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To discuss the effect of various type of weed control practices on crop growth and yield of upland rice

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Abstract
In the present work The object of experiment is to "study the efficacy of different weed control methods and to evaluate the most suitable and economical weed management practice for controlling weeds in upland rice adopted to achieve different agronomic practices" weed management practices with it included seed treatment, fertilizer scheduling and intercropping along its include achieve to for avoidance of weed occurrence, suppression of weed growth and enhancement of crop-competitive ability against weed. The experiment was laid out in randomized bock design was experiment with three replications and nine treatments. The net plot size was 3.50 x 2.60 m.sq. The experimental soil was slightly alkaline with sandy clay loam texture.

Weed population at 60 DAS and at harvest to dry matter were significantly lower in weed free check followed by two hand weeding at 20 and 40 DAS, respectively. It was followed by butachlor pre-emergence application 50% EC @ 1.25 kg a.i. per ha + hand wedding at 40 DAS. Maximum dry matter of weed and weedy check observed in weed population. The measured growth of rice in terms of height, number of functional leaves, leaf area plant^{-1} and dry mater accumulation per plant was favorably influenced by weed free check and 20 and 40 DAS at two hand weeding. It was followed by application pre-emergence of butachlor 50% EC @ 1.25 kg a.i. per ha + hand wedding at 40 DAS. Similarly trend was observed in contributory character namely respect of yield, Number of panicles per m, sq. Number of grains per panicles, Grain weight per plant and 1000 grain weight i.e. test weight (g).

The highest in weedy check treatment was NPK uptake by weeds (9.05, 3.18and 11.27 kg NPK per ha respectively.) and weed free treatments lowest in (1.62, 0.407 and 1.687 kg NPK per ha respectively). It was followed by two hand weeding at 20 DAS & 40 DAS respectively (1.41, 0.537 and 2.160 kg NPK per ha respectively) followed by pre-emergence application of butachlor 50% EC @ 1.25 kg a.i. per ha + hand wedding at 40 DAS (2.16, 0.66 and 2.53 kg NPK per ha respectively.) The weed free check maximum gross monetary return was observed in (Rs.126378 per ha) followed by two hand weeding at 20 DAS & 40 DAS, respectively (Rs.120778 per ha).

Keywords: Weed management, dry matter, hand weeding, application, treatment, weed intensity

Introduction
Rice is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planet's human population. In world, rice has occupied an area of 156.7 million hectares, with a total production of 650.2 million tonnes in 2007 (FAO, 2008). In Asian countries, rice is the main major staple crop covering about ninety per cent of rice grown in the world, with two countries, China and India, growing more than half of the total crop. India the second largest producer after China has an area of over 43.77million hectare under rice and production 96.43 million tonnes of rice in 2008 (Viraktamath and Shobharani, 2009). Rice being the main source of livelihood for more than 120 – 150 million rural household is the backbone of the Indian Agriculture. It occupies about 23.3 per cent of the food grain production and 55 per cent of cereal production.

Rice is the major *Kharif* crop of India covering 43.38 million ha area and amounting to 93.88 million tonnes of production (Anonymous, 2015-16). The conventional system of rice production *i.e.* transplanting under puddled conditions (CT-TPR) is mainly followed by farmers.

Rice is cultivated in India in a very wide range of ecosystems from irrigated to shallow low lands, mid-deep lowlands, deep water to uplands.

Direct-seeding constitutes both wet- and dry seeding and it does away with the need for seedlings, nursery preparation, uprooting of seedlings and transplanting. Upland rice, which is mostly dry-seeded, is found in parts of Assam, Bihar, Chhattisgarh, Gujarat, Jharkhand, Kerala, Karnataka, Uttarakhand, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal. The upland rice area is about 5.5 million hectares which accounts to 12.33% of the total rice area of the country. Wet-seeded rice (WSR) area is increasing in the parts of Andhra Pradesh, Punjab and Haryana. In the rice agro-ecosystems ideal environment conditions are provided for optimal rice productivity are being exploited by the associated weeds.

