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EFFICACY OF READY MIX OF PENOXSULAM AND CYHALOFOP - BUTYL FOR WEED CONTROL IN TRANSPLANTED RICE

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ABSTRACT

Results showed that the weed control treatments were effective in decreasing the weed density and dry matter accumulation over the weedy check (control) and improving the rice yield. Combined application of penoxsulam + cyhalofop-butyl 6% OD @ 135and 150 g/ haresulted least weed dry matter accumulation (average of two years 11.45 and 5.1 g m ^{2}, respectively) than by their alone application (average of two years penoxsulam 43.95 and cyhalofpo butyl 29.95 g m ^{2}, respectively). Highest grain yield (4792 and 6591 kg/ha for the year 2010 and 2011, respectively)was obtained with ready mix application of penoxsulam + cyhalofop-butyl 6% OD @ 135 g/ ha being at par with its higher dose applied @ 150 g/ha and was found more effective than its lower dose and standard checks pretilachlor for weed control causing substantial increase in grain yield (5.9%), higher, net return (7.13 %) and benefit: cost ratio (1.07 and 1.88 for the year 2010 and 2011, respectively). Penoxsulam + cyhalofop- butyl was found more compatible with urea 2% @150+125 g/ha comparable with 135 g/ha resulting in highest grain yield of rice during 2010 and 2011. Ready mix application of Penoxsulam + cyhalofop- butyl @ 135 and 150 g/ha may give an excellent option for the farmers for broad spectrum of weed control with single window application having compatibility with fungicide, insecticide and urea also in rice crop.

KEY WORDS
Biology
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INTRODUCTION

Rice (*Oryza sativa* L.) is the foremost staple food for more than 50% of the world's population. It is estimated that by the year 2025, the world's farmers should produce about 60% more rice than at present to meet the food demands of the expected world population at that time (Fageria, 2007). Transplanted rice favours diverse type of weed flora, consisting of grasses, broad leaved weeds and sedges. Competition offered by weeds is most important and it reduces 15-45 % of the grain yield (Chopra and Chopra, 2003) and the reduction may be upto 76 % (Singh *et al*., 2004).

Hand weeding is very easy and environment friendly but tedious and highly labour intensive. Farmers very often fail to eradicate weeds due to unavailability of labours at peak period, similarity between grassy weeds and rice seedlings make hand weeding difficult at early stages of growth. The herbicides which are popular amongst the farmers are not so effective to control every group of weeds of paddy crop. The compatibility of prevailing herbicides with fungicides, insecticides and nitrogenous fertilizers like urea which are likely to be applied in different stages of crop growth are even questionable as top dressing or spray.Among the post emergence herbicides cyhalofop butyl, bispyribac sodium and penoxsulam effectively controlled weeds in aerobic rice (Mann *et al*., 2007; Singh *et al*., 2008, Mahajan *et al*., 2009, Juraini *et al*., 2009) is of year 2009. Considering all these situations, herbicide is being considered as the most practical, effective and economical means of weed management in rice (de Datta, 1981). The use of herbicides offers selective control of weeds right from beginning, giving the crop an advantage of good crop growth and competitive superiority over weeds (Saha, 2005).

Though there are several herbicides available but still there is need to control weeds like *Leptochloa chinensis*, *Echinocloa* sp with one herbicidal spray. Under certain situations of poor weed management, need of post emergence herbicide is realized. Penoxsulam is a acetolactate synthase (ALS) inhibitor herbicide for post emergence control of annual grasses, sedges and broad leaved weeds in rice culture but it does not control *Leptochloa chinensis* (Jabuscch and Tjeerdema, 2005).

So, the present investigation was carried out with objective to find out an option for the farmers for broad spectrum of weed control with single window application having compatibility with fungicide, insecticide and urea also in rice crop.

