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# Weed management influence on crop-weed competition in sorghum under South Gujarat conditions

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## ABSTRACT

A field experiment was conducted at Instructional Farm, Navsari Agricultural University, Navsari during 2013-14 and 2014-15 with a view to study the crop-weed competition as influenced by different weed management practices in *Rabi* (winter season) sorghum (*Sorghum bicolor* L.). Twelve weed management treatments were evaluated in a randomized block design with four replications. Pre-emergence (PE) application of atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha as tank mixture significantly reduced weed population and weed biomass, increased the weed control efficiency at early stage, next to weed free treatment. However, at the rest of the growth stages, two HW and inter culturing (IC) at 20 and 40 DAS, atrazine 0.5 kg/ha PE + HW and IC at 20 DAS, pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS effectively controlled the weeds, reduced the weed biomass and increased the weed control efficiency. Nutrient losses by weeds were highest under unweeded control and lowest with weed free condition followed by application of atrazine 0.5 kg/ha PE + HW and IC at 20 DAS.

**Key words**: Crop-weed competition, Sorghum, Weed management

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 (Everaarts 2003).

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. Mulching is a diversified agronomic practice which imparts various effects in agriculture. Surface-applied mulches protect the plants against extreme changes in soil temperature and water loss and also prevent the weed growth (Mousavi 2001). 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). Thus, integrated weed management is gaining importance in management of weeds for preventing losses and increasing input-use efficiency.

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## MATERIALS AND METHODS

Field experiments were conducted in the Instructional Farm, during *Rabi* 2014 and 2015 Navsari Agricultural University, Navsari, which is located at 20.930 N latitude, 72.900 E longitude and at height of 9 metres above the mean sea level. The soil of experimental field was clay in texture and slightly alkaline in reaction (pH 7.8) with normal electrical conductivity (EC 0.37/dSm). The soil nutrient status showed lower availability of nitrogen (191 kg/ha), medium for phosphorus (34 kg/ha) and high value for available potassium (350 kg/ha).

Twelve weed management treatments comprising unweeded control, weed free, two hand weeding (HW) and interculturing (IC) at 20 and 40 DAS, atrazine 0.5 kg/ha as pre-emergence (PE), atrazine 0.5 kg/ha PE + HW and IC at 20 DAS, pendimethalin 0.5 kg /ha PE, pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS, pendimethalin 0.5 kg/ha PE + 2, 4-D 0.5 kg/ha post-emergence (PoE) at 20 DAS, atrazine 0.5 kg/ha PE + pendimethalin 0.25 kg/ha PE (tank mixture), atrazine 0.5 kg/ha PE + 2, 4-D 0.5 kg/ha PoE at 20 DAS, atrazine 0.5 kg/ha PE + pyrithiobac-sodium 0.5 kg/ha PoE at 20 DAS and organic mulch (sugarcane trash 2 t/ha, after germination of crop between row) were employed in a randomized block design with four replications during both successive years of experimentation.

The weed free plot was maintained through hand weeding at every 15 days interval from 15 DAS to 75 DAS of sorghum crop (total 5 hand weeding). Pre-emergence herbicides, *viz.* atrazine and pendimethalin were sprayed uniformly in respective plots, next day after sowing of sorghum crop. However, post-emergence herbicides, *viz.* 2,4-D sodium salt and pyrithiobac-sodium were applied uniformly at 20 DAS. Hand weeding and interculturing with wheel hoe were done according to the schedule of treatments in relevant plots. Sugarcane trash 2 t/ha was used as organic mulch and was applied after germination of crop between rows.

