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Integrated weed management practices on ricebean (*Vigna umbellata*) under rainfed condition

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Abstract

A field experiment was conducted during the post - kharif season of 2013 at Instructional Farm of U.B.K.V, Pundibari, Cooch Behar, W.B. to study the “ Integrated weed management practices in Ricebean (*Vigna umbellata*) under rainfed condition” with the following objectives: i) to identify the efficiency of Pendimethalin & Butachlor as pre-emergence, Quizalofop-p-ethyl as post-emergence herbicide in ricebean under Terai Agro - Climatic situation (ii) to assess the performance of pre - emergence application of herbicide as compared to the standard hand weeding/ hoeing in controlling weeds of ricebean and (iii) work out the economics of various treatments for ricebean cultivation. The field experiment was carried out in Randomized block design, having eleven (11) treatments with three replications. Finally, it may be concluded that Weed free control (T10) recorded highest seed yield followed by Hand weeding twice at 20 DAS & 30DAS (T7) and Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha combined with one hand weeding at 30 DAS (T5). Highest Net income and benefit: cost ratio was recorded under Pendimethalin (Stomp-extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha combined with one hand weeding at 30 DAS (T5) and lowest benefit: cost ratio was recorded under weedy check (T11)

Keywords: Ricebean, herbicide, hand weeding and randomized block design

Introduction

The field experiment was carried out at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. The farm is situated at 26°19'86" N latitude and 89°23'53" E longitude, at an elevation of 43 meter above mean sea level. The northern region of West Bengal (*terai zone*) is placed along Kalimpong hills, Kurseong hills and Bhutan hills in northern side and Bangladesh in southern side. Assam border is located at the eastern side. Bihar border is located at the western side. It includes Siliguri subdivision of Darjeeling, entire portion of Jalpaiguri and Cooch Behar and Islampur subdivision of North Dinajpur district. Total geographical area of this zone is 1025 sq. Km which occupies 13.5% of the total state area. Ricebean (*Vigna umbellata*) is one of the kharif/post kharif legumes grown by subsistence farmers in hilly and plain areas. It is known by different local names in different parts of the country, such as *Gaimoong* in Bengali, *Meth* in Hindi, and *Siltung* in Nepali. It is a neglected crop grown under diverse conditions with no additional inputs. It thrives well in marginal lands, rainfed areas, drought-prone areas and exhausted soils. Lack of awareness on potential nutritional and economic use value of ricebean and its narrow socio-traditional perceptions amongst most users are observed to be the barriers to its large scale demand and production. Hence, immediate attention for its conservation and utilization is critical to prevent the loss of this multipurpose crop. It is generally grown as a mixed crop or intercrop with maize. It is also cultivated along rice bunds and terrace-margins in the mid hills. Ricebean is one of the minor legumes grown by Nepalese farmers and its area under cultivation is too low compared to other legumes as lentil, black gram and chickpea. There is an increasing trend in area, production and productivity of grain legumes in the nepal (Neupane, 2003) [1].

Materials and Methods

The experiment was laid out in a Randomized Block Design (RBD) with 11 treatments and replicated thrice giving a total of 33 unit plots each measuring 5.0 m × 3.0 sq. m the plan of layout of the field experiment is given in fig. 3.4 the treatments were allotted randomly in each plots using Fisher and Yates random number. Experimental design: Randomized Block Design (RBD Name of Crop: Ricebean (*Vigna umbellata*) Variety: RBL -6 Replication: 3 (Three) Plot size: 5.0 m × 3.0 m Number of treatment combination: 11 (eleven) T1 – Butachlor

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(Pre- emergence) @ 1kg a.i/ha, T2 – Butachlor(Pre-emergence) @ 1kg a.i/ha + One (1) Hand Weeding at 30DAS, T3 – Quizalofop-p- ethyl (Turga super) @ 60 g ha⁻¹ at 20 DAS as post- emergence, T4- Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha, T5 - Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha + One Hand weeding at 30 DAS (T5), T6 – Hand weeding (once) at 30 DAS, T7 – Hand Weeding (Twice) at 20& 30DAS, T8 – Wheel hoeing (Twice) at 20 &30 DAS, T9 – Hand weeding (once) at 20 DAS & Wheel hoeing at 30 DAS, T10 – Weed- free control and T11 – Weedy check.