MATERIALS AND METHODS

Field experiments were carried out at N.E. Borlaug, Crop Research Centre, G.B.P.U.A and T, Pantnagar during *kharif* 2010 and 2011 in a Randomized Block

Design with ten treatments and three replications. The study site is located in *tarai* (young alluvial soil mollisol with shallow to medium water table) belt of India and is characterized by sub humid and sub tropical climate. During 2010 and 2011, the maximum and minimum temperature were ranging 13.6-38.3 and 6.6 –36.4 ^{0}C respectively. The treatments comprised of weed free, untreated (control) and application of different herbicides at different doses viz. Penoxsulam +cyhalofop butyl 6% OD @ 105,120,135,150 g ha^{-1}, Penoxsulam 24% SC @ 22.5g ha^{-1}, Cyhalofop butyl 10% EC @ 8 g ha^{-1}, Bispyribac sodium 10% SC @ 20g ha^{-1} and Pretilachlor 50% EC @ 750g ha^{-1}. Thirty days old seedling of rice (Variety- Sarjoo52) was transplanted with spacing of 20×10cm. Post emergence herbicides penoxsulam + cyhalofop-butyl, at different doses and cyhalofop butyl were applied at 20 DAT, penoxsulam 24% SC as well as bispyribac sodium 10% SC applied at 12 DAT and pre emergence herbicide Pertilachor 50% EC was applied just one day after transplanting (DAT). To assess the compatibility of penoxsulam 2.5% OD with insecticide (Cholorpyriphos), fungicides (Carbendazim) and fertilizer (urea) the same variety was sown. The experiment was laid out in Randomized Block Design with four replications by taking four treatments viz; Penoxulam +cyhalofop-butyl 6% OD +Chloropyriphos 20 EC @ 150+125 g ha^{-1} , Penoxsulam+cyhalofop-butyl 6% OD+ Carbendazim 50 WP @ 150+125 g ha^{-1} , Penoxsulam+cyhalofop-butyl 6% OD+ urea @ 2 % and untreated check. The rice crop (Var- Sarjoo 52) was raised with recommended local package of practices.

Observations on weed density were recorded at 60 days after sowing (DAS) by randomly placing a quadrate of 50 cm×50 cm at two places in each plot. The weeds inside each quadrate were uprooted, cleaned and dried. After drying, weight and weed control efficiency was calculated by using the formula given by Patel *et al* (1987): WCE = (weed dry biomass in unwedded control– weed biomass in managed treatment)/ weed biomass in unweeded control x 100 .Yield and yield components were recorded at harvest.

RESULTS AND DISCUSSION

The major grassy weed flora of experimental field at 60 DAT consisted of *Echinochloa crusgalli* (34.5%), *Echinochloa colona* (12.3%), *Leptochloa chinensis* (2.5%), *Ischemum rugosum* (2.5%) during first year while *Leptochloa chinensis* and *I. rugosum* were not observedduring second year cropping season. Among broad leaf weeds, *Alternantherasessilis* (17.2%), *Ammania baccifera* (13.6%), *Caesulia axillaris* (2.5%) were recorded. However, among the sedges *Cyperus difformis* was observed in the experimental plots. Similar weed speciesunder transplanted rice, were also reported by Prakash *et al*., 2013 and Yadav *et al*., 2008.

The density of all the weeds were influenced significantly except *L.chinensis* and *I.rugosum* during 1st year cropping season due to various herbicidal treatments applied at 60 DAT (delayed application due to heavy rain at the time). Combined application of penoxsulam+cyhalofop-butyl 6% OD at all the doses as well as alone application of these herbicides reduced the density of *E.colona* and *E.crusgalli* significantly as compared to weedy check. Alone application of penoxsulam @ 22.5g ha^{-1} significantly reduced the density of *A.baccifera* as compared to other treatments. Alone application of cyhalofop-butyl 10% EC @ 80 g ha^{-1} as post emergence was not effective in reducing the population of *A.baccifera*. Application of penoxsulam+cyhalofop-butyl 6% OD @ 150 g ha^{-1} and bispyribac sodium @ 20 g ha^{-1} were more effective in reducing the population of *A. sessilis*

Table 1: List of herbicides used in the experiment with their family and mode of action

Active ingredient	Chemical family	Mode of action
Penoxsulam 24 % SC	Triazolopyrimidine sulfonamide	Acetolactate synthase (ALS) inhibitor
Cyhalofop-butyl 10 % EC	Aryloxyphenoxy propionate	Acetyl CoA carboxylase (ACCase inhibitor)
Bispyribac-Na 10 % EC	Pyrimidinlthio-benzoate	Acetolactate synthase (ALS) inhibitor, also called Acetohy droxyacid synthase (AHAS) inhibitor, blocks branched chain amino acid biosynthesis
Pretilachlor 23.5 % EC	Chloroacetamide	Inhibitor of synthesis of very long chain fatty acids

Present investigation was conducted to evaluate the bio-efficacy of Penoxsulam+cyhalofop-butyl 6% OD in comparison to standard penoxsulam 24% SC, cyhalofop-butyl 10% EC, bispyribac sodium 10% SC as post emergence and pretilachlor 50% EC as pre emergence in transplanted rice crop.