Weeds are responsible for heavy rice yield losses, to the extent of complete crop loss under extreme conditions. Out of the losses due to various biotic stresses, weeds are known to account for nearly one third. Weed competition would be less severe under transplanting than those under direct-seeding. Uncontrolled weeds reduced the grain yield by 75.8%, 70.6% and 62.6% under dry-seeded rice (DSR), wet seeded rice (WSR) and transplanted rice (TPR) respectively (Singh *et al*., 2005) [5]. Experiments showed that yields were comparable across all establishment methods of rice when competition from weeds was removed. Thus, weed control is major pre-requisite for improving rice productivity and production using different methods of rice establishment.

The agricultural growth rate has slowed down (2013-2014 reported less than 2%) in India (Government of India, 2010 Therefore it is needed to produce additional rice production to meet the demand of growing population. Thus weed management would continue to play a key role to meet the growing food demands of increasing population in India. As the weed problems are multi-pronged, a holistic multi-disciplinary integrated approach would be imperative. In this context, integrated weed management (IWM) may provide a more sustainable approach to rice production.

Material and Method

A field experiment was conducted investigate study the efficacy of different weed control methods and to evaluate the most suitable and economical weed management practice for controlling weeds in upland rice adopted to achieve different agronomic practices"

Material

1. Experimental site

The field experiment was carried out during *Kharif* season of 2016 at the Agronomy Farm, College of B.F.I.T, Suddhuwala, Dehradun.

2. Soil of the experimental field

The soil was vertisol (medium black) in nature and about one metre deep with good drainage. The topography of experimental field was fairly uniform and levelled. The collected Soil samples from 0-15 cm depth and 15 randomly selected spots in the experimental area.

3. Climate and Weather condition during crop period

Climatic Study in suddhuwala, dehradun shivalik is classified as slightly moist cool zone. college Suddhuwala, Dehradun lies in the *Tarai* region to the south of foot hills of the Shivalik Himalayas at 29* N latitude, 79.23*E longitude and at an altitude of 243.8 m above mean sea level. The average annual rainfall of dehradun is 1057mm out of which 80 per cent receive from south west monsoon in June to September while rest of rainfall receive in the month of October and November from north west monsoon. The meteorological data of rainfall, temperature, relative humidity, sunshine and potential evapo-transpiration (PET) from July 2016 to November 2016 are furnished in table

M.W. No.	Month	Period	Temp. 0 c		R.H. (%)		Evap (mm/Day)	R.F. mm	Rainy days
			Max	Min.	Morn.	Even.			
24	June	10/06 to 16/06	27.2	21.4	89	81	6.5	20.5	1
25		17/06 to 23/06	26.2	20.2	90	82	5.5	55.2	2
26		24/06 to 30/06	25.7	20.5	92	72	4.3	100.5	4
Average			26.3	20.7	90.3	78.3	5.4		
27	July-Aug	01/07 to 07/07	25.6	21.9	96	82	3.2	157.6	6
28		08/07 to 14/07	24.8	20.6	95	91	4.1	105.8	6
29		15/07 to 21/07	24.7	20.5	96	92	2.9	160.5	6
30		22/07 to 28/07	24.6	20.4	97	90	2.8	165.5	7
31		29/07 to 04/08	25.3	20.7	94	88	3.9	162.5	6
Average			25.0	20.8	95.6	88.6	3.3		
32	Aug-Sep	05/08 to 11/08	27.1	17.5	93	78	3.5	150.5	5
33		12/08 to 18/08	24.6	20.6	92	80	3.8	105.5	4
34		19/08 to 25/08	26.8	20.2	90	74	3.9	115.5	5
35		26/08 to 01/09	27.2	19.8	88	64	3.7	120.6	5
Average			26.4	19.5	90.7	74	3.7		
36	Sep	02/09 to 08/09	29.2	19.6	84	63	3.8	100.8	3
37		09/09 to 15/09	29.4	21.8	89	71	3.6	125.5	4
38		16/09 to 22/09	27.3	21.7	87	81	4.6	60.6	2
39		23/09 to 29/09	28.3	19.7	86	72	5.1	45.5	2
Average			28.5	20.7	86.5	71.7	4.2		
40	Oct-Nov	30/09 to 06/10	30.7	20.3	84	67	6.2	22.6	2
41		07/10 to 13/10	31.7	22.5	80	59	8.9	20.5	1
42		14/10 to 20/10	31.6	21.6	78	49	8.5	5.7	0
43		21/10 to 27/10	31.4	20.9	85	48	8.6	25.5	2
44		28/10 to 03/11	32.3	21.5	79	47	7.5	0.0	0
Average			31.5	21.3	81.2	54	7.9		
45	Nov	04/11 to 10/11	31.2	22.5	78	46	6.5	0.0	0
Average			31.2	22.5	78	46	6.5		
		Total						1826.9	77

