (p<0.05) by seed rate and weed management practices (Table 2).

Among seed rate, the highest grain yield was recorded with 40 kg ha^{-1} (3975 kg ha^{-1}, 40.2%, respectively) and was comparable to 50 and 100 kg ha^{-1}. Straw yield and harvest index were statistically on par with different seed rate. Although 100 kg ha^{-1} had highest straw yield mainly due to dense plant stand that contributes to produce higher straw yield. The lowest grain and straw yield, and harvest index with 30 kg ha^{-1} (3510, 5384 kg ha^{-1} and 38.6%, respectively). The higher yield in 40 kg ha^{-1} was mainly due to better growth and yield attributes that helped the plants to produce more fertile grains.

The highest grain yield and harvest index obtained in pretilachlor+pyrazosulfuron at 615 g ha^{-1}*fb* cyhalofop+penoxsulam at 135 g ha^{-1} (4612 kg ha^{-1} and 44.3%, respectively) and was close to pretilachlor+pyrazosulfuron at 615 g ha^{-1}*fb* hand weeding at 30 DAS. Straw yield was higher with application of pretilachlor+pyrazosulfuron at 615 g ha^{-1}*fb* hand weeding at 30 DAS followed by pretilachlor+pyrazosulfuron at 615 g ha^{-1}*fb* cyhalofop+penoxsulam at 135 g ha^{-1}. Grain and straw yield, and harvest index were lowest with weedy check (2149, 5237 kg ha^{-1}, and 29.0%, respectively) Application of pendimethalin 678 g ha^{-1}*fb* bispyribac-sodium 25 g ha^{-1} also recorded considerably higher grain and straw yield, and harvest index but was less than pretilachlor+pyrazosulfuron at 615 g ha^{-1}*fb* cyhalofop+penoxsulam at 135 g ha^{-1}. The higher grain, straw yield and harvest index were due to better growth and yield attributes of the plants that helped in synthesizing more grains per unit area resulting higher grain, straw yield and harvest index were recorded. Similar to our findings Choudhary and Dixit (2018) [12] also reported that sequential application of herbicides considerably reduced the weeds and obtained higher grain yield under DSR.

Acknowledgements

The author extends thanks to the Director, ICAR-Directorate of Weed Research, Jabalpur for providing all assistance to conduct this study.

Table 1: Seed rate and weed management practices influenced density and biomass of broadleaf weeds, grasses, sedges and total weed in direct-seeded rice

Treatment	Broad leaved weeds		Grasses		Sedges		Total weeds		WCE	WCI
	Density (no. m^{-2})	Biomass (g m^{-2})	Density (no. m^{-2})	Biomass (g m^{-2})	Density (no. m^{-2})	Biomass (g m^{-2})	Density (no. m^{-2})	Biomass (g m^{-2})	(%)	(%)
Seed rate (S, kg ha^{-1})										
S_1	4.01(20.9)	1.85(3.8)	2.71(9.4)	1.29(1.5)	2.20(6.0)	1.07(0.8)	5.82(47.3)	2.54(8.2)	56.7	57.5
S_2	3.59(17.3)	1.7(3.2)	2.52(8.3)	1.19(1.2)	2.1(5.6)	1.05(0.7)	5.26(39.8)	2.30(6.8)	63.6	64.9
S_3	3.46(16.3)	1.64(2.9)	2.36(7.3)	1.14(1.1)	2.01(5.2)	1.03(0.7)	4.98(36.1)	2.17(6.0)	66.9	69.1
S_4	3.44(16.2)	1.60(2.7)	2.15(6.3)	1.08(0.9)	1.69(3.8)	0.95(0.5)	4.7(32.8)	2.05(5.3)	70.0	72.8
SEm±	0.06	0.01	0.06	0.03	0.09	0.02	0.05	0.02		
CD(p=0.05)	0.20	0.05	0.21	0.10	0.31	0.06	0.18	0.08		
Weed management practices (W)										
W_1	3.62(12.8)	1.59(2.0)	2.37(5.4)	1.1(0.8)	2.09(4.0)	0.96(0.4)	5.44(29.7)	2.22(4.5)	72.8	76.7
W_2	3.24(10.2)	1.42(1.6)	1.86(4.0)	0.91(0.3)	1.24(1.2)	0.79(0.1)	4.15(17.1)	1.69(2.4)	84.3	87.5
W_3	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	100.0	100.0
W_4	6.94(47.8)	3.08(9.0)	4.81(22.8)	1.99(3.5)	3.97(15.3)	1.64(2.2)	10.45(109.1)	4.44(19.4)	0.0	0.0
SEm±	0.07	0.04	0.09	0.03	0.06	0.02	0.08	0.05		
CD(p=0.05)	0.21	0.13	0.26	0.10	0.19	0.05	0.23	0.15		
S×W	NS	NS	NS	NS	NS	NS	NS	NS		