The number of weeds present in 1 m² area in each plot was counted at 20, 40, 60 DAS and at harvest. Further, these weeds were oven dried to a constant weight at $65^0$C and the dry weight of weeds was expressed in g per m2. The data on weed count and weed dry weight showed considerable variation and hence, the data were subjected to square root transformation ($\sqrt{X+0.5}$) before statistical analysis (Gomez and Gomez, 2010). The weed control efficiency was calculated by using the formula given by Mani *et al.* (1976).The nutrient uptake by weeds was also calculated by the following formula.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content in weed (\%)} \times \text{Weed biomass at harvest (kg/ha)}}{100}$$

## RESULTS AND DISCUSION

### Weed flora

The dominant weed flora found in the sorghum crop during *Rabi* of 2013-14 and 2014-15 showd the presence of more varieties of broad-leaf weeds as compared to grasses and sedges. These results were in close conformity with the findings of Mishra *et al.* (2012). Grassy weeds *Echinochloa colonum* and *Digitaria sanguinalis* were observed by Mishra *et al.* (2012) at Rajendranagar, Priya and Kubsad (2013) at Dharwad in sorghum crop. Presence of *Digitaria sanguinalis* in sorghum has also been reported by Besancon *et al.* (2015) and Vincent *et al.* (2015) at North Carolina. While, *Eleusine indica* was noticed in sorghum crop by Giri and Bhosle (2001) at Parbhani and Kumar *et al.* (2012) at Pantnagar. *Echinochloa crusgalli* is a prominent weed species found in Navsari district according to Thanki *et al.* (2012).

The broad-leaf weeds, were *Portulaca oleracea, Amaranthus viridis, Acalypha indica, Ageratum conyzoides, Euphorbia geniculata, Digera arvensis, Phyllanthus niruri, Eclipta alba and Phyllanthus maderaspatensis Cyperus rotundus* was prominent weed among sedge

### Weed density, biomass and weed control efficiency

Weed count and weed biomass were found lowest in weed free treatment at 20, 40, 60 DAS and at harvest due to the manual weeding done at every 15 days interval upto 75 DAS, while the highest number of weeds and weed biomass were registered under unweeded control treatment (**Figure 1** and **2**). The non-interference in weed growth under unweeded control treatment resulted in maximum utilization of resources *i.e.* moisture, nutrient, light and space resulting in higher number of weeds and dry weed biomass. Earlier workers (Priya and Kubsad 2013 and Patel *et al.* 2014) have also reported the same for unweeded control treatment.

At 20 DAS, complete control of weeds (grassy, broad-leaf and sedges) was observed with atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha PE as tank mixture. Grichar *et al.* (2005) also reported similar results for atrazine + pendimethalin in sorghum. While at 40 DAS, atrazine 0.5 kg/ha PE + HW and IC at 20 DAS was effective against grassy and broad-leaf weeds and atrazine 0.5 kg/ha PE *fb* 2,4-D 0.5 kg/ha against sedges. Atrazine 0.5 kg/ha PE + HW and IC at 20 DAS was efficient for control of weed population at 40 DAS.

At 60 DAS, two hand weeding (HW) and interculturing (IC) at 20 and 40 DAS effectively restricted grassy weeds, broad-leaf weeds as well as sedges. Apart from this, the treatment of two HW and IC at 20 and 40 DAS successfully managed the total weed population at 60 DAS. At harvest, the treatment of two HW and IC at 20 and 40 DAS efficiently hampered the grassy and broad-leaf weeds, while sedges were limited by the treatment of atrazine 0.5 kg/ha PE + pyrithiobac-sodium 0.5 kg/ha PoE at 20 DAS. Excluding these treatments, the weed population was found lowest among the treatment of atrazine 0.5 kg/ha PE + HW and IC at 20 DAS.

The weed biomass at 20 DAS was lowest in the treatment pendimethalin 0.5 kg/ha PE during first year, whereas in second year and pooled analysis, atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha PE (tank mixture) proved superior with less weed biomass. The weed biomass at 40, 60 DAS and at harvest was consistently influenced by application of two HW and IC at 20 and 40 DAS, atrazine 0.5 kg/ha

