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Sai Kumar Midde
Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Pronitha Chettri
Assistant Professor, Department of Agronomy, Doon PG College of Agriculture and Allied Sciences, Dehradun, Uttarakhand, India

Vikram Sai Mattepally
Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Kalyan Kumar BV
PG Scholar, Department of Agronomy, Doon PG College of Agriculture and Allied Sciences, Dehradun, Uttarakhand, India

Maheswara Reddy
Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Corresponding Author:
Sai Kumar Midde
Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Effect of weed management practices on weed dynamics and yield attributes under system of rice intensification

Sai Kumar Midde, Pronitha Chettri, Vikram Sai Mattepally, Kalyan Kumar BV and Maheswara Reddy

Abstract
An experiment was conducted at experimental research farm Rampur, Doon PG College of Agriculture and Allied Sciences, during the Kharif season 2016-17 to study the effect of different weed management practices on weed population and Yield attributes under the system of rice intensification. The experiment was laid out in Randomized block design which comprises of nine treatments and was replicated thrice *viz*., Weedy check (W_1), Hand weeding (20 & 40 DAT) (W_2), Cono weeding (20 & 40 DAT) (W_3), Butachlor @ 1.5 kg ha^{-1} (Pre-emergence) (W_4), Pretilachlor @ 0.5 kg ha^{-1} (Pre-emergence) (W_5), Butachlor @ 1.5 kg ha^{-1} + Hand weeding at 30 DAT (W_6), Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding at 30 DAT (W_7), Butachlor @ 1.5 kg ha^{-1} + Cono weeding at 30 DAT (W_8), Pretilachlor @ 0.5 kg ha^{-1} + Cono weeding at 30 DAT (W_9). Rice variety "PS 5" was used as a test crop. The study reveals that the lowest weed density and highest yield attributes were found in Hand weeding twice (20 & 40 DAT), which is on par with Pretilachlor in conjunction with Hand weeding 30 DAT. Due to high laborious requirements and expensive Hand weeding, twice is economically not feasible compared with the Pre-emergence application of Pretilachlor in conjunction with Hand weeding (30 DAT).

Keywords: Hand weeding, cono weeding, pretilachlor, butachlor

Introduction
In terms of area, India is the leading rice-producing country, and it is the second-largest producer after China. As per the 2nd Advance estimates of Agriculture crops 2021-22, rice production accounts for 127.93 million tonnes in India (Anonymous, 2022) [1]. Production is not expanding at the same rate as demand as the supply-demand ratio rises. The primary causes of low productivity and profitability are inefficient water usage and traditional farming techniques. To improve resource usage efficiency, rice intensification was supported as a resource management method in rice production that may give the chance to increase rice yields with less external inputs (Uphoff and Randriamiharisoa, 2002) [9].
The emergence of weed will be very high in the rice fields when it is in unflooded condition. During the initial growth phases of crop growth, weed affects the growth of the crop, and finally, it reduces the crop's yield (Jacob and Syriac, 2005) [4]. Effective control of weeds augmented the grain yield by 85.5% (Mukherjee and Singh, 2005) [5]. About 60% of weeds emerge during 7 to 30 days after transplanting and severely compete with rice plants up to tillering stage. Selective and economical control of weeds by herbicides enhances the growth of the crop by decreasing the weed population (Saha, 2005) [8]. Preemergence herbicides like butachlor, Pretilachlor, and Anilofos control the weeds during the early growth of the crop. These herbicides are effective and specific against a narrow range of weed species (Narayan *et al.*, 1999) [6]. In view of the above considerations, the current study was carried out on the Effect of Weed Management Practices on Weed Population and yield Attributes under the System of Rice Intensification.

