Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 510-513
Received: 03-07-2018
Accepted: 04-08-2018

LH Saini
Assistant Research Scientist, Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat, India

BK Davda
Research Scientist, Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat, India

SJ Trivedi
Assistant Research Scientist, Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat, India

AK Saini
Assistant Research Scientist, Centre for Natural Resources Management, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India

Correspondence
LH Saini
Assistant Research Scientist, Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat, India

Integrated weed management in sorghum under South Gujarat conditions

LH Saini, BK Davda, SJ Trivedi and AK Saini

Abstract
A field experiment was conducted during the rainy (*Kharif*) seasons of 2010 to 2012 in heavy black soils at Main Sorghum Research Station, Navsari Agricultural University, Surat (Gujarat), to evaluate the effect of integrated weed management in rainfed sorghum (*Sorghum bicolor* L.) with pre and post emergence herbicides (Atrazine, pendimethaline and 2, 4-D) alone or combination of these herbicide followed by hand weeding and intercrop soybean as smoother crop. The maximum grain (3737 kg/ha) and straw (15258 kg/ha) yields were recorded with treatment T_2 (Three HW at 25, 50 and 75 DAS + IC at 50 DAS) pre-emergence application of atrazine 0.5 kg/ha + 1 HW at 35 DAS, which remained at par with treatments T_5 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence (3612 and 14495 kg/ha), respectively and followed by T_6 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (Grain yield 3448 and Stover yield 13794 kg/ha) on pooled basis. The maximum net returns (68786 Rs. per ha) was realized under the treatment T_5 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence followed by treatments T_2 *i.e.* Three hand weeding at 25, 50 and 75 DAS and inter-culturing operation at 50 DAS (67579 Rs. per ha) *fb* T_6 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (65816 Rs. per ha) *fb* T_7 *i.e.* Pendimethaline @ 1.0 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (62235 Rs. per ha). However, the maximum gross returns (97937 Rs. per ha) was recorded with treatment T_2 *i.e.* Three hand weeding at 25, 50 and 75 DAS and inter-culturing operation at 50 DAS followed by T_5 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence (94030 Rs. per ha) *fb* T_6 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (89653 Rs. per ha) *fb* T_7 *i.e.* Pendimethaline @ 1.0 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (86041 Rs. per ha). Whereas, the maximum B:C was recorded under the treatment T_6 *i.e.* Atrazine @ 1.5 kg/ha as PE (2.76) *fb* T_5 *i.e.* Atrazine @ 1.5 kg/ha as pre-emergence (2.72) *fb* T_7 *i.e.* Pendimethaline @ 1.0 kg/ha as pre-emergence + 2,4-D @ 1 kg/ha (amine form) at 50 DAS as post emergence (2.61).

Keywords: Herbicide, sorghum, weed management post-emergence, pre-emergence

1. Introduction
Sorghum is the fifth most important cereal in the world followed by wheat, rice, maize and barley and it is the major staple diet of the people of the semi-arid tropics. Comparing the production potential of sorghum, the low productivity in India is attributed to several reasons. Among them weed competition is major constraint. Presence of weeds during critical period reduced the yield of sorghum to the extent of 15-40% (Mishra 1997) [1].

Weeds are one of the major problems in sorghum and limiting factor for productivity. It is well established that the most critical period for crop weed competition in sorghum is 45 DAS. At initial stages, the sorghum grows slowly and is a weak competitor to most weeds; even minimal weed infestations in the early growth period reduce sorghum yields significantly. Chemical method of weed control has become efficient, time saving and cheaper with the introduction of herbicides. Use of pre-emergence herbicides assumes greater importance in the view of their effectiveness from initial stages, while post emergence herbicides may help in avoiding the problem of weeds at later stages. Chemical weed control is a better supplement to conventional method however the weed emergence pattern, application timing and stage of crop are important in chemical control. Continuous use of herbicides over a prolonged time leads to development of resistance in weeds making them difficult to control. Traditional hand weeding is the most efficient and widely adopted practice of weed management but it is labour intensive, time consuming and not economical due to high wage rates. Mechanical equipment can be time saving during peak operation, resulting in higher output per worker and reduction in the cost of weeding. However, neither herbicides nor mechanical methods are adequate for consistent and acceptable weed control. The integration of herbicide with some cultural operations or use of pre-emergence and post emergence herbicides in combination with mechanical methods can be more successful (Ishya *et al.* 2007) [5].

