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ORIGINAL ARTICLE

EVALUATION OF NEW HERBICIDES FOR WEED MANAGEMENT IN HYBRID SORGHUM

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ABSTRACT

A field experiment was carried out during March – June, (Summer) 2014 at Annamalai University Experimental Farm, Annamalainagar, Chidambaram to evolve a suitable new herbicide for weed management in hybrid sorghum. The experiment was laid out in Randomized Block Design with eight treatments replicated thrice. The treatments were pre and post-emergence herbicides (pendimethalin and topramezone, imazethapyr, tembotrione, mesotrione + atrazine) which were compared with hand weedings. Among the different treatments, pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS + post-emergence application of topramezone 75 g ha^{-1} on 21 DAS significantly recorded the lowest weed density, weed dry matter and weed control index (WCI). It was also found superior in various growth and yield attributing parameters and attained significantly highest grain yield (4068 kg ha^{-1}) of hybrid sorghum. This was on par with hand weeding twice at 20 and 40 DAS. The least value of growth and yield parameters were recorded in unweeded control with a grain yield of (1820 kg ha^{-1}).

Keywords: Pendimethalin, topramezone, tembotrione, imazethapyr, mesotrione + atrazine, hybrid sorghum.

1.INTRODUCTION

Sorghum [*Sorghum bicolor* (L). Moench] is the fifth most important cereal crop in the world. It is an important coarse cereal crop for semi-arid tropical regions of India and it is traditionally grown for food, fodder, animal feed and more recently as bio-energy crop. Sorghum plants can grown under even in low water conditions and tolerant to high temperature (Laidlaw *et al.,* 2009). Since the crop has grown in wide adaptability, rapid growth and high green fodder yields it is also considered as a "camel crop". It is an important staple food grains for millions of poor and food insecure people. Comparing the production potential of sorghum, the low productivity of sorghum is attributed to several reasons. Among them weeds are a major deterrent for increasing the grain sorghum productivity and quality. Grain sorghum seedlings are comparatively small and grow slowly for first 20-25 days Rizzardi*et al.* (2004) andconsequently do not compete well with weeds in early stages of crop growth. Yield loss in grain sorghum due to weeds ranges from 15 – 83% (Mishra *et al.,* 2012). Now a days labour component in agriculture is becoming scarce, not available at time. Under these situations manual hand weeding is difficult and it is laborious and time consuming (Rajput and Khushwaha, 2005). Under these circumstances chemical weed control is a better supplement to manage the weeds and forms an excellent alternative to manual weeding. Choice of herbicides also decides the success of weed control programme. But it is difficult to find broad spectrum of herbicides as herbicides are often crop specific. Pre-emergence herbicides ensure a significant role for initial weed competition and nutrient losses. Similarly the post-emergence herbicides also have a significant role in reducing the crop weed competition at the time of critical growth stages of crop. The objective of present study was undertaken to find out the new herbicide solution for weed control in hybrid sorghum.

2.MATERIALS AND METHODS

A field experiment was conducted during summer (March – June) 2014 at Annamalai University, Experimental Farm, (11^0 $24^{'}$ N latitude, 79^0 $41^{'}$ E longitude at ± 5.79 meters above mean sea level) to evaluate the new herbicides for weed management in hybrid sorghum. The soil was clay loam in texture with pH 7.2, organic carbon 0.80% and low in nitrogen (227 kg ha^{-ss1}), medium in phosphorus (20 kg ha^{-1}) and high in potassium (323.5 kg ha^{-1}). The experiment was laid out in randomized block design comprised with eight treatments replicated thrice viz., T_1: unweeded control, T_2: hand weeding twice at 20 and 40 DAS, T_3: pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS, T_4: pre-emergence application of pendimethalin 0.70 kg