The rainfall distribution was normal up to first week of September In general, the climatic conditions were quite favorable for the growth of paddy crop.

Methods

The experimental detail in along with symbols used and layout of plan are as given in

Field Preparation

Field preparation was made by cross ploughing of tractor-drawn cultivator followed by planking. After this, the experiment layout was done.

Treatment Details

T_1: Weedy check
T_2: Pendimethalin @ 1.0 kg a.i. per ha as pre emergence + Hand weeding at 40 DAS
T_3: Butachlor 50% EC @ 1.25 Kg a.i. per ha as preemergence + Hand weeding at 40 DAS
T_4: Pendimethalin @ 1.0 Kg a.i. per ha as preemergence + 2,4 D (Sodium salt) @1.0 kg a.i. per ha. at 30 DAS
T_5: Hand weeding at 20 DAS + 2, 4-D (Sodium salt) @1.0Kg a.i. per ha at 30 DAS
T_6: Hoeing at 20 DAS + hand weeding at 30 DAS
T_7: Hand weeding at 20 DAS + Hoeing at 40 DAS
T_8: Two hand weedings at 20 DAS & 40 DAS respectively
T9: Weed Free check (3 weedings at 20,40 and 60 DAS)

Note: Where as

1. DAS: Days After Sowing
2. A.I.: Active Ingredient

The experiment was laid out in Randomized Block Design with three replications and nine treatments. In Replications-Three, Treatment –Nine, Season –Kharif, Design - Randomized Block Design (RBD), Plot size -Gross: 4.0 m × 3.15 m. Net: 3.50 m × 2.60 m.

Spacing -2.5 cm row to row (line sowing), Variety - Pant Dhan 4, Date of sowing - 15.06.2016, Fertilizer application - 110 kg N + 60 kg P_2O_5 + 50 kg K_2O per ha.

In prepare tillage in field was ploughed with tractor drawn mould board plough. The harrowing was carried out with tractor drawn harrow and stubbles were removed. the experiment was lay out in Randomized Block Design with three replication. the treatment consist of nine weed management in sub plot treatment Small bunds were raised around each plot.

In seeds and sowing in Paddy seed use variety '*Pant Dhan 4'* were treated with carbendazim @ 2 g kg^{-1} seed. This variety matures within 128 to 130 days and yields about 55-60 q per ha. Sowing was performed on 15th June, 2016 by manually (line sowing) after basal application of fertilizer using seed rate of 100 kg ha^{-1}. The seed was sown 2 to 3 cm deep by manual labors and was covered with soil.

The recommended doses of fertilizer application in paddy crop N, P_2O_5 and K_2O *i.e.* 110:60:50 kg ha^{-1} was applied through urea, single super-phosphate and muriate of potash, respectively. The desired plant population per plot was maintained by gap filing at 7 DAS.

In application of herbicide in The required quantity of spraying of pre-emergence herbicides *viz*, Pendimetalin @ 1.0 kg a.i. per ha in T2 and T2 treatments and butachlor 50% EC @ 1.25 kg a.i. per +ha in T3 treatment were done three DAS i.e. Pendimethalin @ 3.33 lit. per ha and butachlor @ 2.5 lit. per ha were dissolved in 500 lit. of water and sprayed by using knapsack sprayer with flat fan nozzle on soil surface. The spraying of post-emergence herbicide 2,4-D (Sodium salt) @ 1.0kg a.i. per ha was done 30 DAS in treatment T4 and T5. The spray solution was made by dissolving 1.25 kg per ha 2,4- D (Sodium salt) in 500lit. water and sprayed by using knapsack sprayer with flat fan nozzle.

