Biological Forum – An International Journal (SI-AAEBSSD-2021) 13(3b): 124-128(2021)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Weed Management in Kodo Millet (*Paspalum scrobiculatum* L.)

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(Received 01 July 2021, Accepted 29 September, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Kodo millet is one of the important nutri cereal crop and the extent of yield reduction due to weed is in the rage of 33-50% depending on the intensity and persistence of weed density. To find out an alternative weedicide for 75% Isoproturon due to its scarce availability in market, the experiment was conducted at AICRP on Small Millets, Bangalore during *Kharif* 2018, 2019 to 2020. The field experiment was laid out in Randomized Complete Block Design with eleven treatments that included the application of pre-emergence application of Oxadiargyl 80 WP, Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G, Butachlor 50 EC, postemergence herbicides like bispyribacsodium 10% SC and Ethoxysulfuron15 WG followed by one intercultivation at 25-30 DAS in all the herbicide imposed treatments. The results revealed that among different treatments, pre-emergent application of Butachlor 50 EC 750 g a.i./ha (within 3DAS) has recorded significantly higher grain yield (2218 kg/ha), straw yield (4815 kg/ha), net returns (Rs.47927) and B:C ratio (3.11) followed by Bensulfron ethyl 0.6 G + Pretilachlor 6.0 G + one inter cultivation at 25-30 DAS. Higher weed control efficiency and lower weed index was also achieved with these treatments.

Keywords: Butachlor, Pre-emergent, Post emergence, Yield and Weed control efficiency.

INTRODUCTION

Kodo millet (*Paspalum scrobiculatum* L.) is the coarsest and long duration crop among millets. It is also known asvaragu, kodo, haraka and arakalu. Kodo millet is known to be originated in India and its domestication was found about 3000 years ago (Arendt and Dal, 2011). Best suited for its cultivation in tropical and subtropical regions (Saxena *et al*., 2018). It forms the mainstay of the dietary nutritional requirements of farmers of marginal and drylands in many parts of India. The fiber content of the whole grain is very high. Kodo millet has around 11% protein and the nutritional value of the protein is slightly better than that of foxtail millet but comparable to that of other small millets. Kodo millet is suggested as a substitute for rice next to finger millet for diabetic patients (Vanithasri *et al*., 2012). The factors responsible for low yields are severe infestation by weeds due to slow initial growth of crops coupled with frequent rains in the rainy season inflict huge yield losses up to an extent of 37 % (Yaduraju, 2006). If weeds are not controlled depending upon soil moisture level, cultivars, soil form, and other environmental conditions, the yield reduction in Kodo millet would be 55-61 percent (Lekhana *et al.* 2021). To obtain an economical yield of Kodo millet, weeds must be kept under check. Information on appropriate herbicides used for weed management practices is not available for recommendation in this crop. For controlling weeds in this crop, the application of isoproturon has been recommended; however, its availability is less. The infestation of these weeds is increasing day by day in the Kodo millet growing areas of the state year after year. So to widen the weed control spectrum, it is imperative to use herbicides and their combinations having a different mode of action (Walia *et al*., 2006). Since Kodo millet is a long-duration crop as compared to other small millets and hence provides great scope for weed control during the early growth stages of the crop. As vegetative growth of the crop is more, pre, as well as post-emergent herbicides, also play a major role in effective control of the weeds. Therefore, herbicide molecules like oxadiargyl, bensulfuron methyl + pretilachlor, butachlor, bispyribac sodium, and ethoxysulfuron in different concentrations, two inter cultivation and one hand weeding, weed-free check, and unweeded check are different treatments imposed in the present investigation.