Table 2: Effect of treatments on weeds in transplanted rice at 60 DAT (2010)

Treatments	Dose (g ha^{-1})	Weed density (No. m^{-2}) Grassy *E.colona*	*E.Crus-galli*	*L.chinesis*	*I.rugosum*	BLWs *A.baccifera*	*C.axillaris*	*A.sessalis*	Sedges *C.difformis*	Weed dry weight(gm^{-2})
Penox.+Cyh.	105	2.0 (6.7)	0.0 (0.0)	0.0(0.0)	0.5 (1.3)	2.2 (8.0)	0.0(0.0)	2.9(17.3)	0.0 (0.0)	37.3
Penox.+Cyh.	120	0.0 (0.0)	0.0 (0.0)	0.0(0.0)	0.5 (1.3)	2.0 (6.7)	0.0(0.0)	2.7(14.7)	0.0 (0.0)	31.5
Penox.+Cyh.	135	0.0 (0.0)	0.0 (0.0)	0.0(0.0)	0.0 (0.0)	1.8 (5.3)	0.0(0.0)	2.6(13.3)	0.0 (0.0)	15.3
Penox.+Cyh.	150	0.0 (0.0)	0.0 (0.0)	0.0(0.0)	0.0 (0.0)	1.8 (5.3)	0.0(0.0)	2.4(10.7)	0.0 (0.0)	7.7
Penoxsulam	22.5	0.0 (0.0)	0.0 (0.0)	0.5(1.3)	0.0 (0.0)	1.3 (4.0)	0.0(0.0)	2.7(14.7)	0.0 (0.0)	20.5
Cyhalofop- butyl	80	2.3 (9.3)	3.3 (25.3)	0.0(0.0)	0.5 (1.3)	2.4(10.7)	1.6(4.0)	3.4(29.3)	2.9(18.7)	79.7
Bispyribac- sodium	20	0.5 (1.3)	2.3 (9.3)	1.1(2.7)	0.0 (0.0)	1.1 (2.7)	0.0(0.0)	2.7(14.7)	0.0 (0.0)	37.1
Pretilachlor	750	0.5(1.3)	2.0 (6.7)	0.7(2.7)	0.0 (0.0)	0.0 (0.0)	0.5(1.3)	4.0(53.3)	0.0 (0.0)	88.8
Untreated	-	2.7(13.3)	3.6 (37.3)	1.1(2.7)	1.1 (2.7)	2.7(14.7)	1.1(2.7)	3.0(18.7)	2.8(16.0)	182.3
Weed free	-	0.0 (0.0)	0.0 (0.0)	0.0(0.0)	0.0 (0.0)	0.0 (0.0)	0.0(0.0)	0.0 (0.0)	0.0 (0.0)	0.0
LSD (P=0.05)	-	0.7	0.3	NS	NS	0.9	0.8	0.3	0.2	31.4

Table 3: Effect of different treatment on weeds in transplanted rice at 60 DAT (2011)

Treatments	Dose (g ha^{-1})	Weed density (No. m^{-2}) Grassy *E.colona*	*E. crusgalli*	*A.baccifera*	BLW *C.axillaris*	*A.sessalis*	Sedges *C.difformis*	Weed dry weight (gm^{-2})
Penox.+Cyh.	105	0.0 (0.0)	0.0 (0.0)	3.5 (33.3)	0.0 (0.0)	2.3 (9.3)	0.0 (0.0)	12.7
Penox.+Cyh.	120	0.0 (0.0)	0.0 (0.0)	3.1 24.0)	0.0 (0.0)	1.8 (5.3)	0.0 (0.0)	8.2
Penox.+Cyh.	135	0.0 (0.0)	0.0 (0.0)	3.3 (27.0)	0.0 (0.0)	1.3 (4.0)	0.0 (0.0)	7.6
Penox.+Cyh.	150	0.0 (0.0)	0.0 (0.0)	3.4 (32.0)	0.0 (0.0)	0.5 (1.3)	0.0 (0.0)	2.5
Penoxsulam	22.5	0.0 (0.0)	0.0 (0.0)	2.5 (12.0)	0.0 (0.0)	2.0 (6.7)	0.0 (0.0)	4.1
Cyhalofop- butyl	80	1.1(2.7)	0.5 (1.3)	3.8 (44.0)	0.5 (1.3)	2.4 (10.7)	2.4 (10.7)	22.8
Bispyribac- sodium	20	0.5 (1.3)	0.0 (0.0)	3.3 (26.7)	0.0 (0.0)	0.5 (1.3)	1.3 (4.0)	2.5
Pretilachlor	750	0.5 (1.3)	0.0 (0.0)	0.0 (0.0)	0.5 (1.3)	2.6 (13.3)	0.0 (0.0)	21.2
Untreated	-	2.0 (6.7)	2.4 (10.7)	3.7 (40.0)	1.6 (4.0)	2.6 (13.3)	2.8 (16.0)	48.5
Weed free	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0
LSD (P=0.05)	-	0.8	0.5	0.5	0.7	0.9	0.7	5.0

