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Effect of weed management on growth and yield of *kharif* fodder sorghum (*Sorghum bicolor* L. Moench)

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Abstract
The experiment was carried out at RCA, Udaipur (Rajasthan) during *Kharif* season, 2022 to study the "Weed Management in *kharif* Forage Sorghum (*Sorghum bicolor* L. Moench)". The experiment consists of twelve treatments in randomized block design within three replications. Results revealed that maximum growth characters and yield was recorded under weed free treatment. Among the weed control practices, Maximum plant height, stem girth (246.13 and 3.18 cm respectively) and maximum green and dry fodder yield (66.49 and 14.84 t ha^{-1}) was recorded by the application of atrazine 50% WP @ 0.50 kg *a.i.* ha^{-1} applied as PE followed by atrazine 50% WP @ 0.50 kg *a.i.* ha^{-1} as PoE (T_5).

Keywords: Forage sorghum, herbicides, weeds, growth parameters, yield Indian mustard, path coefficient analysis

Introduction
Kharif forage sorghum [*Sorghum bicolor* (L.) Moench] has played an indispensable role in animal nutrition as nutritious, palatable, dietary staple forage. In *Kharif*, it constitutes a major part of green fodder and later as a stover. Sorghum is known as the "camel crop" because of its resistance to drought. In comparison to maize, sorghum has high nutritive (Nicholas *et al*., 1998) [1]. It's juicy and well-liked by cattle and can withstand high temperature extremes and minimal soil moisture. Sorghum have wonderful features like it has quick and profuse tillers, leafiness, high dry matter content, hardiness, low oxalate and fibre and relevance for silage make it an supreme fodder crop. The forage sorghum on dry matter basis, contains 9 to 10% crude protein, 65% neutral detergent fibre, 7 to 42% acid detergent fibre, 32% cellulose and 21 to 23% hemi cellulose at 50% flowering stage (Kumar *et al*., 2012) [3]. One of the major anti-quality factors of sorghum is the Cyanogenic (HCN) glycoside Dhurrin which is harmful to cattle when fed at early vegetative stage. Sorghum is extensively cultivated throughout the world. By area, than ninety percent of the world's sorghum may be located in growing countries, in particular in Africa and Asia. Globally, sorghum production was 58.54 million metric tonnes in 2022. India ranks sixth and contributes 8 percent to the total sorghum production globally *i.e.*, 4.40 million metric tonnes (USDA, 2022) [4]. Out of 4.80 million hectares total area under forage sorghum is 2.6 million hectares. Weeds are considered as a major constraint in *Kharif* forage sorghum. As the crop is sown soon after beginning of the monsoon and environmental factors that are favorable for weed growth and this become major restraint in increasing the sorghum productivity.
The integration of herbicides with cultural methods such as intercropping with legume crops and use of pre-emergence and post-emergence herbicides in combination, with manual weeding methods will make the sorghum forage crop weed free effectively and thus enhance the crop growth and yield. The aim of this study investigates high quality *Kharif* forage sorghum production which is economically sound and can be achieved by application of environmentally viable treatment of herbicides and intercropping system for weed management.

Material and Method
To evaluate the effect of various weed management treatments on growth parameters and yield of fodder. The experiment was conducted at Instructional Farm, Department of Agronomy, RCA, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan during *Kharif* season 2022.

Treatments in the study were Atrazine 50% WP @ 0.50 kg a.i ha^{-1} as pre-emergence (PE) (T_1), Metolachlor 50% EC @ 1.00 kg *a.i* ha^{-1} as PE(T_2), Pyroxasulfone 85% w/w WG @ 0.1275 kg *a.i* ha^{-1} as PE (T_3), 2,4-D Na Salt 80% WP @ 0.75 kg *a.i.* ha^{-1} as post- emergence (PoE) at 20 DAS (T_4), T_1 + Atrazine 50% WP @ 0.50 kg *a.i.* ha^{-1} as (PoE) (T_5), T_1 + 2,4-D Na Salt 80% WP @ 0.75 kg *a.i.* ha^{-1} ha as PoE at 20 DAS (T_6), Intercropping with cowpea (1:1 additive series) without herbicides (T_7), Intercropping with cowpea (1:1 additive series) + Pendimethalin 30% EC @ 0.75 kg *a.i.* ha^{-1} as PE (T_8), Intercropping with blackgram (1:1 additive series) without herbicides (T_9), Intercropping with blackgram (1:1 additive series) + Pendimethalin 30% EC @ 0.75 kg *a.i.* ha^{-1} as PE (T_{10}), Weed free (Two hand weeding at 15 and 35 DAS) (T_{11}), Weedy check (T_{12}). At initial soil of the field was clay loam which was low in organic carbon and available nitrogen (274.14 kg ha^{-1}), medium in available phosphorus (22.00 kg ha^{-1}) and higher in available potassium (316.00 kg ha^{-1}). Forage sorghum variety CSV 32F was sown in 4.00 m×5.10 m size plot. Immediately after sowing Pre emergence herbicides were applied in moist soil and post emergence herbicides were applied at 20 DAS with a knapsack sprayer of volume 15 litre.