Intercultural and hand Weedings

Hand hoeing was done 20 DAS in T7 treatment and 40 DAS in T8 treatment. Hand weeding was done at 20, 40 and 60 DAS as per in hand weeding treatments.

Biometric observation use in the effect of various treatments on plant characters of Paddy, periodical biometric observations were recorded at 20, 40, 60, 80, 100 DAS and at harvest. Functional Leaves per plant was periodically recorded from five randomly selected the no of functional leaves and marked plants and averages of five plants were worked out at each observation for comparing treatment effects. Dry matter of three plants samples were taken at 20, 40, 60, and 80 DAS and at harvest. The plants were kept in oven at 60^0C for 36-48 hours to obtain the constant dry biomass. Leaf area per plant was recorded from the five plants which were selected for dry matter studies, all the leaves of these five plants used for measuring leaf area with the help of leaf area meter at 20, 40, 60 and 80 DAS of crop growth**.**

The crop from each plot was harvested separately. The grains were separated from straw by threshing. The weight of grains was recorded and expressed in q ha^{-1} and the straw weight was worked out by subtracting the weight of grains from the bundle weight of the produce it was expressed in q ha^{-1} Harvest index was computed as the ratio of economic yield *i.e.* grain yield to the total biomass *i.e.* biological yield (grain and straw) from same area and expressed in per cent.

Result and Discussion

To presented the data in revealed that at Effect of weed control measures At to use of the treatment pre- emergence pendimethalin @ 1.0 kg a.i. application apply in starting time to reduce the 20 DAS the weed density, as pre-emergence + hand weeding at 40 DAS, butachlor 50% EC @ 1.25 Kg a.i. per ha emergence + hand weeding at 40 DAS, Pendmethalin @1.0 Kg a.i. per ha as pre emergence followed by 2,4-D (Sodium salt) @ 1.0 Kg a.i. per ha at 30 DAS which was significantly superior over all remaining weed control measures. Lowest weed intensity was observed in weed free check followed by, hoeing at 20 DAS + hand weeding at 30 DAS. At 60, 80 and 100 DAS significantly lowest weed intensity was observed in weed free check which was followed by two hand weedings at 20 DAS & 40 DAS, respectively. Followed by butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS and pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS respective.

Growth study in rice growth measured in terms of height, functional leaves, leaf area per plant and dry mater accumulation per plant was favorably influenced by weed free check and two hand weedings at 20 and 40 DAS, It was followed by pre-emergence application of butachlor 50% EC @ 1.25 Kg a.i per ha + hand weeding at 40 DAS. Rice Plants in weed free check achieved maximum height (85.56 cm) at harvest, number of functional leaves (22) at 80 DAS and also maximum dry matter per plant (24.86 g) at harvest.

The Effect of weed control measures The Mean height of 20 DAS plant was not influenced significantly by different weed control measures. The plant height at 40, 60, 80, 100 DAS

and at harvest was influenced significantly by different weed control treatments. The weed free check treatment recorded the highest plant height at each stage of observation. However it was at par with the treatment two hand weedings 20 and 40 DAS at 60 and 80 DAS respectively. At harvest the weed free treatment recorded significantly more plant height (85.56 cm) as compared to other treatment under study. The weedy check treatment recorded significantly lower plant height at harvest (75.83cm) as compared to other treatment which indicating that weeds reduces the plant height due to competition Similar results were recorded by Jadhav *et al.*, 2010 [3].