Table 4: Effect of treatment on yield and yield attributing character of transplanted rice

Treatment	Dose (gha^{-1})	Panicles(no. m^{-2})		Grains/ panicles		1000 grain weight (g)		Grain yield (kg ha^{-1})		Straw yield(kg ha^{-1})	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Penox+Cyhalofop- butyl	105	195	187	154	180.9	21.6	23.4	4688	6372	7708	10876
Penox+Cyhalofop	120	198	197	154	181.2	22.6	24.0	4714	6512	7865	11240
Penox+Cyhalofop	135	200	204	156	184.5	23.0	24.0	4792	6591	8151	11501
Penox+Cyhalofop	150	202	204	155	192.9	22.7	24.1	4792	6552	8542	10641
Penoxsulam	22.5	200	201	157	178.5	22.8	24.7	4688	6463	8438	10771
Cyhalofop- butyl	80	167	193	151	165.3	23.4	23.4	3802	6099	7136	10980
Bispyribac- sodium	20	202	196	156	178.0	22.9	24.0	4635	6598	8021	10199
Pretilachlor	750	173	192	153	170.7	22.9	23.9	4375	6375	7448	10016
Untreated	-	155	169	146	163.1	22.6	23.4	3490	5184	6980	9052
Weed free	-	207	200	153	184.3	23.9	24.1	4792	6552	7761	12009
LSD (P=0.05)		15	9.4	NS	15.5	NS	NS	393	535	968	1382

Table 5: Effect of treatment on economics in transplanted rice

Treatment	Dose(g ha^{-1})	Total cost(x10^{3}'/ha)		Net return(x10^{3}'/ha)		Benefit: Cost ratio	
		2010	2011	2010	2011	2010	2011
Penoxsulam+Cyhalofop- butyl	105	26.659	28.659	27.929	52.309	1.05	1.83
Penoxsulam+Cyhalofop- butyl	120	26.896	28.896	28.109	53.976	1.05	1.87
Penoxsulam+Cyhalofop- butyl	135	27.133	29.133	28.938	54.869	1.07	1.88
Penoxsulam+Cyhalofop- butyl	150	27.370	29.370	29.092	53.343	1.06	1.82
Penoxsulam	22.5	26.975	28.975	28.343	52.889	1.05	1.83
Cyhalofop- butyl	80	26.600	28.600	18.556	49.469	0.70	1.73
Bispyribac- sodium	20	26.750	28.750	27.621	54.027	1.03	1.88
Pretilachlor	750	25.563	27.563	25.636	52.579	1.00	1.91
Weedy check	-	25.000	27.000	16.880	39.076	0.68	1.45
Weed free	-	27.250	29.250	28.431	54.831	1.04	1.87

compared to other herbicides. All the herbicides significantly reduced the density of *C. difformis* except the alone application of cyhalofop-butyl10 % EC (Table 2 and 3).

Weed dry matter is a better parameter to measure thecompetition than the weed number (Channappagoudar *et al*., 2013). The herbicides reduced the total weeds dry weight over control treatment (weedy check) very effectively which is manifested by their higher weed control efficiency (Koger *et al*. 2006; Singh *et al*. 2006; Mahadi *et al*., 2007; Singh *et al*., 2008). The lower dry weight of weeds in weed free check was due to complete removal of weeds whenever they emerged. The lowerweed dry weight in weed control treatments may be ascribedto lesser number of weeds, rapid depletion of carbohydratereserves of weeds through rapid respiration (Hill