MATERIALS AND METHOD

A field investigation was carried out during *Kharif* 2018, 2019 and 2020 in red sandy loam soil at Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bangalore coming under the Eastern Dry Zone of Karnataka. The present investigation was conducted to study the effect of weed management practices with different herbicide molecules on weed density and yield parameters of kodo millet. The field experiment was laid out in RCBD replicated thrice with 11 treatments*viz*., Oxadiargyl 80 WP at 150 g a.i./ha (within 3DAS) *fb* one intercultivation at 25-30 DAS(T_1) Oxadiargyl 80 WP at 200 g a.i./ha (within 3DAS) *fb* one intercultivation at 25-30 DAS(T_2), Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.165 kg a.i./ha (within 3DAS) + one intercultivation at25-30 DAS(T_3), Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.33kg a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS(T_4), Butachlor 50 EC 750 g a.i./ha (within 3DAS) *fb* one intercultivation at 25- 30 DAS(T_5), Bispyribac sodium 10 SC 10 g a.i./ha (15-20 DAS) *fb* one intercultivation 35- 40 DAS(T_6),Bispyribac sodium 10 SC 15 g a.i /ha(15-20 DAS) *fb* one intercultivation 35-40 DAS(T_7), Ethoxysulfuron15 WG 12g a.i /ha (15-20 DAS) *fb* one intercultivation 35- 40 DAS(T_8), Ethoxysulfuron15 WG 15g a.i /ha (15-20 DAS) *fb* one intercultivation 35- 40 DAS(T_9), Two intercultivation with hand weeding at 20 and 40 DAS(T_{10}), Un weeded check(T_{11}). Fifty per cent of recommended N (40 kg ha^{-1}) and 100 per cent recommended P_2O_5 (20 kg ha^{-1}) were applied as basal dose. The remaining 50 per cent N was top dressed at 30 days after sowing (DAS). The spray volume used was 750 liters per hectare for pre-emergent herbicide and 375 liters per hectare for post emergent herbicides.

Observations were recorded on weed parameters like weed density, dry weight as suggested by Burnside and Wicks (1965) and weed control efficiency (WCE) was worked out on the basis of weed dry weight recorded in each treatment at 30, 60,90 DAS and at harvest using the formula suggested by Mani *et al*. (1973). The grain and straw yield were recorded at harvest in kg ha^{-1}. All the data obtained were analyzed and the results are presented and discussed at a probability level of 0.05 per cent.

Weed control efficiency (%): The weed control efficiency was calculated as the percentage reduction in density and growth of weeds in case of the treatments under study compared to the control treatment. Weed control efficiency (WCE) was worked out on the basis of weed dry weight recorded in each treatment

$$\text{Weed control efficiency (\%)} = \frac{W_0 - W_t}{W_0} \times 100$$

Where, W_0 = Total dry weight of weeds from unweed plot.

W_t = Total dry weight of weeds from treated plot.

Weed index: Weed index is defined as the reduction in yield due to presence of weeds in comparison to weed free check. Weed index was calculated by using the formula given by Gill and Kumar (1969).

$$\text{WI (\%)} = \frac{(X - Y)}{X} \times 100$$

Where,

WI = Weed index expressed in percentage

X = Yield of weed free plot

Y = Yield from treatment for which weed index is to be worked out

RESULTS AND DISCUSSION

The results obtained from the present investigation conducted at Bengaluru during *kharif* 2018, 2019 and 2020 as well as relevant discussion have been summarized here under. The pooled data over years on crop growth, yield, economics weed control efficiency are presented in Table 1, 2 3, 4 and 5.

During the year 2018 and 2020, significantly higher plant heights (61cm and 57cm, respectively) were obtained in the treatment T_5 i.e. Butachlor 50 EC 750 g a.i./ha (within 3DAS) + one intercultivation at 25- 30 DAS, Whereas, significantly taller plants was seen at T_{10} during 2019. The pooled mean of three years also revealed that the plant height is more in treatment T_5. The number of days taken to attain maturity remained non-significant in all the three years. Significantly higher 1000 seed weight (g) during 2018, 2019 and 2020 was recorded in T8 (4.96, 4.54 and 6.57, respectively). Even the pooled data of three year also confirmed that significantly higher 1000 grain weight was recorded in treatment T_8(5.47 g).

Table 1: Growth parameters of kodo millets as influenced by the chemical weed management practices (3 years pooled data).

