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EVALUATION OF WEED MANAGEMENT PRACTICES FOR RECENTLY RELEASED SORGHUM CULTIVARS (SORGHUM BICOLOR (L.) MOENCH) UNDER RAINFED CONDITION

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ABSTRACT
The present investigation was conducted at Research Farm, College of Agriculture, Indore during *Kharif* 2009 and2010 on weed management practices for sorghum cultivars. The experiment comprising of five weed management practices as main plot treatments and four sorghum cultivars as sub plot treatments was laid out in Split Plot Design with 3 replications on vertisol with P^H 7.50. The experimental field was infested with *Echinochloa colonum, Cyprus rotandus, Commelina benghalensis, Cinotis axillaria, Cynodon dactylon, Degitaria restroflexa, Setaria glauco, Digeria arvensis, Amaranthus virdis, Alternaria sessills, Euporbia geniculata* and *Parthenium histrophorus*. The weed free treatment and pre emergence application of Atrazine @ 0.5 kg a.i. /ha with one hand weeding at 30 DAS were found effective weed management practices to control the weeds (100% and 70.2% Weed Control Efficiency) for all sorghum cultivars. Among the sorghum cultivars, CSH 16 produced the significantly highest grain yield (4223 kg/ha), while sorghum variety CSV 20 recorded the maximum stover yield (16028 kg/ha). Sorghum hybrid CSH 16 and sorghum variety CSV 20 had more weed suppressing ability (48.9% and 46.7% WCE) as compared to other cultivars.

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] an important staple food crop in the world, it is the fifth most important cereal crop after wheat, rice, maize and barley. In Madhya Pradesh sorghum crop is grown mainly in *kharif* season and covered an area of 0.39 million ha and production 0.61 million tonnes with productivity 1583 kg/ha (Commissioner Land Record, Gwalior, 2011-2012). To increase the productivity of sorghum weed management and cultivars are very important factor. Sorghum being a rainy season crop, it faces the problem of heavy infestation of weeds. Weeds not only reduce the yield by 15 to 97% depending on crop cultivars, nature and intensity of weeds and environmental conditions but also deteriorate the quality of the produce (Tamado *et al*., 2002.). Therefore weed management in rainfed sorghum is an important aspect to check the nutrient, water loss and to increase the grain and fodder yield. Manual weeding and hoeing is a difficult task in sorghum, as the operation coincides with continuous rains. Expensive wages of labours and their unavailability during the critical period of weed competition are other problems (Rajput and Khushwah, 2005). Pre-emergence application of herbicides has been reported to provide adequate control over weeds in the early stage of crop growth through reduction of crop weed competition resulting increase in yields. Inclusion of legume like cowpea, green gram and black gram has proved effective for reducing the weeds due to their smothering effect (Solaimalai and Shivakumar, 2000). Development of better adapted, high yielding sorghum cultivars has increased the yield potential and the appropriate weed management practice required by the crop. Cultivars producing large amounts of biomass remove greater quantities of soil nutrients. High yielding varieties of sorghum removed on an average 22 kg N, 13.3 kg P2O5 and 34 kg K2O to produce one tone of grains (Kaore, 2006). Weed suppressing ability is also differing of particular cultivar. Present investigation aims to control early weeds of the sorghum crop during *kharif* season with the help of combinations of pre emergence herbicides and hand weeding. Therefore, keeping this in view, an investigation of weed management in cultivars of sorghum was conducted to study the relative efficacy of different herbicides to control weeds. Therefore, keeping this in view an investigation was carried out.

MATERIALS AND METHODS

The present investigation was taken up during *Kharif* season of 2009 and 2010 at Research Farm, RVSKVV, College of Agriculture, Indore. Indore is situated in Malwa Plateau in western parts of Madhya Pradesh at 22º43' N latitude and 75º66' E longitudes with an altitude of 555.5 meters above the mean sea level. Total rainfall received during the crop growing period was 1017 and 786.6 mm with 39 and 34 rainy days respectively in both the years. The soil of the experimental field was typical medium black soil (vertisol) low in organic carbon (0.41%), available N (200 kg ha^{-1}), medium in available phosphorus (11.6 kg ha^{-1}) and high in