The data pertaining to the grain and straw yield as affected by weed control measures are presented in Data showed that the average yield of grain and straw 59.74, 85.89 q per ha, respectively. The significantly grain yield was influenced due to various treatments. Highest Grain yield (76.54 q /ha) was obtained in Weed free check, followed by two hand weeding at 20 DAS and 40 DAS respectively (73.52 q /ha) and the next best treatment was butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS (71.96 q/ ha) in respect of Grain yield. Further pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS (65.71), Hoeing at 20 DAS + hand weeding at 30 DAS (61.44q /ha), followed by Hand weeding at 20 DAS + 2,4-D (Sodium salt) @ 1.0 Kg a.i.ha^{-1} at 30 DAS (57.90 q /ha), Hand weeding at 20 DAS followed by Hoeing at 40 DAS (54.60 q /ha), Pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + 2,4-D (Sodium salt) @ 1.0 Kg a.i. per ha at 30 DAS (52.53 q/ ha). Lowest grain yield was recorded in weedy check (21.71 q/ ha) Thus weed control the effective achieved in the earlier mentioned treatment resulted in enhancing various growth and yield attributing character of rice and gave significantly higher yield over weedy check. The weed free check, treatments two hand weeding at 20 DAS and 40 DAS and butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS recorded the grain yield 76.96 q per ha73.52 q/ha and 71.96 q per ha, respectively. These results are in conformity with Jadhav *et.al*. (2010) [3] and Sharma *et al*. (2007) [4].

The significantly straw yield was influenced due to various treatment. Significantly highest straw yield (109.45 q/ha) was obtained in weed free check and it was followed by two hand weeding at 20 DAS and 40 DAS respectively (104.38 q/ ha). The next best treatment for producing straw yield was butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS. Further pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + hand weeding at 40 DAS (100.27 q /ha), Hoeing at 20 DAS + hand weeding at 30 DAS (84.33 q /ha), followed by Hand weeding at 20 DAS + 2,4-D (Sodium salt) @ 1.0 Kg a.i. per ha at 30 DAS (73.33 q/ ha), Hand weeding at 20 DAS followed by Hoeing at 40 DAS (77.33 q/ ha), Pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + 2,4-D (Sodium salt) @ 1.0 Kga.i. per ha at 30 DAS (81.22 q /ha). Lowest straw yield was recorded in weedy check (41.39q /ha). These results are in conformity with Sharma *et al*. (2007) [4].

Table 1: Weed population in upland rice as influenced by different weed control measures

	Treatment	Weed Intensity (m^{-2})				
		20 DAS	40 DAS	60 DAS	80 DAS	100 DAS
T1	Weedy check	53.50	105.20	77.63	128.32	135.27
T2	Pendimethalin @ 1.0 kg a.i. per ha as pre emergence + Hand weeding at 40 DAS	47.70	75.20	86.80	94.27	105.27
T3	Butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + Hand weeding at 40 DAS	49.89	71.37	83.00	86.29	91.43
T4	Pendimethalin @ 1.0 Kg a.i. per ha as pre emergence + 2,4-D (Sodium salt) @ 1.0 kg a.i. Per ha. at 30 DAS	50.40	61.22	79.93	109.33	107.38
T5	Hand weeding at 20 DAS + 2, 4-D (Sodium salt) @1.0Kg a.i. per ha at 30 DAS	50.00	62.53	80.10	102.41	110.20
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	49.50	53.13	80.63	98.42	103.32
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	49.06	73.38	82.00	100.22	104.35
T8	Two hand weedings at 20 DAS & 40 DAS respectively	49.80	69.31	75.00	86.24	91.39
T9	Weed Free check 3 weedings at 20,40 and 60 DAS	49.26	59.22	83.50	73.24	65.25
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	1.29	0.63	2.00	2.26	2.89
	CD at 5%	3.35	3.90	5.20	6.82	7.66
	G.M.	50.20	70.09	80.95	94.82	98.72

Table 2: Weed dry matter as influenced periodically by different weed control measures.