Table 2: Seed rate and weed management practices influenced grain and straw yield and harvest index in direct-seeded rice

Treatment	Grain yield(kg ha^{-1})	Straw yield(kg ha^{-1})	Harvest index(%)
Seed rate (S, kg ha^{-1})			
S_1: 30	3510	5384	38.6
S_2: 40	3972	5690	40.2
S_3: 50	3958	5745	40.0
S_4: 100	3908	5808	39.6
SEm±	71	100	0.79
CD (p=0.05)	249	NS	NS
Weed management practices (W)			
W_1	4050	5767	41.3
W_2	4612	5791	44.3
W_3	4537	5832	43.8
W_4	2149	5237	29.0
SEm±	70.49	118.96	0.99
CD (p=0.05)	207	349.3	2.91
S×W	NS	NS	NS

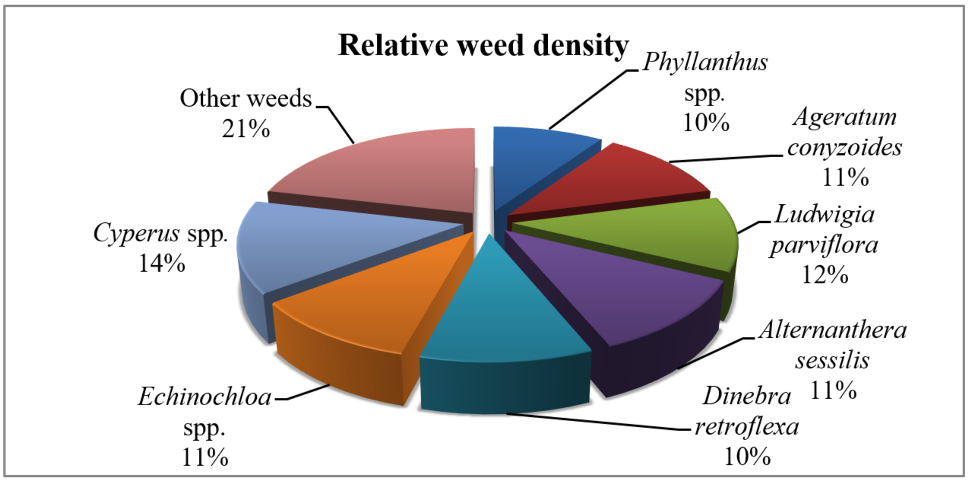

Fig1: Relative weed density

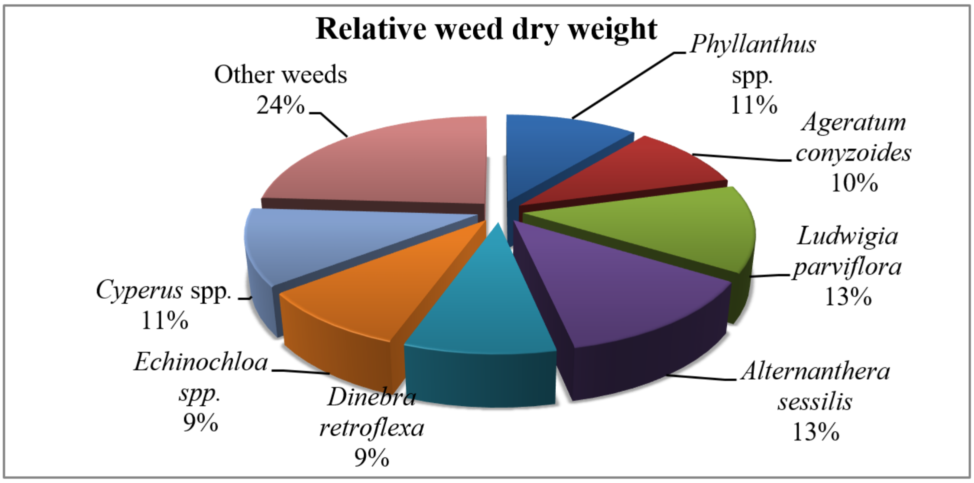

Fig 2: Relative weed biomass

References

1. Baloch MS, Hassan G, Morimoto T. Weeding techniques in transplanted and wet seeded rice in Pakistan. Weed Biology and Management. 2005;5:190-196.
2. Chauhan BS, Mahajan G, Sardana V, Timsina J, Jat ML. Productivity and sustainability of the rice–wheat cropping system in the Indo- Gangetic Plains of the Indian subcontinent:problems, opportunities, and strategies. Advances in Agronomy. 2012;117:315-369.
3. Choudhary VK, Naidu D, Dixit A. Weed prevalence and productivity of transplanted rice influences by varieties, weed management regimes and row spacing. Archives of Agronomy and Soil Science, 2021. https://doi.org/10.1080/03650340.2021.1937606.
4. Choudhury BU, Bouman BAM, Singh AK. Yield and water productivity of rice–wheat on raised beds at New Delhi, India. FieldCrops Research. 2009;100:229-239.