Thus, integrated weed management is gaining importance in management of weeds for preventing losses and increasing input-use efficiency.

Materials and Methods

The experiment was conducted at Main Sorghum Research Station, Navsari Agricultural University, Surat during kharif season of the 2010, 2011 and 2012 under south Gujarat agro climatic zone - II. Main Sorghum Research Station is located on southern part of Gujarat state and geographically located 20°-12' N latitude and 72°-52' E longitude with an altitude of 12.0 meters above mean sea level. The soil of the experimental field was heavy black which represents the typical black cotton soils of South Gujarat and medium in organic matter, medium in organic carbon (0.38 to 0.45%) and available nitrogen (159 kg/ha), medium in available phosphorus (29-30 kg/ha) and high in available potash (550-650 kg/ha) with 7.6 to 7.7 soil pH. The soil has flat topography and characterized by medium to poor drainage with good water holding capacity. The soil was slightly alkaline (PH 7.7) with normal electric conductivity (0.36 dS/m). Eight treatments comprising of weed management practices *viz.,* T1: Weedy check, T2: Weed free condition, weeding at 25, 50 and 75 DAS + one inter culturing at 50 DAS, T3: Pre-emergence application of Atrazine @ 1.5 kg/ha, T4: Pre-emergence application of Pendimethaline @ 1.0 kg/ha, T5: Atrazine Pre-emergence application of Atrazine @ 1.5 kg/ha + one hand weeding at 50 DAS, T6: Pre-emergence application of Atrazine @ 1.5 kg/ha + post emergence application of 2,4-D @ 1 kg/ha (amine form) at 50 DAS, T7: Pre-emergence application of Pendimethaline @ 1.0 kg/ha + post emergence application of 2,4-D @ 1 kg/ha (amine form) at 50 DAS, T8: Pre-emergence application of Pendimethaline @ 1.0 kg/ha + soybean intercrop as a smoother crop, were evaluated in randomized block design with three replications. The improved and popular cultivar *i.e.* GJ 38 of sorghum was used for cultivation.

The crop was harvested manually with the help of sickle when seed almost matured and stover had turned yellow. The sun dried bundles were threshed and winnowed and seed so obtained were weighed and data on seed and stover yields were recorded. The economics of the treatments was carried out on the basis of prevailing market prices of inputs and outputs. Gross returns were calculated based on the seed and stover yields of the crop and their prevailing market prices during the respective crop seasons. Net returns were calculated by subtracting cost of cultivation from gross returns. The benefit: cost ratio was calculated by dividing the net returns with cost of cultivation. The statistical analysis of data was done using analysis of variance (ANOVA) technique for split plot design at 0.05 probability level.

Results and Discussion

Effect on grain yield

Grain yield of *kharif* sorghum GJ 38 was significantly affected by integrated weed management during all three years and over the years (Table-2). Significantly higher grain yield 3737 kg/ha was obtained due to the treatment T_2 (Weed free condition), however it was reported at par (3612 kg/ha) with the treatment T_5 (Atrazine @ 1.5 kg/ha as pre emergence + one hand weeding at 50 DAS) under pooled results and more or less similar trend of grain yield was observed in individual year of the experimental period. These results were in close conformity with those reported by.

Effect on stover yield

Differences in stover yield of *kharif* sorghum GJ 38 was recorded significant due to integrated weed management treatments during all the years and in pooled analysis (Table-2). Like grain yield, stover yield was also reported significantly higher (15258 kg/ha) in treatment T_2 (Weed free condition) over rest of the treatments, however, it did not differ significantly (14495 kg/ha) with the treatment T_5 (Atrazine @ 1.5 kg/ha as pre- emergence + one hand weeding at 50 DAS) in pooled results and same is also nearly true for individual year.

Effect on weed dry matter

Significantly the highest and the lowest weed dry matter was recorded in T_1 (weedy check) and T_2 (Weed free condition), respectively during all the years and over the years (Table-3). Looking to the pooled data, it is was noted significantly the highest weed dry matter (502 g/m^2), while its value was significantly the lowest (14 g/m^2) in treatment T_2 (Weed free condition) which was followed by treatment T_5 (Atrazine @ 1.5 kg/ha as pre-emergence + one hand weeding at 50 DAS) with the weed dry matter of 141 g/m^2. The similar efficacy of pre emergence herbicide with one hand weeding or interculturing in sorghum are supported by Kumar *et al.* (2012) [6], Priya and Kubsad (2013) [9].