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ha^{-1} on 3 DAS + one hand weeding on 30 DAS, T_5: pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS + post-emergence application of toptamezone 75 g ha^{-1} on 21 DAS, T_6: pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS + post-emergence application of imazethapyr 500 g ha^{-1} on 21 DAS, T_7: pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS + post-emergence application of tembotrione 120 g ha^{-1} on 21 DAS, T_8: pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS + post-emergence application of mesotrione+atrazine 0.275 kg ha^{-1} on 21 DAS. Bold and healthy seeds of sorghum hybrid (MSH-51) were sown by ridges and furrows at a spacing of 45 x 15 cm with the seed rate of 7.5 kg ha^{-1}. Recommended doses of FYM at 12.5 t ha^{-1} were applied before sowing and inorganic fertilizers (80:40:40 N, P_2O_5, K_2O ha^{-1}) were applied to hybrid sorghum. Pre-emergence and post-emergence herbicides were applied with knapsack sprayer and fitted with flood jet nozzle using 500 litres of water ha^{-1} with adequate soil moisture as per the treatment schedule. Irrigation was adjusted with weather condition, receipt of rains and as per the crop requirement. Weed population and biomass were recorded at 30 and 60 DAS by using quadrat of 0.25 m^{-2}. Data on weed biomass, WCI, crop yield components and yield was recorded from net plot areas. The experimental data was subjected to analysis (ANOVA) as suggested by Panse and Sukhatme (1978). The critical difference was worked out at P = 0.05.

3.RESULTS AND DISCUSSION

The major dominant weed flora in the sorghum field constituted by *Cynodondactylon, Cyperusrotundus, Echinochloacrusgalli* and *Commelinabenghalensis.*Weed management employed in the sorghum field showed a significant change in weed count, dry weed biomass and nutrient uptake by weeds and ultimately demonstrated on weed control efficiencies

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Weed parameters

The practiced weed management treatments significantly influenced the weed population. Among that pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of topramezone 75 g ha^{-1} on 21 DAS recorded the lowest weed population, which remained statiscally on par with hand weeding twice at 20 and 40 DAS. This was followed by pre-emergence application of pendimethalinm 0.70 kg ha^{-1} on 3 DAS and post-emergence application of imazethapyr 500 g ha^{-1} on 21 DAS. The lowest dry weight of weeds was observed under pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of topramezone 75 g ha^{-1} on 21 DAS though it was found statiscally on par with twice hand weeding. The data presented in Table 1. Indicated that maximum weed control index (93.22% at 30 DAS and 92.76% at 60 DAS) and minimum nutrient removal by weeds (15.13 kg N, 6.75 kg P, 13.86 kg K ha^{-1}) was observed under pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of topramezone 75 g ha^{-1} on 21 DAS and it was on par with twice hand weedings. This might be due to effective control of weeds under these treatments in initial stagess which reduces the crop weed competition resulted in less number of weeds and ultimately lower weed biomass.

The weedy check recorded significantly the highest number and dry weight of weeds. This is due to weed competition throughout the crop duration and resulted in maximum weed count, dry matter and maximum nutrient removal by weeds. This finding was reported by kandasamy (2014).

Table 1. Weed density, weed dry weight, weed control index as influenced by different treatments

Treatments	Weed density		Weed biomass (g m^{-2})		WCI (%)	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Unweeded control	130.64 (11.45)	177.59 (13.34)	139.95	157.85	-	-
Hand weeding twice on 20 and 40 DAS	28.23 (5.36)	52.85 (7.30)	11.15	13.56	92.03	91.40
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence	106.08 (10.32)	147.89 (12.18)	64.85	75.62	53.66	52.09
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ one hand weeding on 30 DAS	84.39 (9.21)	119.99 (10.97)	55.60	65.76	60.27	58.34
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ topramezone 75 g ha^{-1} on 21 DAS as post-emergence	26.19 (5.16)	49.01 (7.03)	9.48	11.43	93.22	92.76
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ imazethapyr 500 g ha^{-1} on 21 DAS as post-emergence	42.65 (6.56)	71.42 (8.48)	17.83	21.05	87.26	86.66
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ tembotrione 120 g ha^{-1} on 21 DAS as post-emergence	58.16 (7.65)	91.56 (9.59)	23.42	27.28	83.26	82.72
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ mesotrione + atrazine 0.275 kg ha^{-1} on 21 DAS as post-emergence	64.88 (8.08)	95.64 (9.80)	24.20	29.04	82.70	81.60
S.Ed	0.42	0.51	2.26	2.49	-	-
CD	0.90	1.10	4.85	5.35	-	-