Treatment	Plant height (cm)				Days to maturity				1000 seed weight (g)			
	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled
T_1	45.7	70.4	47.0	54.4	108	117	117	112	4.67	4.44	6.8	5.3
T_2	45.5	71.7	46.6	54.6	108	117	112	112	4.65	4.18	6.53	5.12
T_3	59.3	78.2	48.0	61.8	108	117	112	112	4.72	4.48	6.4	5.2
T_4	53.0	75.7	49.3	59.3	108	117	112	112	4.61	4.52	6.47	5.2
T_5	61.5	80.8	57.0	66.4	108	117	112	112	4.69	4.57	6.43	5.23
T_6	45.9	70.9	54.0	56.9	108	117	112	112	4.67	4.5	6.53	5.23
T_7	51.4	73.0	52.0	58.8	108	117	112	112	4.65	4.54	6.47	5.15
T_8	50.7	74.5	43.0	56.0	108	117	112	112	4.96	4.54	6.57	5.42
T_9	53.9	70.5	51.0	58.5	108	117	112	112	4.75	4.47	6.43	5.22
T_{10}	58.8	87.3	51.2	65.8	108	117	112	112	4.91	4.55	6.47	5.31
T_{11}	49.0	66.7	46.5	54.1	108	117	112	112	4.53	4.44	6.57	5.18
S.Em±	**3.90**	**5.58**	**5.57**	**4.40**	**0**	**0**	**0**	**0**	**0.38**	**0.37**	**0.60**	**0.47**
CD at 5%	**11.4**	**16.4**	**16.3**	**12.9**	**NS**	**NS**	**NS**	**NS**	**1.12**	**1.09**	**1.75**	**1.37**
CV	**13.0**	**12.9**	**12.9**	**12.9**	**0**	**0**	**0**	**0**	**14.02**	**14.45**	**15.90**	**15.47**

$\mathbf{T_1}$: Oxadiargyl 80 WP at 150 g a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS, $\mathbf{T_2}$: Oxadiargyl 80 WP at 200 g a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS, $\mathbf{T_3}$: Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.165 kg a.i./ha (within 3DAS) + one intercultivation at25-30 DAS, $\mathbf{T_4}$: Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.33kg a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS, $\mathbf{T_5}$:Butachlor 50 EC 750 g a.i./ha (within 3DAS) + one intercultivation at 25- 30 DAS, $\mathbf{T_6}$: Bispyribac sodium 10 SC 10 g a.i./ha (15-20 DAS) + one intercultivation 35- 40 DAS, $\mathbf{T_7}$: Bispyribac sodium 10 SC 15 g a.i /ha(15-20 DAS) + one intercultivation 35-40 DAS, $\mathbf{T_8}$: Ethoxysulfuron15 WG 12g a.i /ha (15-20 DAS) + one intercultivation 35- 40 DAS, $\mathbf{T_9}$: Ethoxysulfuron15 WG 15g a.i /ha (15-20 DAS) + one intercultivation 35- 40 DAS, $\mathbf{T_{10}}$:Two intercultivation with hand weeding at 20 and 40 DAS, $\mathbf{T_{11}}$:Un weeded check.

In all the three years and their pooled analysis data indicated that, treatment $T_{10,}$ two intercultivation with hand weeding at 20 and 40 DAS recorded higher values for yield (1858, 2708, 2353 and 2306 kg/ha, respectively) and yield attributes as the treatment received all standard agronomic practices. Among different herbicide molecules tested, treatment imposed with Butachlor 50 EC 750 g a.i./ha (within 3 DAS) + one intercultivation at 25- 30 DAS (T_5) resulted significantly higher grain yield during 2018, 2019 and 2020 (1796, 2606 and 2253 kg/ha, respectively) (Table 2) and it was found on par to Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.33kg a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS with a grain yield of 1749, 2368 and