available potash (482 kg ha^{-1}) with soil P^H 7.50. The experiment was laid out in split plot design having 20 treatment combinations comprising 5 weed management practices (Weedy check, weed free check, atrazine @ 0.50 kg/ha as pre-emergence alone, atrazine @ 0.50 kg/ha as pre-emergence + one hand weeding at 30 DAS and intercropping with cowpea (2:2 rows) + one hand weeding) as main plot treatments and 4 sorghum cultivars (CSH 16, CSH 23, CSV 20 and JJ 1022) as sub plot treatments with 3 replications. The recommended dose of nitrogen @ 80 kg/ha through Urea, P_2O_5 @ 40 kg/ ha through Single Super Phosphate and K_2O @ 40 kg/ ha through Muriate of Potash were applied. The entire dose of phosphorus and potassium and half of the nitrogen were applied at the time of sowing in the furrow below the seed. The remaining dose of nitrogen was applied at 30 DAS. Sorghum seed was treated with Thiomethoxam @ 3 g kg^{-1} of seed. Seed rate of sorghum was used 8 kg/ ha. Hand sowing was done with the help of argada with row-to-row distance of 45 cm. Depth of sowing 3-4 cm was kept. Under plant protection measures, application of Phorate 10 G @ 20 kg/ ha, applied before sowing in furrow of the experimental plots. Application of Carbofuron 3 G @ 10 kg/ ha was done at 30 days after sowing to control stem borer. The total number of weeds was counted in a quadrate of 1 m at 3 random places in each plot and mean was worked out for recording weed population/m^2. The weeds from each quadrate were then uprooted and bulked. The dry weight of this bulk was recorded after kept in an oven at 54ºC for drying. The average dry weight per quadrate (1 m) was worked out and expressed in g/m^2.

Weed-control efficiency was calculated and expressed as:

$$WCE = \frac{DWC - DWT}{DWC} X100$$

Where, WCE, weed-control efficiency; DWC, dry weight of weeds in control plots; DWT, dry weight of weeds in treated plots. The plant height was measured on the main shoot from the ground surface to the tip at harvest. The observation of leaf-area index was taken at harvesting. It expresses the total leaf area in relation with the total ground area in which the crop is grown, as calculated by the following equation:

$$LAI = \frac{Y}{X}$$

Where, LAI, Leaf area index; y, Total leaf area of the crop; x,Total ground area under the crop.

Dry matter/plant studies were made on a sample of 3 plants per plot removed from each of the plot at harvesting and was kept in an oven at 54ºC for 24 hours. The dry weight of the sample was recorded and averaged for recording dry matter/ plant. The crop was harvested on 21 and 23 October, respectively, in 2009 and 2010.

RESULTS AND DISCUSSION

Weed flora

Important weed species recorded in the experimental field were *Echinochloa colonum , Cyprus rotandus ,Commelina benghalensis ,Cinotis axillaria, Cynodon dactylon , Degitaria restroflexa , Setaria glauco, Digeria arvensis , Amaranthus virdis L ,Alternaria sessills, Euporbia geniculata* and *Parthenium histrophorus*. During both the years, *Echinochloa colonum* and *Cyprus rotandus* were predominant weeds.

Weed population, dry weight of weeds and weed control efficiency

On the basis of two year pooled data of experiment revealed that weed free condition produced significantly lesser weed population, dry weight of weeds and the maximum weed control efficiency (100%). Application of atrazine @ 0.5 kg ai /ha as pre emergence + one hand weeding at 30 DAS was the second best treatment with weed population (36.33/m^2), weed biomass (43.33g/m^2) and weed control efficiency (70.22%). Superiority of these treatments with respect to less weed population and dry weight of weeds was mainly due to effective control of early as well as late flushes of weeds under these treatments during both the years. These findings of close conformity with Budher and Tamilskhvan. (2003), Rao *et al*. (2007), Sujathamma, P. (2015). Among the sorghum cultivars,

Table 1 : Effect of weed management practices and genotypes on growth and yield attributing characters of sorghum (Pooled data of 2009 and 2010)

SN	Treatment	Plant height(cm)	Dry matter (g)/plant	Leaf Area Index (%)	CGR (g/day/m^2)	Length of earhead(cm)	Grain weight /earhead	No. of grains /ear head (g)	1000 Grain weight(g)
A	Weed management practices								
1	Weedy check	226.7	66.4	3.61	0.89	25.22	48.17	1931	29.09
2	Weed free	297.2	70.6	4.73	1.74	28.06	61.58	3012	35.93
3	Atrazine alone	255.9	68.1	4.06	1.26	25.66	53.92	2490	31.23
4	Atrazine + 1 HW	295.8	70.1	4.43	1.5	27.84	58.42	2789	34.5
5	Int. Cowpea 1 HW	287.9	68.4	4.21	1.31	26.84	54.67	2609	30.93
	SEm +	5.02	0.38	0.06	0.06	0.6	1.81	92	0.39
CD (5%)	16.37	1.22	0.2	0.2	1.95	5.91	301	1.27	
B	Genotypes								
1	CSH 16	267.3	69	4.1	1.19	29.99	59.53	2695	32.69
2	CSH 23	259.3	68	4.1	1.31	26.39	51.8	2390	34.47
3	CSV 20	288.4	68.6	4.23	1.31	26.11	52.2	2512	31.35
4	JJ 1022	275.8	69.2	4.4	1.4	24.41	57.87	2668	30.83
	SEm +	7.03	0.3	0.07	0.09	0.5	2.44	145	0.61
	CD (5%)	20.33	0.87	0.21	NS	1.43	7.06	NS	1.77