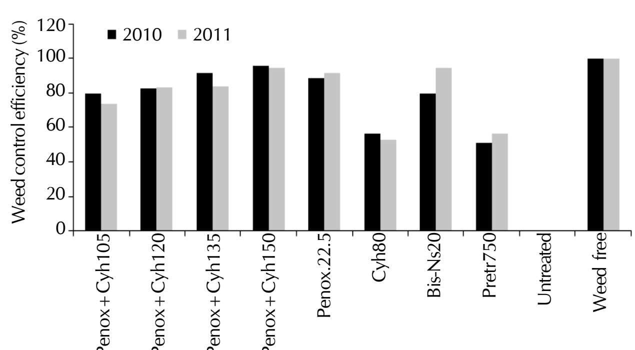

Figure 1: Effect of different treatment on weed control efficiency at 60 DAT

Table 6: Compatibility of penoxsulam + cyhalofop butyl with insecticide, fungicide and urea and their effect on weed species and total dry weight at 60DAT in transplanted rice (2010)

Treatments	Dose(g ha^{-1})	*E. colona*	*E.crusgalli*	*L.chinensis*	*C.axillaris*	*E. alba*	*A. baccifera*	Total Weed Dry weight(g/m^2)
Penoxsulam+Cyhalofop-butyl+ Chloropyriphos	150+125	(0.9)2.0	(1.2)3.5	(0.0)0.0	(0.5)1.0	(0.3)0.5	(2.4)10.0	14.9
Penoxsulam+Cyhalofop-butyl+ Carbendazim	150+125	(0.7)1.5	(0.9)3.0	(0.0)0.0	(0.3)0.5	(0.5)1.0	(2.5)11.0	18.1
Penoxsulam+Cyhalofop-butyl+2% Urea	150+2%	(0.8)2.0	(1.2)3.5	(0.0)0.0	(0.3)0.5	(0.3)0.5	(2.3)9.0	15.9
Untreated	-	(2.5)11.0	(3.3)26.0	(1.5)3.5	(1.7)4.5	(1.8)5.0	(2.9)19.0	126.4

Table 7: Compatibility of penoxsulam + cyhalofopbutyl with insecticide, fungicide and urea and their effect on weed species and total dry weight at 60DAT in transplanted rice (2011)

Treatments	Dose(g ha^{-1})	*E.colona*	*E.crusgalli*	*L.chinensis*	*C.axillaris*	*E.alba*	*A.baccifera*	Total Weed dry weight(g/m^2)
Penoxsulam+Cyhalofop-butyl+Chloropyriphos	150+125	1.39 (3.0)	1.4 (3.0)	0.5 (1.0)	0.8 (1.5)	0.8 (1.5)	2.3 (9.0)	13.0
Penoxsulam+Cyhalofop-butyl+Carbendazim	150+125	1.2 (2.5)	1.1 (2.5)	0.3 (0.5)	0.5 (1.0)	0.8 (1.5)	2.2 (8.5)	15.5
Penoxsulam+Cyhalofop-butyl+2% Urea	150+2%	1.1 (2.5)	1.4 (3.0)	0.5 (1.0)	0.5 (1.0)	0.5 (1.0)	2.1 (7.5)	16.1
Untreated	-	2.4 (10.0)	3.1 (22.0)	1.7 (5.0)	1.8 (5.5)	1.9 (6.0)	2.9 (18.0)	112.6

Table 8: Compatability of penoxsulam + cyhalofop butyl with insecticide, fungicide and urea 2% and their effect on yield and yield attributesin transplanted rice

Treatments	Dose(g ha^{-1})	Panicles(no. m^{-2})		Grains / panicles		1000 grain weight(g)		Grain yield(kg ha^{-1})		Straw yield (kg ha^{-1})	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Penoxsulam+Cyhalofop-butyl+Chloropyriphos	150+125	191	192	106	107	22.7	23.7	4425	4625	8519	8520
Penoxsulam+Cyhalofop-butyl+ Carbendazim	150+125	192	194	105	106	22.7	23.7	4446	4649	8493	8690
Penoxsulam+Cyhalofop-butyl+2% Urea	150+2%	193	195	106	107	23.1	22.2	4489	4789	8589	8790
Untreated	-	161	170	93	95	22.6	21.6	4115	4217	7562	7661

and Santlemann, 1969). Significantly lower weed dry matter accumulation was found with application of penoxsulam+cyhalofop-butyl 6% OD @ 150 g a.i. ha^{-1}(Table 2 and 3) due to elimination of both the grassy and non grassy weeds resulting in maximum weed control efficiency followed by application of same herbicides combination applied @ 135 g a.i. ha^{-1}(Fig. 1). Weed control efficiency is a measure of the efficiency of weed control methods in restricting the weed growth. Lower weed control efficiency among herbicide treatments was noticed with pre emergence application of pretilachlor @ 750 g/ha during 2010 while in 2011 it was with cyhalafop-butyl @ 80 g/ha. The lower weed control efficiency was due to poor control of weeds as a result recordedhigher weed population and their dry weight.