5. FAO. FAOSTAT database collections. Food and Agriculture Organization of the United Nations, Rome, 2017. Access date: 2017 12 17. http://faostat.fao.org.

6. Mani VS, Malla ML, Gautam KC, Das B. Weed killing chemical in potato cultivation. PANS 1973;23:17-18.
7. Oerke EC. Crop losses to pests. Journal of Agricultural Science. 2006;144(1):31-43. doi:10.1017/S0021859605005708.
8. Pathak H, Tewari AN, Sankhyan S, Dubey DS, Mina U, Singh VK,*et al*. Direct-seeded rice: Potential, performance and problems – A review. Current Advances in Agricultural Sciences. 2011;3(2):77-88.
9. Rao AN, Johnson DE, Sivaprasad B, Ladha JK, Mortimer AM. Weed management in direct seeded rice.Advances in Agronomy. 2007;93:153-255.
10. Sivaesarajah K, Sangakkara UR, Sandanam S. Effect of plant density, nitrogen and gypsum on yield parameters of groundnut (*Arachis hypogea* L.) in regosols of Batticloa district, Tropical Agriculture Research. 1995;7:112-123.
11. Tripathi J, Bhatta MR, Justice S, Sakya NK. Direct seeding-An emerging resource conserving technology for rice cultivation in rice-wheat system. Gautam AK, Akhtar T, Chaudhary B, Gaireb J and Bhatta KR (ed) Proc 24th Rice Research in Nepal summer crop workshop, 2004, Pp 273- 281, Hardinath, Baniniya, Dhanusha.
12. Choudhary VK, Dixit A. Herbicidal weed management on weed dynamics, crop growth and yield in direct seeded rice. Indian Journal of Weed Science. 2018;50(1):6-12.
13. Choudhary VK, Dixit A. Bio- efficacy of sequential herbicide application for weed management in dry direct seeded rice. Indian Journal of Agricultural Sciences. 2021;91(1):79-83.