Note - Application of Atrazine @ 0.5 kg a.i. /ha as pre emergence

Table 2 : Effect of Weed management practices and genotypes on yields and returns of sorghum (Pooled data of 2009 and 2010)

SN	Treatment	Yield kg ha^{-1}		Weed population (m^2)	Dry wt. of weeds (g/m^2)	WCE (%)
		Grain	Fodder			
A	Weed management practices:					
1	Weedy check	3118	10337	142.67	146.1	0
2	Weed free	4228	14940	0	0	100
3	Atrazine @ 0.5 kg a.i./ha	3565	13051	80.42	113.3	20.79
4	Atrazine @ 0.5 kg a.i./ha + 1 HW	3968	14794	36.33	43.3	70.22
5	Int. Cowpea + 1 HW	3553	13446	75.67	87.2	40.6
	SEm +	77	211	2.16	1.91	0.87
	CD (5%)	250	688	7.03	6.22	2.83
B	Genotypes					
1	CSH 16	4223	12048	48.2	60.67	48.97
2	CSH 23	3087	10399	80.67	85.67	45.17
3	CSV 20	3883	16028	80.67	87.27	44.45
4	JJ 1022	3553	14780	58.53	78.33	46.7
	SEm +	110	276	1.63	1.44	1.16
	CD (5%)	318	798	4.71	4.16	3.36

Rate: Grain Rs 850/q and Dry fodder Rs 100/q

CSH 16 was recorded minimum weed population (48.2 /m$^{2)}$ and dry weight of weeds (60.67g/m^2) with higher weed control efficiency as compared to other cultivars (Table-1). This may be due to weed suppressing ability of particular cultivar.

Growth and yields attributes

On the basis of pooled data of two year, weed free condition and application of atrazine @ 0.5 kg ai /ha as pre emergence + one hand weeding at 30 DAS were recorded significantly taller plants , more dry matter accumulation, CGR, LAI, ear head length ,weight of earhead and 1000 grain weight as compared to other weed management practices and weedy check. These manifestations in yield attributes could be seen in the light of the improvement brought by the proper management of weeds through different treatments, which resulted less competition between weeds and the crop. Ultimately increases the attributing characters of crop. The present results are accordance with the findings of Bhalla *et al*. (1998), Pandey *et al*. (2001) and Veeramani *et al*. (2001). . Sorghum cultivar CSH 16 was also found superior in these growth and yield attributing parameters over other sorghum cultivars (Table-1). It may be due to yield attributing characters of particular cultivar. Mishra *et al*. (2015) also reported that maximum panicle length (31.52 cm) and 100 –seed weight (2.98 g) was recorded by CSH 16.

Grain and Stover yield

In the year 2009, adversely affected the crop yield due to long dry spell during the month of August and September 2009. Pooled data of two year experimentation showed that weed free condition and pre- emergence application of atrazine @ 0.5 kg ai /ha + one hand weeding at 30 DAS were recorded significantly higher grain yield (42.28q and 39.68q /ha) and stover yield (149.40q and 147.94q/ha) respectively as compared to other weed management practices . It may be attributed to the competition free situation emerged due to effective weed control. Results corroborate with the findings of Kaushik and Shaktawat (2005), Singh and Sheoran (2008) and Sujathamma, P. (2015). Chhodavadia *et al*. (2014) also reported that the highest grain and stover yield was recorded with weed free treatment in greengram. Among the sorghum cultivars, CSH 16 was recorded the highest grain yield (42.23 q /ha) but maximum stover yield (160.28 q/ha) obtained by sorghum cultivar CSV 20 (Table 2). The variation in grain and stover yield of cultivars might be related to yield potential of particular cultivar. Mishra *et al*. (2015) also found that sorghum hybrid CSH 16 produced the highest grain yield (3.07 t/ha) and sorghum variety CSV 20 (SPV 1616) was recorded the maximum stover yield (12.60 t/ha).

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