Results and discussion

1. Effect of treatments on plant height

The data pertaining to the effect of different treatments on plant height have been presented in Table 1. Perusal of data in Table 1 would revealed that plant height went on increasing till the last observation recorded at harvest due to indeterminate type of growth habit. In general, weedy check plot recorded shortest plant height at any particular stage of crop growth during the year of the investigation (Table 1). This was probably due to presence of larger weed population per unit area compared to any other treatment causing greater weed-crop competition and there by affecting the growth of plant as measure by plant height. Hand weeding, wheel hoeing and herbicide treatment did not record any depressive effect on plant height. Significantly highest plant height was recorded when hand weeding was done (twice) at 20 & 30 DAS (T7) followed by pre-emergence application of Pendimethalin (Stomp- extra 38.7% E.C) @ 1.0 kg a.i ha⁻¹ integrated with one hand weeding at 30 DAS (T5). Hand weeding (once) at 20 DAS & wheel hoeing (once) at 30 DAS (T9) and Pre-emergence applications of Butachlor @ 1 kg a.i ha⁻¹ with one hand weeding at 30 DAS (T2).

2.1 Effect of treatments on number of nodules

The data pertaining to the effects of different treatments on the number of nodules have presented in Table 2. It would be revealed that no of nodules went on increasing from 40 DAS to 60 DAS their after the nodules are disappeared. In general weedy check plot recorded lowest number of nodules at 40 DAS and 60 DAS during the year of investigation (Table 2). This was probably due to presence of larger weed population and less development of crop as well as root. Among the herbicidal treatment Pendimethalin @ 1kg a.i / as pre-emergence with one hand weeding at 30 DAS gives the maximum no. of nodules followed by Butachlor as pre-emergence combined with one hand weeding at 30 DAS (T2) Highest number of nodules was observed in the treatment, T10 i.e. that is weed free control (T10) followed by hand weeding (twice) at 20 &30 DAS (T7). This was due to aggressive growth of crop at early stages and less crop- weed competition for nutrient, moisture, light and space (Table 2)

2.2. Effect of treatments on dry weight of nodules

Data on dry weight of nodules was recorded at 40 DAS & 60 DAS and relevant data have been presented in Table 2. Perusal of data in Table 2 would reveal that the nodules went on increasing from 40 DAS to 60 DAS. In general, weedy check plot was recorded lowest dry weight of nodules. The highest dry weight of nodules were noted in the treatment weed free control (T10) followed by the treatment hand weeding (twice) at 20 &30 DAS (T7). These treatments are statistically at par. Among the herbicidal treatment maximum

dry weight of nodules were recorded in the pre- emergence application of pendimethalin (Stomp-extra 38.7% E.C) with one hand weeding at 30 DAS (T5) followed by hand weeding (Once) at 20 DAS & Wheel hoeing (Once) at 30 DAS (T9), pre- emergence applications of Butachlor @ 1kg a.i / ha + One hand weeding at 30 DAS (T2), Hand weeding once at 30 DAS (T6) and Wheel hoeing (twice) at 20 & 30 DAS (T8) at all the stages of crop growth (Table 2).

3. Effect of treatment on crop growth rate (CGR) of Ricebean

The data on crop growth rate (Table 3) revealed that irrespective of weed control practices crop growth rate (CGR) was low at early stages of crop growth and kept on increasing with the advancement of crop age up to 60 DAS, when it reached its peak. There after it declined towards maturity of the crop touching the lowest value at harvest. This was due to the emergence and enlargement of new branches and leaves during vegetative stage of crop growth, which stopped at reproductive stage of the crop growth. Among the weed control practices, highest values of CGR was recorded under weed free control (T10) followed by hand weeding (twice) at 20 & 30 DAS (T7), pre-emergence application of Pendimethalin (Stomp- extra 38.7% E.C) @ 1.0 kg a.i/ ha combined with one hand weeding at 30 DAS (T5), Hand weeding at 20 DAS & wheel hoeing at 30 DAS (T9), Butachlor @ 1kg a.i / ha as pre- emergence with one hand weeding at 30 DAS (T2), Hand weeding (Once) at 30 DAS (T6) Wheel hoeing (twice) at 20 & 30 DAS (T8), Pre – emergence application of Pendimethalin (Stomp- extra 38.7% E.C) @ 1.0 kg a.i/ ha (T4), post – emergence application of Quizalofop-p-ethyl (Turga super) @ 60 g ha-1 (T3) and pre-emergence application of Butachlor @ 1kg.a.i / ha (T1). Lowest values of CGR were recorded under weedy check (T11) (Table 3).