	Treatment	Total weed dry matter net /plot (g)					weed drymatter (q/ha)
		20 DAS	30 DAS	40 DAS	60 DAS	At harvest	
T1	Weedy check	-	-	-	-	1124.04	11.170
T2	Pendimethalin @ 1.0 kg a.i. per Ha as pre emergence + Hand weeding at 40 DAS	-	-	129.85	-	293.56	2.690
T3	Butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence+ Hand weeding at 40 DAS	-	-	105.32	-	257.96	2.233
T4	Pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + 2,4-D (Sodium salt) @ 1.0kg a.i. per ha at 30 DAS	-	-	-	-	375.94	3.717
T5	Hand weeding at 20 DAS + 2,4-D (Sodium salt) @ 1.0Kg a.i. per ha at 30 DAS	66.60	-	-	-	370.84	3.820
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	64.06	76.63	-	-	315.01	3.013
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	65.40	-	88.58	-	372.53	3.777
T8	Two hand weedings at 20 DAS & 40 DAS respectively	64.26	-	68.41	-	212.47	2.623
T9	Weed Free check (3 weedings at 20, 40 and 60 DAS	64.24	-	56.49	41.65	181.94	1.650
	'F' test	-	-	-	-	Sig.	Sig.
	S.E ±	-	-	-	-	0.72	0.10
	CD at 5%	-	-	-	-	2.17	0.32
	G.M.	-	-	-	-	389.31	3.85

Table 3: Nutrient (NPK) content (%) in grains and straw of upland rice Effect of weed control measures

	Treatment	Nitrogen(%)		Phosphorous(%)		Potassium(%)	
		Grain	Straw	Grain	Straw	Grain	Straw
T1	Weedy check	1.67	0.36	0.21	0.16	0.15	1.03
T2	Pendimethalin @ 1.0 kg a.i. per ha as pre emergence + Hand weeding at 40 DAS	1.96	0.76	0.50	0.13	0.11	1.40
T3	Butachlor 50% EC @ 1.25 Kg a.i. per ha as pre emergence + Hand weeding at 40 DAS	1.90	0.65	0.46	0.14	0.13	1.30
T4	Pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + 2,4-D (Sodium salt) @ 1.0 kg a.i. per ha at 30 DAS	1.81	0.50	0.25	0.12	0.12	1.22
T5	Hand weeding at 20 DAS + 2,4-D (Sodium salt) @1.0Kg a.i. per ha at 30 DAS	1.85	0.44	0.35	0.14	0.11	1.30
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	1.82	0.40	0.20	0.15	0.10	1.16
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	1.85	0.41	0.36	0.12	0.14	1.20
T8	Two hand weedings at 20 DAS & 40 DAS respectively	1.80	0.41	0.25	0.14	0.13	1.12
T9	Weed Free check (3 weedings at 20, 40 and 60 DAS)	1.80	0.041	0.28	0.16	0.16	1.23
	'F'test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
	S.E.(m)	0.05	0.02	0.02	0.01	0.01	0.06
	C.D. (5%)	-	-	-	-	-	-
	G.M.	1.83	0.79	0.32	0.14	0.13	1.22

Table 4: Nutrient content and uptake of nutrient (NPK) in weed at harvest as affected by different weed control treatment

	Treatment	Nitrogen		Phosphorous		Potassium	
		(%)	Uptake Kg per ha	(%)	Uptake kg per ha	(%)	Uptake kg per ha
T1	Weedy check	0.830	9.057	0.233	3.180	1.010	11.270
T2	Pendimethalin @ 1.0 kg a.i.per ha as pre emergence + Hand weeding at 40 DAS	0.787	2.000	0.283	0.753	0.960	2.690
T3	Butachlor 50% EC @ 1.25 Kg a.i. per haas preemergence+ Hand weeding at 40 DAS	0.817	2.167	0.243	0.660	0.980	2.530
T4	Pendimethalin @ 1.0 Kg a.i. per ha as preemergence+ 2,4-D (Sodium salt) @ 1.0 kg a.i. ha^{-1} at 30 DAS	0.813	3.220	0.273	1.010	1.020	3.663
T5	Hand weeding at 20 DAS + 2, 4-D(Sodium salt) @1.0Kg a.i. per ha at 30 DAS	0.820	3.033	0.253	1.030	0.990	3.660
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	0.813	2.690	0.270	0.850	0.980	3.170
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	0.797	3.013	0.273	1.073	1.040	3.690
T8	Two hand weedings at 20 DAS & 40 DAS respectively	0.790	1.410	0.290	0.537	0.900	2.160
T9	Weed Free check (3 weedings at 20,40 and 60 DAS)	1.020	1.620	0.283	0.407	0.930	1.687
	F 'test	N.S.	Sig.	N.S.	Sig.	N.S.	Sig.
	S.E.	0.08	0.01	0.01	0.02	0.02	0.02
	C.D.(5%)	-	0.05	-	0.08	-	0.08
	G. Mean	0.83	3.13	2.26	1.05	0.97	3.82