Materials and Methods
An experiment was conducted during the Kharif season of 2016 in Doon (PG) College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun (Uttarakhand), situated at 30° N latitude, 77.8° E longitude at an altitude of 682.58 m above the mean sea level in the Tarai belt of Shivalik range of Himalayan foothills. This experiment was conducted with nine treatments Weedy check (W_1), Hand weeding (20 & 40 DAT) (W_2), Cono weeding (20 & 40 DAT) (W_3),

Butachlor @ 1.5 kg ha^{-1} (Pre-emergence) (W_4), Pretilachlor @ 0.5 kg ha^{-1} (Pre-emergence) (W_5), Butachlor @ 1.5 kg ha^{-1} + Hand weeding at 30 DAT (W_6), Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding at 30 DAT (W_7), Butachlor @ 1.5 kg ha^{-1} + Cono weeding at 30 DAT (W_8), Pretilachlor @ 0.5 kg ha^{-1} + Cono weeding at 30 DAT (W_9) laid out in Randomized Block design (RBD) with three replications. Sand mix application of pretilachlor and butachlor were applied on 3rd DAT, cono weeding was practiced twice at 20 and 40 DAT. The grain yield was recorded at 14% moisture level while the straw was sundried for three days, the weight of grain and straw yield were recorded and expressed in kg ha-1. The data obtained under study were analyzed by the method of analysis of variance as described by Gomez and Gomez (1984) [3].

Results and Discussion

Weed flora

Among the Grassy weeds, Echinochloa colonum (30.7%) and Cyanodon dactylon (26.6%) were found in the field experiment. In contrast, Cyperus rotundus (16%), Cyperus iria (12%) among sedges and Ageratum conyzoides (9%), Celosia argentia (6%) among broadleaf weeds were the most dominant weeds found in the field.

Weed Density (No/m^2)

The extent of reduction in weed density varied significantly contingent upon management practices espoused. The data shows that Hand weeding twice at 20 & 40 DAT recorded the lowest weed density, which was on par with the Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding at 30 DAT (Table 1), which may be due to effectual control of weed seed germination in the initial stages of crop growth by pretilachlor + safener (Subramanian, 2003) [7]. The highest weed density was found in the Weedy check plot. One supplementary Hand weeding beside with herbicide application moreover had an advantage over the treatments of herbicide alone. Better weed management under chemical, cultural integration was because soil application of herbicide inhibited weed germination during initial crop growth stages and later emerged weeds were eliminated by Hand weeding.

Table 1: Effect of Weed Management practices on total weed density (No /m^2) of grasses, sedges and broad leaf weeds and weed control efficiency at 30 & 60 DAT

Treatments	Grasses		Sedges		Broadleaf weeds		Total Weed density	
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
Weedy Check	4.49 (19.72)	4.86 (23.41)	4.10 (16.36)	4.18 (17.04)	3.18 (9.67)	3.73 (13.48)	11.77 (45.75)	12.77 (53.93)
Hand weeding (20 & 40 DAT)	0.31 (0.90)	1.28 (1.14)	0.92 (0.34)	1.25 (1.06)	0.87 (0.25)	1.25 (1.05)	2.10 (1.49)	3.78 (3.25)
Cono weeding (20 & 40 DAT)	2.04 (3.68)	3.18 (9.64)	1.94 (3.28)	2.89 (7.89)	1.90 (3.14)	2.54 (5.98)	5.88 (10.10)	8.61 (23.51)
Butachlor @ 1.5 kg ha^{-1} (PE)	2.84 (7.59)	4.32 (18.26)	2.71 (6.89)	3.75 (13.89)	2.60 (6.28)	3.28 (10.26)	8.15 (20.76)	11.35 (42.41)
Pretilachlor @ 0.5 kg ha^{-1} (PE)	2.41 (5.34)	3.78 (13.84)	2.29 (4.78)	3.32 (10.61)	2.25 (4.58)	2.89 (7.91)	7.38 (16.95)	9.99 (32.36)
Butachlor @ 1.5 kg ha^{-1} + Hand weeding	1.26 (1.09)	1.94 (3.26)	1.24 (1.04)	1.88 (3.05)	1.21 (0.98)	1.73 (2.48)	3.71 (3.11)	5.55 (8.79)
Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding	0.94 (0.38)	1.40 (1.46)	0.96 (0.42)	1.44 (1.57)	0.90 (0.31)	1.36 (1.36)	2.80 (1.11)	4.20 (4.39)
Butachlor @ 1.5 kg ha^{-1} + Cono weeding	1.96 (3.36)	3.07 (8.97)	1.85 (2.92)	2.74 (7.05)	1.81 (2.79)	2.45 (5.51)	5.62 (9.07)	8.26 (21.53)
Pretilachlor @ 0.5 kg ha^{-1} + Cono weeding	1.61 (2.08)	2.48 (5.69)	1.54 (1.87)	2.33 (4.94)	1.53 (1.84)	2.09 (3.89)	4.68 (5.79)	6.90 (14.52)
S.Ed	0.15	0.24	0.13	0.18	0.11	0.16	0.31	0.49
C.D (P=0.05)	0.33	0.50	0.27	0.39	0.24	0.34	0.65	1.04