4.1. Effect of treatments on seed yield of Ricebean

An appraisal of crop produce as affected by various treatments is the primary object in agronomy investigation. An attempt has been made to examine the effect of various treatments as measured by yield of Ricebean seeds. The data pertaining to seed yield of Ricebean and % increase in yield over control have been presented in Table 4. The lowest seed yield of Ricebean was recorded under weedy check (T11) during the year of experimentation (Table 4). This was due to heavy infestation and rank growth of weeds in weedy check treatment. The improve method cultivation of such as good tilth of the soil, application of manure and fertilizer provided a highly congenial environment for rank growth of weeds. This was ultimately reflected on the yield of the crop. The highest seed yield was recorded under weed free control (T10) (Table 4), which was closely followed by hand weeding (twice) at 20 & 30 DAS (T7) which was also reported by Ozair *et al* (1989) ^[2] and Jain *et al* (1997) ^[3] and pre-emergence application of pendimethalin combined with one hand weeding at 30 DAS (T5), Hand weeding (once) at 20 DAS & Wheel hoeing (once) at 30 DAS (T9). Similar results also reported by Arvadiya (1996) ^[4], Singh *et al* (2008) ^[5] This was due to the fact that these three treatments were quite effective throughout the period of crop growth in controlling weed infestation in ricebean field. These treatments affected not only the number of weeds per unit area but also their vegetative vigour and effectively reduce the dry weight of total as well as different categories of weed and thereby reduce crop weed competition for moisture, nutrients and

light which is usually considered to be the most important single factor limiting crop yield. Yield attributing characters like number of pods per plant, number of seeds per pod and test weight were quite high in these treatments. Cumulative effect of all these has been reflected on the seed yield of the crop. Hoeing once at 30 DAS (T6) and wheel hoeing twice at 20 & 30 DAS (T8) recorded higher seed yield than the herbicidal treatment. Pre-emergence application of pendimethalin (T4), Butachlor as pre-emergence (T1) and application of Quizalofop-p- ethyl (Turga super) as post-emergence (T3), when applied alone (Table 4).

4.2. Effect of treatment on Stover yield of ricebean

The Table 4. showed that the ricebean stover yield was influenced by the different weed control practices. The maximum stover yield was obtained under weed free control (T10) followed by hand weeding (twice) at 20 & 30 DAS (T7), pre-emergence application of pendimethalin along with one hand weeding at 30 DAS (T3), Hand weeding once at 20 DAS & Wheel hoeing once at 30 DAS (T9) and Pre-emergence application of Butachlor combined with one hand weeding at 30 DAS (T2) respectively. Pre-emergence application of Pendimethalin (stomp-extra) (T4) and Butachlor (T1), post-emergence application of Quizalofop-p-ethyl (Turga super) when applied alone gave higher stover yield over weedy check. The lowest value of stem yield was recorded under weedy check (T11) (Table 4).

4.3. Effect of treatment on harvest index (HI) of Ricebean

From the Table 4 it is observed that the highest value of HI was noted weed free control (T10) followed by when hand weeding was done at 20 & 30 DAS (T7) followed by pre-emergence application of Pendimethalin (Stomp- extra 38.7% E.C) @ 1.0 kg / ha with one ha weeding at 30 DAS (T5), Hand weeding once at 20 DAS & Wheel hoeing once at 30 DAS (T9) and Pre-emergence application of Butachlor combined with one hand weeding at 30 DAS (T2) and hand

weeding once at 30 DAS respectively. Pre-emergence application of Pendimethalin (stomp- extra) (T1), Butachlor and post-emergence application of Quizalofop-p- ethyl (Turga super) @ 60 g ha⁻¹ at 20 DAS (T3) recorded significantly highest HI over control. Lowest HI was recorded under weedy check (T11) (Table 4).

5. Effect of treatment on economics of Ricebean

5.1. Gross Income (Rs. ha⁻¹)

Different weed control practices influenced the gross income (Table 5). The highest gross income was recorded under hand weeding (twice) at 20 & 30 DAS (T5) followed by pre-emergence application of Pendimethalin (stomp-extra 38.7% E.C) along with one hand weeding at 30 DAS (T5) and Hand weeding (once) at 20 DAS & Wheel hoeing once at 30 DAS (T9) respectively. Lowest gross income was recorded under weedy check plot (T11) (Table 5).