Table 5: Grain yield and straw yield of upland rice as influenced by different weed control measures

	Treatment	Grain Yield (q /ha)	Straw yield(q /ha)
T1	Weedy check	28.93	41.02
T2	Pendimethalin @ 1.0 kg a.i. per ha as pre emergence + Hand weeding at 40 DAS	44.00	100.27
T3	Butachlor 50% EC @ 1.25 Kg a.i. per ha as pre emergence + Hand weeding at 40 DAS	47.10	101.39
T4	Pendimethalin @ 1.0 Kg a.i. ha^{-1} as pre emergence + 2,4-D (Sodium salt) @ 1.0 kg a.i. Per ha at 30 DAS	40.07	81.22
T5	Hand weeding at 20 DAS + 2, 4-D (Sodium salt) @1.0Kg a.i. per ha at 30 DAS	44.70	73.33
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	36.90	84.33
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	36.05	77.33
T8	Two hand weedings at 20 DAS & 40 DAS respectively	44.60	104.38
T9	Weed Free check (3 weedings at 20, 40 and 60 DAS)	50.02	109.45
	'F' test	Sig.	Sig.
	S.E. ±	1.96	0.38
	CD at 5%	7.21	1.16
	G.M.	41.77	85.89

Table 6: Economic of upland rice as influenced by different weed control measures

	Treatments	Gross returns (Rs. /ha)	Cost of cultivation (Rs./ha)	Net returns (Rs/ha)	Benefit: Cost ratio
T1	Weedy check	36602	41856	-5254	0.87
T2	Pendimethalin @ 1.0 kg a.i. per ha as pre-emergence +Hand weeding at 40 DAS	1,11289	50452.5	60836.5	2.20
T3	Butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + Hand weeding at 40 DAS	1,17367	48998	68369	2.39
T4	Pendimethalin @ 1.0 Kg a.i. per ha as pre-emergence + 2,4- D (Sodium salt) @ 1.0 kg a.i. per ha at 30 DAS	86243	45792.5	40406.5	1.88
T5	Hand weeding at 20 DAS + 2,4-D(Sodium salt) @1.0Kg a.i. per ha at 30 DAS	94422	48622	45800	1.94
T6	Hoeing at 20 DAS + hand weeding at 30 DAS	100728	49921	50807	2.01
T7	Hand Weeding at 20 DAS + Hoeing at 40 DAS	90115	49915	40200	1.80
T8	Two hand Weedings at 20 DAS & 40 DAS respectively	120778	53308	67470	2.26

T9	Weed Free check (3 Weedings at 20, 40 and 60 DAS)	126328	58908	67420	2.14
	S.E. ±	2837.89	-	3218.04	-
	C.D (5%)	8507.99	-	9647.68	-
	G.Mean	98208	-	5762.85	-

Conclusion

Rice is major crop of Uttarakhand and about 40-50 per cent of rice crop is grown under direct seeded condition. In direct seeded rice, weeds play the vital role in reducing the crop yield and there by resulting in high economic losses of farmers. Rice maximum growth and yield was obtained when the crop was kept weed free for the first 60 days by three hand- weedings. (20, 40 and 60 DAS). The highest crop growth, grain yield, weed control efficiency and weed dry matter in Under integrated weed management, treatment in recorded was practices butachlor 50% EC @ 1.25 Kg a.i. per ha as pre-emergence + hand-weeding at 40 DAS when compared with other integrated weed management practices. It is therefore imperative to manage weeds from early crop growth period so that the crop can make efficient utilization of applied and native input.

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