Economics

The economics of the trial was computed using three years data of pooled analysis (Table-4). Application of Atrazine @ 1.5 kg/ha as pre-emergence along with one hand weeding at 50 DAS (T_5) showed maximum net return of 68786 Rs./ha with BCR 2.72. It was concluded that pre-emergence application of atrazine @ 1.5 kg/ha followed by one hand weeding at 50 DAS appeared to be the best integrated weed management practice for *kharif* sorghum is sown in heavy black soils of south Gujarat region.

Table 1: Effect of different weed management practices on sorghum grain yield (kg/ha)

Treatments	2010-11	2011-12	2012-13	Pooled
T_1 : Weedy check	1639	1843	1981	1821
T_2 : Weed free	3567	3638	4008	3737
T_3 : Atrazine 1.5 kg/ha (PE)	2675	2963	3074	2904
T_4 : Pendimethaline 1.0 kg/ha (PE)	2568	2892	3018	2826
T_5 : Atrazine 1.5 kg/ha (PE) + 1 HW at 50 DAS	3347	3555	3934	3612
T_6 : Atrazine 1.5 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	3004	3482	3857	3448
T_7 : Pendimethaline 1.0 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	2846	3397	3780	3341
T_8 : Pendimethaline 1.0 kg/ha (PE) + soybean intercrop as a smoother crop	2449	3430	2965	2948
S.Em.±	69	203	113	88
CD @ 5%	208	617	343	251

DAS- Days after sowing, HW- Hand weeding; PE- Pre-emergence; PoE- Post-emergence

Table 2: Effect of different weed management practices on sorghum stover yield (kg/ha)

Treatments	2010-11	2011-12	2012-13	Pooled
T_1 : Weedy check	7133	7570	7834	7512
T_2 : Weed free	16050	14966	14756	15258
T_3 : Atrazine 1.5 kg/ha (PE)	11797	12390	11630	11939
T_4 : Pendimethaline 1.0 kg/ha (PE)	11366	12095	11444	11635
T_5 : Atrazine 1.5 kg/ha (PE) + 1 HW at 50 DAS	14761	14171	14554	14495
T_6 : Atrazine 1.5 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	13368	13780	14235	13794
T_7 : Pendimethaline 1.0 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	12552	12541	14010	13034
T_8 : Pendimethaline 1.0 kg/ha (PE) + soybean intercrop as a smoother crop	10899	12929	11221	11683
S.Em.±	303	616	430	299
CD @ 5%	918	1869	1304	846

DAS- Days after sowing, HW- Hand weeding; PE- Pre-emergence; PoE- Post-emergence

Table 3: Effect of different weed management practices on weed dry matter (g/m^2)

Treatments	2010-11	2011-12	2012-13	Pooled
T_1 : Weedy check	450	601	455	502
T_2 : Weed free	11	21	12	14
T_3 : Atrazine 1.5 kg/ha (PE)	249	136	142	176
T_4 : Pendimethaline 1.0 kg/ha (PE)	254	152	158	188
T_5 : Atrazine 1.5 kg/ha (PE) + 1 HW at 50 DAS	198	122	102	141
T_6 : Atrazine 1.5 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	219	135	127	160
T_7 : Pendimethaline 1.0 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	230	148	139	173
T_8 : Pendimethaline 1.0 kg/ha (PE) + soybean intercrop as a smoother crop	208	127	138	158
S.Em.±	5	7	15	26
CD @ 5%	15	22	44	80

DAS- Days after sowing, HW- Hand weeding; PE- Pre-emergence; PoE- Post-emergence

Table 4: Economics of different weed management treatments (Pooled basis)

Treatments	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	BCR
T_1 : Weedy check	47916	21434	26482	1.24
T_2 : Weed free	97937	30358	67579	2.23
T_3 : Atrazine 1.5 kg/ha (PE)	76312	22498	53814	2.39
T_4 : Pendimethaline 1.0 kg/ha (PE)	74304	22467	51837	2.31
T_5 : Atrazine 1.5 kg/ha (PE) + 1 HW at 50 DAS	94030	25244	68786	2.72
T_6 : Atrazine 1.5 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	89653	23837	65816	2.76
T_7 : Pendimethaline 1.0 kg/ha (PE) + 2, 4-D 1.0 kg/ha (PoE) at 50 DAS	86041	23806	62235	2.61
T_8 : Pendimethaline 1.0 kg/ha (PE) + soybean intercrop as a smoother crop	76376	26128	50248	1.92