1460 kg/ha during year 2018, 2019 and 2020, respectively. Whereas, unweeded control (T_{11}) recorded significantly the lowest grain yield in all years i.e., 2018, 2019 and 2020(691, 946, 240 and 626 kg/ha, respectively) compared to all other treatments. Similar trend was observed in straw yield (Table 2). Pooled mean of three year data also followed the same trend where T_5 Butachlor 50 EC 750 g a.i./ha (within 3 DAS) *fb* one intercultivation at 25- 30 DAS recorded higher grain yield(2218 kg/ha) immediately followed by Bensulfuron ethyl 0.6 G *fb* pretilachlor 6.0 G @ 0.33kg a.i./ha (within 3DAS) *fb* one intercultivation at 25-30(1859 kg/ha), Bispyribac sodium 10 SC 10 g a.i./ha (15-20 DAS) *fb* one intercultivation 35- 40 DAS(1856 kg/ha)straw yield and harvest index followed the similar trend (Table 2).

Table 2: Yield of kodo millets as influenced by the chemical weed management practices (3 years pooled data).

Treatment	Grain yield(kg/ha)				Straw yield(kg/ha)				Harvest Index(%)			
	2018	**2019**	**2020**	**Pooled**	**2018**	**2019**	**2020**	**Pooled**	**2018**	**2019**	**2020**	**Pooled**
T_1	903	1280	1113	1099	5585	3310	2538	3811	16.17	38.67	43.85	28.84
T_2	929	1343	1177	1150	5688	3776	2365	3943	16.33	35.57	49.77	29.17
T_3	1561	2030	1326	1639	6081	5847	3069	4999	25.67	34.72	43.21	32.79
T_4	1749	2368	1460	1859	7503	6515	3941	5986.	23.31	36.35	37.05	31.06
T_5	1796	2606	2253	2218	7781	6753	4185	6239.	23.08	38.59	53.84	35.55
T_6	1726	2245	1599	1856	7345	6217	3562	5708	23.50	36.11	44.89	32.52
T_7	1501	1756	1520	1592	6329	5208	2912	4816.	23.72	33.72	52.20	33.06
T_8	1429	1981	1882	1764	6706	4706	2752	4721	21.31	42.10	68.39	37.36
T_9	1445	1723	1678	1615	6700	6498	2645	5281	21.57	26.52	63.44	30.58
T_{10}	1858	2708	2353	2306	8244	7579	4262	6695	22.54	35.73	55.21	34.44
T_{11}	691	946	240	626	4173	3089	2138	3133	16.56	30.62	11.23	19.98
S.Em±	**115.02**	**174.00**	**130.86**	**139.92**	**647.10**	**521.69**	**280.16**	**410.70**	**1.56**	**2.11**	**2.42**	**2.17**
CD at 5%	**337.36**	**510.37**	**383.83**	**450.38**	**1897.99**	**1530.17**	**821.72**	**1204.63**	**4.57**	**6.18**	**7.09**	**6.36**
C.V.	**14.03**	**15.85**	**15.02**	**15.04**	**17.09**	**16.71**	**15.53**	**14.14**	**13.64**	**14.05**	**13.23**	**14.56**

The higher grain yield of kodo millet among herbicide treatments at Butachlor 50 EC 750 g a.i./ha (within 3 DAS) + one intercultivation at 25- 30 DAS (T_5) was due to the control of the pre-emergent broad spectrum of weeds effectively during the critical period of crop weed competition, which otherwise were quite notorious for imposing competition for light, space and nutrients with crop. It has provided favourable environment for better expression of growth and yield attributes. The cumulative effect of all these yield components resulted in increased grain yield. These findings are in confirmatory with the work of Prashanth kumar (2015). The increased yield in the inter-cultivation might be attributed to better weed control at initial stages by pre-emergence application of herbicides and subsequently by inter-cultivation during critical period of crop-weed competition, which might have resulted in increased and translocation of photosynthates sufficient to the sink needs. The results are in agreement with the findings of Channa Naik *et al*. (2000) with the application of butachlor at 0.5 kg/ha along with hoeing.

In unweeded control treatment, all the yield contributing parameters are adversely affected by the severe weed competition exerted by weeds for environmental factor like space, light, moisture and nutrients throughout the crop growth period which resulted in lowest grain yield of kodo millet. This is in conformation with the results of Manjunatha *et al.* (2013).