5.2. Net Return (Rs. ha⁻¹)

Net income was also influenced by different weed control practices (Table 5). Maximum net income (Rs. 54222.00) was recorded under pre-emergence application of Pendimethalin (stomp-extra 38.7% E.C) along with one hand weeding at 30 DAS (T5) followed by hand weeding twice at 20 & 30 DAS (T7) in the terms of seed as well as stover yield in ricebean. Jain *et al* (1997) [3], Ramanathan and Chandraskharan (1998) [6] and Rathi *et al* (2004) [7] made similar observation. The minimum net income (Rs. 29434) was recorded weedy check plot (T11) due to lowest seed yield of Ricebean (Table 5).

5.3. Benefit: Cost ratio

Pre-emergence application Pendimethalin (stomp-extra 38.7% E.C) application along with one hand weeding at 30 DAS (T5) recorded highest Benefit: Cost (B: C) ratio (2.16). The lowest Benefit: cost (B: C) ratio recorded under weedy check (T11) because of lowest net return.

Table 1: Effect of treatments on plant height at different stages of crop growth

Treatments	Plant height (cm)			
	Days after sowing			
	40	60	80	At harvest
T1 = Pre- emergence application of Butachlor @ 1kg.a.i / ha	20.97	32.35	41.03	45.60
T2= Pre- emergence applications of Butachlor @ 1kg a.i / ha + One hand weeding at 30 DAS	26.07	37.52	47.35	49.99
T3= Quizalofop-p- ethyl (Turga super) @ 60 g ha-1 at 20 DAS	22.58	33.16	42.52	46.97
T4= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha	24.12	34.25	43.67	48.30
T5= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha + One hand weeding at 30 DAS	26.94	38.95	48.61	51.45
T6= Hand weeding (Once) at 30 DAS	25.68	36.32	46.85	49.55
T7= Hand weeding (Twice) at 20 DAS & 30 DAS	27.38	39.95	49.65	53.06
T8= Wheel hoeing (Twice) at 20 & 30 DAS	24.94	35.46	44.71	48.87
T9= Hand weeding (Once) at 20 DAS & Wheel hoeing (Once) at 30 DAS	26.58	38.33	47.65	50.38
T10= Weed free control	28.30	40.73	51.21	54.35
T11= Weed Check	17.32	28.41	37.48	41.58
S.E m (±)	0.63	0.78	0.68	0.39
C.D. (P = 0.05)	1.88	2.30	2.03	1.17

Table 2: Effect of treatments on no. of nodules / plant and dry weight at different stages of crop growth

Treatments	No of nodules plant ⁻¹		Dry weight of nodules plant ⁻¹ (g)	
	Days after sowing			
	40	60	40	60
T1 = Pre- emergence application of Butachlor @ 1kg.a.i / ha	18.17	36.63	0.0099	0.036
T2= Pre- emergence applications of Butachlor @ 1kg a.i / ha + One hand weeding at 30 DAS	22.53	46.35	0.0156	0.048
T3= Quizalofop-p- ethyl (Turga super) @ 60 g ha-1 at 20 DAS	19.83	40.20	0.0113	0.040
T4= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha	21.14	42.77	0.0124	0.042

T5= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha + One hand weeding at 30 DAS	23.90	50.89	0.0185	0.050
T6= Hand weeding (Once) at 30 DAS	21.92	45.05	0.0145	0.046
T7= Hand weeding (Twice) at 20 DAS & 30 DAS	24.92	52.05	0.0194	0.051
T8= Wheel hoeing (Twice) at 20 & 30 DAS	21.70	44.04	0.0135	0.045
T9= Hand weeding (Once) at 20 DAS & Wheel hoeing (Once) at 30 DAS	22.79	47.67	0.0173	0.049
T10= Weed free control	25.79	54.10	0.0207	0.055
T11= Weed Check	15.68	30.67	0.0074	0.030
S.E m (\pm)	0.45	1.24	0.0010	0.001
C.D. (P = 0.05)	1.33	3.67	0.0020	0.003

Table 3: Effect of treatments on crop growth rate ($\text{g m}^{-2} \text{day}^{-1}$) of ricebean at different stages of crop growth