Weed Control Efficiency (%): Among the various treatments, weed control efficiency was highest in Hand weeding twice (95%), followed by treatment Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding at 30 DAT (94%) (Table 2). The lowest weed control efficiency was found in the weedy check abide by Butachlor @ 1.5 kg ha^{-1} alone treatment. The observations showed that when we integrate chemical with physical methods of control shows the best results.

Table 2: Effect of Weed Management practices on Weed Control Efficiency (%)

Treatments	Weed Control Efficiency (%) at 60 DAT
Weedy Check	0.0
Hand weeding (20 & 40 DAT)	94
Cono weeding (20 & 40 DAT)	56
Butachlor @ 1.5 kg ha^{-1} (PE)	21
Pretilachlor @ 0.5 kg ha^{-1} (PE)	40
Butachlor @ 1.5 kg ha^{-1} + Hand weeding	84
Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding	92
Butachlor @ 1.5 kg ha^{-1} + Cono weeding	60
Pretilachlor @ 0.5 kg ha^{-1} + Cono weeding	73
S.Ed	-
C.D (P=0.05)	-

Effect on Yield and Yield Attributes

All the weed control treatments substantially increased the No of grains Panicle^{-1} & no of Panicles hill^{-1} compared with weedy check. The highest no of Panicles hill^{-1} and grains Panicle^{-1} were found in Hand weeding twice (20 & 40 DAT) (22.48 & 226.75), which was on par with Pretilachlor @ 0.5 kg ha^{-1} along with Hand weeding (30 DAT) (21.96 & 220.61) (Table 3). Similar results were stated by Parthipan *et al.*, (2013) [7].

Grain and straw yields were high in the treatment that underwent hand weeding twice, and they were equivalent to Pretilachlor @ 0.5 kg ha^{-1} when accompanied with hand weeding at 30 DAT (6364 kg ha^{-1} & 10182 kg ha^{-1}). It is most likely related to lower weed density and improved weed control efficiency and a lower nutrient loss by weeds due to a reduction in crop weed competition, compared to un weeded control, the yield increase was about 48.94% in the treatment that included pretilachlor with hand weeding, which is comparable to hand weeding twice.

Table 3: Effect of Weed Management practices on Yield attributes

Treatments	No of Panicles	Panicle length (cm)	No of filled grains panicle^{-1}	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Weedy Check	10.0	16.08	149.79	3249	5198
Hand weeding (20 & 40 DAT)	17.40	22.48	226.75	6419	10271
Cono weeding (20 & 40 DAT)	14.49	18.96	188.32	4689	7503
Butachlor @ 1.5 kg ha^{-1} (PE)	13.09	17.01	170.04	3852	6163
Pretilachlor @ 0.5 kg ha^{-1} (PE)	13.80	17.94	179.87	4337	6939
Butachlor @ 1.5 kg ha^{-1} + Hand weeding	16.02	20.61	208.94	5945	9512
Pretilachlor @ 0.5 kg ha^{-1} + Hand weeding	16.99	21.96	220.61	6364	10182
Butachlor @ 1.5 kg ha^{-1} + Cono weeding	15.19	19.54	196.85	5108	8174
Pretilachlor @ 0.5 kg ha^{-1} + Cono weeding	15.31	19.77	199.86	5526	8842
S.Ed	0.29	0.38	3.82	184.24	264.82
C.D (P=0.05)	0.62	0.80	8.09	390.58	561.39

Conclusion

The study shows that Hand weeding twice (20 & 40 DAT), which is being on par with the Pre-emergence application of Pretilachlor along with Hand weeding at 30 DAT, showed the best results. Thereby it resulted in an increase in the grain and straw yield by decreasing the weed population. Whereas Hand weeding twice (20 & 40 DAT) is expensive and time-consuming based on economical aspect and feasibility, Pre-emergence application of Pretilachlor conjunction with Hand weeding at 30 DAT is economically feasible and effective.

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Conflict of Interest

The authors have declared no conflict of interest

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