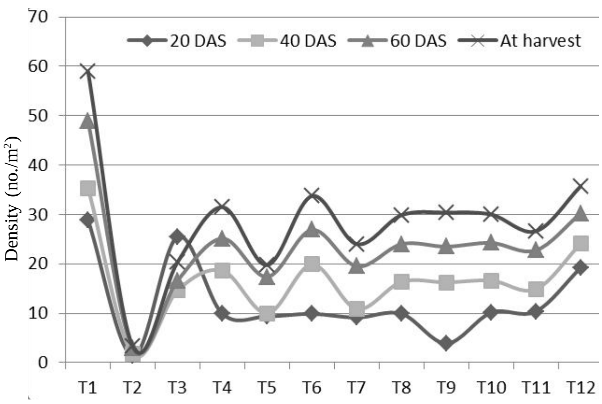



**Figure 1. Density of weeds in *Rabi* sorghum**

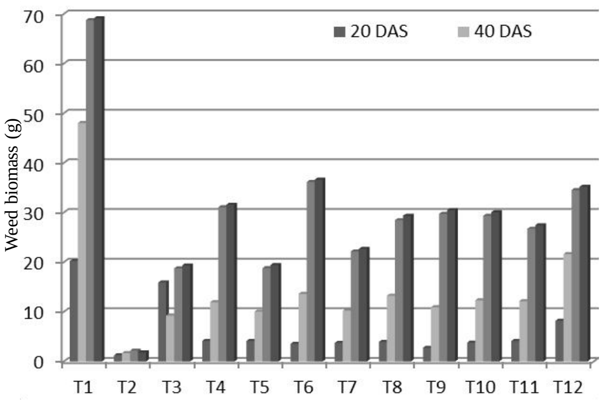
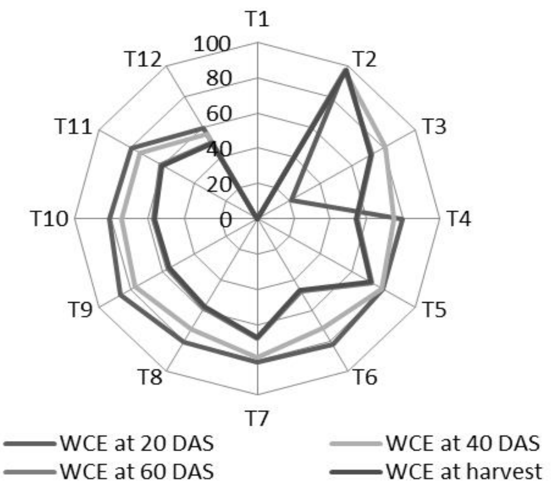



**Figure 2. Weed biomass (g) in *Rabi* sorghum**




T1 - Unweeded control; T2 - Two HW and IC at 20 and 40 DAS; T3 - Weed free; T4 - Atrazine 0.5 kg/ha PE; T5 - Atrazine 0.5 kg/ha PE + HW and IC at 20 DAS; T6 - Pendimethalin 0.5 kg/ha PE; T7 - Pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS; T8 - Pendimethalin 0.5 kg/ha PE + 2,4-D 0.5 kg/ha PoE at 20 DAS; T9 - Atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha PE (tank mixture); T10 - Atrazine 0.5 kg/ha PE + 2, 4-D 0.5 kg/ha PoE at 20 DAS; T11 - Atrazine 0.5 kg/ha PE + pyrithiobac sodium 0.5 kg/ha PoE at 20 DAS; T12 - Organic mulch (sugarcane trash 2 t/ha)

**Figure 3. Efficiency (%) of different weed management treatments in *Rabi* sorghum (based on means values)**

PE + HW and IC at 20 DAS and pendimethalin 0.5 Kg/ha PE + HW and IC at 20 DAS treatments.

The weed control efficiency at 20 DAS (**Figure 3**) was maximum during first year with the application of atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha PE (tank mixture) and pendimethalin 0.5 Kg/ha PE during second year. Whereas, at the rest of the growth stages, two HW and IC at 20 and 40 DAS had the highest weed control efficiency. The integrated weed management treatment of atrazine 0.5 kg/ha PE + HW and IC at 20 DAS closely followed the treatment two HW and IC at 20 and 40 DAS at 40, 60 DAS and at harvest for weed control efficiency on pooled basis. Patel *et al.* (2006) has justified the similar results in maize crop with the longer persistence of atrazine and pendimethalin up to harvest of crop. While, the similar efficacy of pre-emergence herbicide with one hand weeding or interculturing in sorghum are supported by Kumar *et al.* (2012), Priya and Kubsad (2013) and Patel *et al.* (2014).