Table 3: Economics of kodo millets as influenced by the chemical weed management practices (3 years pooled data).

Treatment	Gross return (Rs./ha)				Net return (Rs./ha)				B:C ratio			
	2018	**2019**	**2020**	**Pooled**	**2018**	**2019**	**2020**	**Pooled**	**2018**	**2019**	**2020**	**Pooled**
T_1	31605	42240	31164	35003	11187	19822	8844	13284	1.55	1.88	1.40	1.61
T_2	32515	44319	32956	36597	11637	23097	11413	15382	1.56	2.09	1.53	1.73
T_3	54635	66990	37128	52918	32519	42874	12500	29298	2.47	2.78	1.51	2.24
T_4	61215	78144	40880	60080	39059	53988	16011	36353	2.76	3.23	1.64	2.53
T_5	62860	85998	63084	70647	40761	61899	41120	47927	2.84	3.57	2.87	3.11
T_6	60410	74085	44772	59756	38290	49965	21909	36721	2.73	3.07	1.96	2.59
T_7	52535	57948	42560	51014	30392	33805	18600	27599	2.37	2.40	1.78	2.18
T_8	50015	65373	52696	56028	27867	41225	28576	32556	2.26	2.71	2.18	2.39
T_9	50575	56859	46984	51473	28409	32693	21846	27649	2.28	2.35	1.87	2.16
T_{10}	65030	89364	65884	73426	38455	60789	36534	45259	2.45	3.13	2.24	2.61
T_{11}	24185	31218	6720	20708	4360	9393	-14912	-386	1.22	1.43	0.31	0.98

The data on economics of kodo millet as influenced by different herbicides imposed indicated that traditional method of weed management by two intercultivation with hand weeding at 20 and 40 DAS has recorded higher gross return in all the three years and their pooled mean(Rs. 73426/ha) also in accordance with it. But higher net returns was found with the treatment(T_5) Butachlor 50 EC 750 g a.i./ha (within 3DAS) *fb* one intercultivation at 25- 30 DAS (Rs. 47927)followed by T_6(Rs.36721) and T_4 (Rs. 36353). The same treatment T_5 also recorded higher B: C ratio (3.11). The higher net returns in these treatments when compared to weed free plot was because of lesser cost involved in the herbicide treated plot than weed free plot maintained by two intercultivation with hand weeding at 20 and 40 DAS. This confirms the finding of Pruthvi *et al*., (2015)

Among different treatments, significantly lower weed dry weight at 30, 60, 90 DAS and at harvest were reported in the treatment T_{10} i.e., Two intercultivation with hand weeding at 20 and 40 DAS (0.67, 7.66, 10.82 and 7.22 g m^{-2}, respectively) and followed by Butachlor 50 EC 750 g a.i./ha (within 3DAS) + one intercultivation at 25- 30 DAS(2.61, 17.18, 14.06 and 13.43 g m^{-2},respectively).

Weed control efficiency attests the magnitude of effective reduction of weed dry weight by different weed control treatments throughout the crop period. Among the weed management practices imposed, pooled mean on the weed control treatment for all the three year with Butachlor 50 EC 750 g a.i./ha (within 3 DAS) + one intercultivation at 25- 30 DAS (T_5) at 30 , 60, 90 DAS and at harvest showed highest weed control efficiency (92.50, 82.60, 87.09 and 94.95% ,respectively) and it was found on par to

Bensulfuron ethyl 0.6 G + pretilachlor 6.0 G @ 0.33kg a.i./ha (within 3DAS) + one intercultivation at 25-30 DAS(T_4) and Bispyribac sodium 10 SC 10 g a.i./ha (15-20 DAS) + one intercultivation 35- 40 DAS(T6) (Table 4). This is due to the reason that butachlor is used as pre-emergence broad spectrum herbicide which was found very effective for the control of sedges and broad leaf weeds. It is mainly obsorbed by the leaves and is translocated within the plant (Hussain *et al.,* 2008).

Table 4: Weed dry weight (g m^{-2}) at 30, 60, 90 DAS and at harvest as influenced by chemical weed management in kodo millet (3 years pooled data).