The yield and yield attributing characters were influenced significantly due to various herbicidal treatments except test weight. All the herbicidal treatments resulted in significantly more number of panicles, grains per panicle and grain yield over the weedy check. Among the herbicidal treatments, ready mix application of Penoxsulam+cyhalofop-butyl @ 150 g ha^{-1}gavehighestnumber of panicles (no. m^{-2}) and grains per panicle. All the weed control treatments produced significantly higher yield attributes than unweeded control plot. The highest grain yield was recorded under the combined application penoxsulam+cyhalofop-butyl 6% OD @ 135 g ha $^{-1}$of being at par with its higher dose applied @ 150 g/ha. Unweeded control had recorded significantly lowest grain as well as straw yield *i.e.* 3490 and 6980 kg/ha during 2010 and 5184 and 9052 kg/ha during 2011, respectively. The increase in crop yield was due to increase in number of panicles owing to decrease in crop- weed competition and higher weed control efficiency (Table 4). Among the alone application of herbicides, penoxsulam @ 22.5 g/ha recorded the highest grain yield of rice as compared to other herbicides. Higher efficacy of penoxsulam in controlling weedsand increased rice grain yield was also reported by Bond *et al.*, 2007 and Mishra *et al.*, 2007.

The effectiveness of any production system is ultimately evaluated on the basis of its economics. Economic analysis is the basic consideration in determining which treatment gives the highest return. A perusal of data revealed that there was an overall increase in net income in different weed control treatments over the control (Table 5). This indicates that with appropriate weed control, TPR production can be a profitable venture. Among the different herbicides, the highest net return, net field benefit and BCR (benefit: cost ratio) were recorded with ready mix application of penoxsulam + cyhalofop- butyl @ 135 g/ha which was comparable with its higher dose applied @ 150 g/ha and both of them were higher with rest of the weed management practices (Table 6). These results were due to higher grain yield of transplanted rice in these treatments. Weedy check had lowest BCR and net returns which depicted TPR to be unprofitable without effective weed control. This concluded that use of herbicides was an efficient and cost-effective method for weed control in TPR.

The herbicide was also tested against its compatibility with insecticide, fungicide and urea. Among the tested mixtures, penoxsulam + cyhalofop- butyl was found to be more compatible with carbendazim 50 % WP @ 150 + 125 g ha^{-1} towards the density of *E. colona* and *E. crusgalli* during first year cropping season and towards *L. chinensis* over weedy check and no phytotoxicity symptoms were observed on rice crop (Table 6). Penoxsulam + cyhalofop- butyl 6 % OD along with urea @ 2 % was found effective in arresting *A. baccifera* population and their growth during first year while against the population of *E. colona* and *E. alba* during second year. No population of *L. chinensis* was recorded in all the treatments. This may be attributed to the compatible nature of penoxsulam + cyhalofop- butyl 6% OD with fungicide, insecticide and urea.

During both the years, significant reduction in dry weight of weeds was brought about by different treatment over the weedy check. However compatibility of penoxsulam + cyhalofop butyl 6 % OD with chlorpyriphos 20 EC @ 150 + 125 g ha^{-1} recorded the least total dry weight of weeds (Table 6 and 7).

Among the different treatments, penoxsulam + cyhalofop-butyl 6% OD was found compatible with urea 2% @ 150 + 125 g ai ha^{-1}, increased the number of panicles m^{-2} and grain per panicle as compared to weedy check. The highest yield attributes under these treatments were attributed to lower weed density & their dry weight. The maximum grain and straw yield was obtained under the combination of penoxsulum + cyhalofop-butyl 6% OD with urea @ 150 + 2% and the lowest was obtained with the application of penoxsulam + cyhalofop-butyl along with chloropyriphos @ 150 + 125 g/ha. This differential response might be due to difference in nature of weeds, herbicides, insecticides, pesticides, fertilizer or environmental conditions (Chhokar *et al*., 2013) (Table 6, 7 and 8).

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