References

1. Mishra JS. Critical period of weed competition and losses due to weeds in major field crops. Farmer and Parliament. 1997; 3:19-20.
2. Sundari A. Weed management in sorghum based intercropping system 25th Asian-Pacific Weed Science Society Conference on "Weed Science for Sustainable Agriculture, Environment and Biodiversity", Hyderabad, India during, 2015
3. Vijayakumar, Jayanthi C, Kalpana R, Ravisankar D. Integrated Weed Management in Sorghum [*Sorghum bicolor* (L.) Moench] – A Review Agri. Review. 2014; 35(2):79-91.
4. Dhar S, Das SK, Kumar S, Thripathi SB. Response of fodder sorghum to different weed management techniques and nitrogen levels. Indian J Agron. 2006; 51(4):310-313.
5. Ishaya DB, Dadari SA, Shebayan JAY. Evaluation of herbicides for weed control in sorghum (*Sorghum bicolor*) in Nigeria. Crop Protection. 2007; 26:1697-1701.
6. Kumar V, Tyagi S, Singh D. Yield, N uptake and economics of fodder sorghum and associated weeds as affected by different weed management practices. Progressive Agri., 2012; 12(1):96-102.
7. Mishra JS, Rao SS, Dixit A. Evaluation of new herbicides for weed control and crop safety in rainy season sorghum. Indian J Weed Sci., 2012; 44(1):71-72.
8. Paterson AH, Bowers JE, Bruggmann R. The Sorghum bicolor genome and the diversification of grasses. Nature. 2009; 457:551-556.
9. Priya, HR, Kubsad VS, Integrated weed management in rainy season sorghum (*Sorghum bicolor*). Indian J Agron., 2013; 58(4):548-553.
10. Rao SS, Regar PL, Jangid BL, Singh YV. Effect of nutrient and weed management on forage sorghum (*Sorghum bicolor*) under rainfed condition. Indian J Agron. 2007; 52(2):139-142.
11. Rathod SS, Zade KK, Jawale SA. Integrated weed management in kharif sorghum. Int. J Forestry Crop Improvement. 2010; 1:109-111.
12. Thakur NS, Kushwaha BB, Girothia OP, Sinha NK, Mishra JS. Effect of integrated weed management on growth and yields of rainy season sorghum. Indian J Agron. 2016; 61(2):217-222.
13. Verma BR, Virdia HM, Dinesh Kumar. Effect of Integrated Weed Management on Yield, Quality and Economics of Summer Sorghum (*Sorghum bicolor* L.) Int. J Curr. Microbiol. App. Sci. 2017; 6(8):1630-1636

14. Akobundu IO. Weed Science in the Tropics: Principles and Practices. A Wiley-Interscience Publication, Chichester, 1987.
15. Baker, Terry. In: Tropical grassy weeds. Chemical control of grassy weeds (Collins, Sc. (ed)). CAB Internal, 1991, 73-84.
16. Balyan RS, Malik RK, Dhanker RS. Atrazine as post emergence herbicide for weed control in maize (*Zea mays*). Indian J Weed Sci. 1994; 26:35-39.
17. Brar LS, Walia US. Some problematic weeds and their management. Indian J Weed Sci. 1991; 23:36-39.
18. Davies DHK, Welsh JP. Weed control in organic cereals and pulses, in Younie, D.; Taylor, B.R.; Welch, J.M. and Wilkinson, J.M. Eds. Organic cereals and pulses. Papers presented at conference held at the Heriot- Watt university, Edinburgh and at Cranfield university silsoe campus, Bedfordshire, 6 and 9 November 2001, chapter Chalcombe publications, 2002; 5:77-114.
19. Dubey MP, Sharma RS, Khare JP. Integrated weed management in soybean (*Glysine max*). Indian J Agron. 1996; 41:69-73.
20. Guar BL, Rao DS, Kaushik MK. Comparative efficacy of pre - and post emergence herbicides in controlling weeds in rainy - season maize (*Zea mays*). Indian J Agron. 1991; 36:261-262.
21. Iqbal S. Screening of different herbicides for controlling weeds in wheat crop. M. Sc (Hons) Thesis, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan, 1994.
22. Khosla SN, Sobti SN. Effective control of Parthenium hysterophorus. L. Pesticides. 1981; 15(4):18-19.
23. Kushwah SS, Kushwaha HS. Influence of weed control methods on growth, yield and economics of rainfed soybean (*Glysine max*) at farmer's field. Indian J Weed Sci. 2001; 46:511-515.