Treatments	Crop growth rate ($\text{g plant}^{-1} \text{day}^{-1}$)		
	Days after sowing		
	40 - 60 DAS	61 -80 DAS	81 - AT HARVEST
Butachlor @ 1.0 kg a.i/ha as Pre-emergence	10.93	5.79	1.98
Butachlor @ 1.0 kg a.i/ha as Pre-emergence + One Hand Weeding (35DAS)	13.25	7.02	2.40
Pretilachlor as Post-Emergence @ 0.75 kg a.i/ha at 21DAS	11.74	6.22	2.13
Pendimethalin(38.7%) as Pre-emergence @ 1.0 kg a.i/ha	11.93	6.32	2.16
Pendimethalin(38.7%) as Pre-emergence @ 1.0 kg/ha + One Hand Weeding At 35 DAS	14.12	7.48	2.56
Hand Weeding (Once) at 35DAS	13.21	7.00	2.39
Hand Weeding (Twice) at 21& 35 DAS	14.67	7.77	2.66
Wheel hoeing (Twice) at 21 & 35DAS	12.92	6.84	2.34
Hand Weeding (Once) at 21DAS & Wheel Hoeing (Once) at 35 DAS	13.79	7.30	2.50
Weed Free Control	15.45	8.18	2.80
Weedy Check	10.04	5.32	1.82
S.E m(\pm)	0.289	0.154	0.052
CD	0.859	0.456	0.156

Table 4: Effect of treatment on seed yield (kg/ ha), stover yield and harvest index of ricebean

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Increase in yield over control (%)
T1 = Pre- emergence application of Butachlor @ 1kg.a.i / ha	749.95	4915.76	13.96	23.44
T2= Pre- emergence applications of Butachlor @ 1kg a.i / ha + One hand weeding at 30 DAS	1085.41	5780.58	16.43	79.43
T3= Quizalofop-p- ethyl (Turga super) @ 60 g ha-1 at 20 DAS	828.04	5257.35	14.54	36.79
T4= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha	905.75	5277.95	15.28	50.12
T5= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha + One hand weeding at 30 DAS	1218.54	6104.88	17.18	101.69
T6= Hand weeding (Once) at 30 DAS	1061.56	5784.08	16.02	75.64
T7= Hand weeding (Twice) at 20 DAS & 30 DAS	1295.80	6306.43	17.43	114.65
T8= Wheel hoeing (Twice) at 20 & 30 DAS	1009.76	5685.72	15.57	66.95
T9= Hand weeding (Once) at 20 DAS & Wheel hoeing (Once) at 30 DAS	1161.87	5985.23	16.84	92.28
T10= Weed free control	1387.78	6621.45	17.71	129.31
T11= Weed Check	612.27	4594.00	12.61	0.00
S.E m (\pm)	31.76	152.20	—	—
C.D. (P = 0.05)	94.36	452.16	—	—

Table 5: Economics of rice bean cultivation as influenced by different treatments (Rs. ha^{-1})

Treatments	Common cost of cultivation	Treatment cost	Total cost of cultivation	Gross return	Net return	B:C ratio
T1 = Pre- emergence application of Butachlor @ 1kg.a.i / ha	18027	1308	19335	54577.0	35242.0	1.82
T2= Pre- emergence applications of Butachlor @ 1kg a.i / ha + One hand weeding at 30 DAS	18027	6870	24897	72319.0	47422.0	1.90
T3= Quizalofop-p- ethyl (Turga super) @ 60 g ha-1 at 20 DAS	18027	2744	20771	59416.0	38645.0	1.86
T4= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha	18027	2485	20512	62593.0	42080.0	2.05
T5= Pendimethalin (Stomp- extra 38.7% E.C) as Pre-emergence @ 1.0 kg a.i/ ha + One hand weeding at 30 DAS	18027	7017	25044	79256	54222.0	2.16
T6= Hand weeding (Once) at 30 DAS	18027	5562	23589	71383.0	47794.0	2.03
T7= Hand weeding (Twice) at 20 DAS & 30 DAS	18027	11124	29151	83364.0	54213.0	1.86
T8= Wheel hoeing (Twice) at 20 & 30 DAS	18027	5356	23383	68819	45436.0	1.94
T9= Hand weeding (Once) at 20 DAS & Wheel hoeing (Once) at 30 DAS	18027	8240	26267	76401.0	50134.0	1.91
T10= Weed free control	18027	-	-	-	-	-
Weedy Check	18027	—	18027	47461.0	29434.0	1.63

Grain= Rs 40 kg^{-1} Stover = Rs 5 kg^{-1}

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