Treatment	Weed dry weight (g) 30 DAS				Weed dry weight (g) 60 DAS				Weed dry weight (g) 90 DAS				Weed dry weight (g) at harvest			
	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled
T_1	0.27	0	1.00	0.42	10.3	16.42	23.70	16.80	13.92	15.89	28.50	19.44	1.4	2.36	53.77	19.18
T_2	0.24	0	1.00	0.41	30.9	28.01	22.47	27.14	25.24	26.65	29.70	27.20	2.99	4.15	54.93	20.69
T_3	0.85	0.94	1.00	0.93	16.8	27.39	14.13	19.45	4.58	10.42	29.53	14.84	4.23	5.56	35.28	15.02
T_4	0.67	1.04	1.00	0.90	18.7	28.2	14.13	20.35	5.47	11.16	28.47	15.03	1.72	7.31	31.25	13.49
T_5	4.15	1.69	2.00	2.61	14.0	23.29	14.27	17.18	10.86	20.09	11.23	14.06	9.88	8.01	22.57	13.43
T_6	2.49	4.13	2.00	2.87	12.7	29.77	13.74	18.73	41.27	73.02	12.25	42.18	13.57	29.69	28.56	23.94
T_7	2.39	2.89	2.00	2.43	22.0	41.54	14.23	25.93	18.88	66.9	18.45	34.74	6.62	13.56	52.37	24.18
T_8	3.6	2.42	2.00	2.67	19.8	35.32	21.15	25.41	16.55	27.61	24.57	22.91	11.18	9.83	52.90	24.64
T_9	3.92	2.32	2.00	2.75	19.6	46.21	14.10	26.64	10.41	34.28	24.10	22.93	5.99	18.11	58.73	27.61
T_{10}	0	0	2.00	0.67	3.4	6.61	13.03	7.66	4.38	4.06	24.03	10.82	0.66	1.45	19.56	7.22
T_{11}	9.58	11.69	3.00	8.09	42.8	98.51	36.56	59.29	87.72	167.36	57.80	104.29	72.56	149.76	78.96	100.43
S.Em±	**0.20**	**0.10**	**0.18**	**0.19**	**1.19**	**1.81**	**1.09**	**1.32**	**1.17**	**2.34**	**2.60**	**1.90**	**0.73**	**1.31**	**2.75**	**1.61**
CD at 5%	**0.58**	**0.30**	**0.52**	**0.56**	**3.48**	**5.30**	**3.22**	**3.88**	**3.44**	**6.85**	**7.62**	**5.57**	**2.13**	**3.85**	**8.07**	**4.73**
CV	**13.44**	**7.16**	**17.90**	**14.59**	**10.73**	**9.04**	**10.38**	**9.54**	**9.32**	**9.73**	**17.14**	**11.01**	**10.59**	**10.00**	**10.73**	**10.59**

Significantly higher weed index was noticed in the treatment T_5 i.e., Butachlor 50 EC 750 g a.i./ha (within 3 DAS) + one intercultivation at 25- 30 DAS (3.82) followed by treatment T_4(19.38) and treatment T_6(19.51).Whereas, significantly higher weed index was found in the treatment T_{11}i.e, unweeded check (72.85).

The lower weed index attributed to the reduction in the weed dry weight as a result of effective weed control in these treatments (Table 4). Lower weed index is a result of satisfactory control of weeds owing to increase in yield. This enabled the crop to utilize available resources like light, nutrients, moisture and space resulting in higher yield. This is in agreement with the findings of Satish Kumar Pandey *et al.,* (2018); Vinothini and Murali Arthanari (2018).

Table 5: Weed control efficiency (%) at 30, 60, 90 DAS and at harvest as influenced by chemical weed management in kodo millet(3 years pooled data).