Results and Discussion

Growth studies

Data presented in table 1 showed that plant height and stem girth at 3rd node was significantly affected by diverse weed management practices. Plant height (246.95 cm) was maximum under weed free treatment (two HW at 15 and 35 DAS) (T_5). Among herbicide treatments, T_1 + atrazine 50% WP (T_5) recorded maximum plant height (246.13 cm) which was 17.59 percent more over weedy check. It was statistically at par with T_1, T_2, T_3, T_6, T_8 and T_{10}. Maximum stem girth (3.18 cm) of sorghum was recorded by the application of T_1 + atrazine 50% WP (T_5) which was statistically at par with all the treatment over weedy check. The aforesaid improvements was due to direct impact of least crop-weed competition while, indirect effect might be due to least competition for plant growth factors *viz*., light, space, water and nutrient *etc*. (Kropff, 1993) [2]. Due to lower crop-weed competition for growth resources and a favorable condition for better crop growth corresponding to increase in plant growth parameters. Leaf: stem at flowering was not affected by treatments of weed management.

Green and dry fodder yield was appreciably prejudiced by weed management. Significantly maximum green fodder yield (69.62 and 20.71 t ha^{-1} respectively) was obtained in weed free treatment (two hand weeding at 15 and 35 DAS) (T_{11}) and it was superior over rest of the treatments. Among weed control treatments, higher green and dry fodder yield was recorded under T_1 + atrazine 50% WP (T_5). Declined crop weed competition enables favourable environment for the fodder sorghum for its enhanced expression in terms of vegetative potential. This increment in potential results in significant increase in growth characters and yield attributes ultimately leading to higher green and dry fodder yield of sorghum.

Table 1: Effect of weed management on growth parameters and yield of *Kharif* fodder sorghum

Treatments	Growth parameters			Yield	
	Plant height (cm) at harvest	Leaf: Stem at Flowering	Stem girth at 3rd node (cm)	Green fodder (t ha^{-1})	Dry fodder (t ha^{-1})
T_1: Atrazine 50% WP	234.93	0.19	3.04	42.99	13.04
T_2: Metolachlor 50% EC	240.93	0.19	3.07	46.99	13.41
T_3: Pyroxasulfone 85% w/w WG	232.40	0.18	3.05	36.51	11.48
T_4: 2,4-D Na salt 80% WP	220.50	0.19	3.03	21.49	6.69
T_5: T_1+ atrazine 50% WP	246.13	0.22	3.18	66.49	14.84
T_6: T_1+ 2,4-D Na salt 80% WP	241.13	0.24	3.05	34.40	11.20
T_7: IC with cowpea without herbicides	224.60	0.19	3.05	29.32	9.35
T_8: IC with cowpea + Pendimethalin	230.47	0.19	3.08	33.84	10.43
T_9: IC with blackgram without herbicides	218.10	0.22	3.07	28.82	9.02
T_{10}: IC with blackgram + Pendimethalin	228.27	0.18	3.08	32.16	10.38
T_{11}: Weed free (two HW at 15 and 35 DAS)	246.95	0.23	3.16	69.62	20.71
T_{12}: Weedy check	202.83	0.18	1.35	8.99	2.88
SEm+	7.22	0.02	0.10	2.08	0.62
CD (P=0.05)	21.17	NS	0.29	6.09	1.81

Conclusion

Weeds in *Kharif* season can affect production of forage sorghum awfully. In this study weed free treatment gave maximum growth, green fodder and dry fodder yield. However, among various herbicide treatments atrazine 50% WP @ 0.50 kg *a.i.* ha^{-1} applied as Pre emergence followed by atrazine 50% WP @ 0.50 kg *a.i.* ha^{-1} as post emergence (T_5) gave best result and recorded maximum growth characters, green fodder yield and dry fodder yield.

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