Table 2. Yield and yield attributes of sorghum as influenced by different weed management treatments

Treatments	Ear head length	Ear head diameter	No.of grains ear head^{-1}	Grain yield	Stover yield
Unweeded control	18.57	9.01	925.13	1820	5088
Hand weeding twice on 20 and 40 DAS	30.73	16.16	1673.00	3970	8422
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence	20.67	10.32	1126.31	2207	5706
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ one hand weeding on 30 DAS	22.97	11.53	1262.38	2622	6340
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ topramezone 75 g ha^{-1} on 21 DAS as post-emergence	31.10	16.25	1694.59	4068	8760
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ imazethapyr 500 g ha^{-1} on 21 DAS as post-emergence	28.53	14.93	1542.89	3547	7815
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ tembotrione 120 g ha^{-1} on 21 DAS as post-emergence	25.70	13.73	1413.47	3148	7208
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ mesotrione + atrazine 0.275 g ha^{-1} on 21 DAS as post-emergence	25.34	13.21	1402.45	3025	6930
S.Ed	0.95	0.55	59.17	177.90	267.32
CD	2.04	1.19	126,92	381.59	573.41

Treatments	Cost of cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	B:C Ratio
Unweeded control	30717	33498	2781	1.09
Hand weeding twice on 20 and 40 DAS	35276	71711	36435	2.03
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence	32692	40386	7694	1.24
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ one hand weeding on 30 DAS	34973	47753	12780	1.37
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ topramezone 75 g ha^{-1} on 21 DAS as post-emergence	34213	73536	39323	2.15
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ imazethapyr 500 g ha^{-1} on 21 DAS as post-emergence	32865	64210	31345	1.95
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ tembotrione 120 g ha^{-1} on 21 DAS as post-emergence	34517	57124	22607	1.65
Pendimethalin 0.70 kg ha^{-1} on 3 DAS as pre-emergence+ mesotrione + atrazine 0.275 kg ha^{-1} on 21 DAS as post-emergence	34567	54896	20329	1.59

Crop growth and yield

Growth and yield attributes as well as grain and stover yield were significantly influenced by different weed control practices. Results showed that significantly the highest ear head length (31.10 cm), ear head diameter (16.25 cm), number of grains ear head^{-1} (1694.59), grain yield (4068 kg ha^{-1}), stover yield (8760 kg ha^{-1}) were recorded under pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of topramezone 75 g ha^{-1} on 21 DAS. Howeverthis treatment remained statiscally equivalent to twice hand weeding at 20 and 40 DAS. This was followed by pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of imazethapyr 500 g ha^{-1} on 21 DAS. The next highest growth and yield parameters were observed under pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of tembotrione 120 g ha^{-1} on 21 DAS and it was on par with pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of mesotrione + atrazine 0.275 kg ha^{-1} on 21 DAS. The better growth characters of sorghum under these treatments might be due to effective control of weeds which might have reduced the competition of nutrients, moisture, space and radiant energy and favourable conditions encouraged the higher uptake of nutrients and better utilization of other resources the crop. Similar findings were reported by Hatti *et al.* (2014).

Economics

The investigated data revealed that maximum net returns of Rs. 39323 ha^{-1} and B:C ratio of 2.15 were realized with pre-emergence application of pendimethalin 0.70 kg ha^{-1} on 3 DAS and post emergence application of topramezone 75 g ha^{-1} on 21 DAS and it was followed by hand weeding twice. This might be due to utilize the resources effectively by crop. The least B:C ratio of 1.09 was recorded under unweeded control. This might have been due to unrestricted weed growth resulted in affecting the performance of the crop.

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