Treatment	Weed control efficiency (%) 30 DAS				Weed control efficiency (%) 60 DAS				Weed control efficiency (%) 90 DAS				Weed control efficiency (%) at harvest				Weed Index (%)			
	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled	2018	2019	2020	Pooled
T_1	42.79	50.4	53.56	48.92	46.88	57.7	64.85	56.48	53.38	56.73	60.97	57.03	86.56	80.2	55.27	74.01	51.40	52.73	52.70	52.34
T_2	49.71	52.2	56.77	52.89	52.17	64.15	64.64	60.32	79.39	59.93	63	67.44	81.2	90.94	57.25	76.46	50.00	50.41	49.98	50.13
T_3	83.54	64.24	59.1	68.96	53.81	53.1	70.29	59.07	81.61	83.52	57.05	74.06	90.9	93.45	57.56	80.64	15.98	25.04	43.65	28.92
T_4	84.4	90.88	95.87	90.38	68.43	76.31	84.34	76.36	93.79	93.33	72.69	86.60	97.66	97.23	87.92	94.27	5.87	12.56	37.95	19.38
T_5	88.09	91.89	97.53	92.50	79.57	83.37	84.87	82.60	94.61	93.81	72.86	87.09	98.12	98.43	88.29	94.95	3.34	3.77	4.25	3.82
T_6	84.43	85.31	91.17	86.97	66.46	72.24	84.17	74.29	92.86	90.46	70.47	84.60	95.98	96.29	85.06	92.44	7.10	17.10	32.04	19.51
T_7	84.37	80.02	75.17	79.85	58.06	71.64	80.98	70.23	87.51	87.95	63.85	79.77	91.88	94.65	72.19	86.24	19.21	35.16	35.40	30.96
T_8	51.55	79.35	74.07	68.32	53.37	69.7	75.82	66.30	88.35	79.55	68.68	78.86	84.84	87.91	80.1	84.28	23.09	26.85	20.02	23.50
T_9	58.97	75.1	93.07	75.71	68.41	71.38	75.41	71.73	87.05	84.03	70.13	80.40	94.29	95.12	72.65	87.35	22.23	36.37	28.69	29.97
T_{10}	88.66	100	100	96.22	91.77	93.31	87.67	90.92	95.45	98.45	76.72	90.21	99.11	99.03	92.29	96.81	0.00	0.00	0.00	0.00
T_{11}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62.81	65.07	89.80	72.85
S.Em±	**6.08**	**6.80**	**6.30**	**6.21**	**5.73**	**6.03**	**6.93**	**6.20**	**7.06**	**7.05**	**5.26**	**7.03**	**7.58**	**7.04**	**7.03**	**2.68**	**23.73**	**29.55**	**35.86**	**30.13**
CD at 5%	**17.84**	**19.96**	**18.49**	**18.21**	**16.80**	**17.69**	**20.34**	**18.18**	**20.72**	**20.68**	**15.44**	**20.63**	**22.23**	**20.65**	**20.63**	**7.24**	**1.28**	**1.74**	**2.27**	**1.99**
CV	**16.18**	**16.85**	**15.08**	**15.55**	**17.08**	**16.12**	**17.09**	**16.67**	**15.76**	**16.23**	**14.83**	**17.05**	**15.69**	**14.37**	**17.90**	**13.96**	**3.74**	**5.11**	**6.67**	**5.83**

CONCLUSION

Significantly higher grain and straw yield were obtained with two intercultivation and one hand weeding(T10) followed by Butachlor 50 EC 750 g a.i./ha(within 3 DAS) + one inter cultivation at 25-30 DAS(T_5), Bensulfron ethyl 0.6 G + Pretilachlor 6.0 G + one inter cultivation at 25-30 DAS, Byspiribac sodium 10 SC (15-20 DAS) + one intercultivation at 35-40 DAS which all found superior over other treatments. This option was found to be the feasible option due to control of the broad spectrum of weeds more efficiently and thereby increasing the grain, straw yield and economics of kodo millet. Therefore, herbicide weed control appears to be the viable measure to reduce a wide variety of weeds in a short time and economically.

Acknowledgements. The authors are thankful to the Indian Council of Agricultural Research, New Delhi and ICAR-IIMR, Hyderabad for providing financial support to carry out the research.

Conflict of interest. There is absolutely no conflict of interest by the authors to declare.

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