**Nutrient uptake by weeds**

Minimal nutrient uptake of N, P and K in weeds was observed during both the years as well as in pooled results under weed free treatment and highest under unweeded control. Mishra *et al.* (2014) and Vijayakumar *et al.* (2014) also observed similar results for unweeded treatment.

Besides weed free treatment, Nitrogen uptake by weeds was found significantly lower with atrazine 0.5 kg/ha PE + HW and IC at 20 DAS followed by two HW and IC at 20 and 40 DAS, pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS and atrazine 0.5 kg/ha PE + pyrithiobac-sodium 0.5 kg/ha PoE at 20 DAS during 2013-14, while in 2014-15, two HW and IC at 20 and 40 DAS registered decreased N uptake by weeds followed by atrazine 0.5 kg/ha PE + HW and IC at 20 DAS and atrazine 0.5 kg/ha PE + pyrithiobac-sodium 0.5 kg/ha PoE at 20 DAS. However in pooled results, atrazine 0.5 kg/ha PE + HW and IC at 20 DAS was found to minimize the N uptake by weeds followed by two HW and IC at 20 and 40 DAS and pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS. These results were in close conformity with that of Kaushik and Shaktawat (2005).

In case of P and K uptake by weeds, atrazine 0.5 kg/ha PE + HW and IC at 20 DAS treatment was found with lowest value along with two HW and IC at 20 and 40 DAS, pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS and atrazine 0.5 kg/ha PE + pyrithiobac-sodium 0.5 kg/ha PoE at 20 DAS during

**Table 1. Effect of different weed management practices on nutrients uptake by weeds at 60 DAS**

| Treatment | N uptake (kg/ha) | | | P uptake (kg/ha) | | | K uptake (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled |
| Atrazine 0.5 kg/ha PE | 6.36 | 6.06 | 6.21 | 3.67 | 3.54 | 3.61 | 6.87 | 6.56 | 6.72 |
| Atrazine 0.5 kg/ha PE + HW and IC at 20 DAS | 4.68 | 4.53 | 4.60 | 3.03 | 2.95 | 2.99 | 5.03 | 4.77 | 4.90 |
| Pendimethalin 0.5 kg/ha PE | 7.10 | 6.78 | 6.94 | 3.93 | 3.76 | 3.85 | 7.68 | 7.32 | 7.50 |
| Pendimethalin 0.5 kg/ha PE + HW and IC at 20 DAS | 5.17 | 4.88 | 5.02 | 3.21 | 3.08 | 3.15 | 5.55 | 5.24 | 5.39 |
| Pendimethalin 0.5 kg/ha PE + 2,4-D 0.5 kg/ha PoE at 20 DAS | 5.98 | 5.83 | 5.91 | 3.56 | 3.45 | 3.51 | 6.55 | 6.24 | 6.40 |
| Atrazine 0.5 kg/ha + pendimethalin 0.25 kg/ha PE (tank mixture) | 6.21 | 5.89 | 6.05 | 3.57 | 3.48 | 3.52 | 6.69 | 6.42 | 6.55 |
| Atrazine 0.5 kg/ha PE + 2, 4-D 0.5 kg/ha PoE at 20 DAS | 6.10 | 5.79 | 5.95 | 3.53 | 3.45 | 3.49 | 6.62 | 6.34 | 6.48 |
| Atrazine 0.5 kg/ha PE + pyrithiobac sodium 0.5 kg/ha PoE at 20 DAS | 5.71 | 5.53 | 5.62 | 3.42 | 3.35 | 3.38 | 6.21 | 5.98 | 6.10 |
| Organic mulch (sugarcane trash 2 t/ha) | 7.89 | 7.49 | 7.69 | 4.81 | 4.74 | 4.77 | 8.39 | 8.13 | 8.26 |
| Two HW and IC at 20 and 40 DAS | 4.75 | 4.52 | 4.64 | 3.06 | 2.95 | 3.00 | 5.03 | 4.78 | 4.91 |
| Weed free | 1.28 | 1.22 | 1.25 | 1.11 | 1.08 | 1.10 | 1.31 | 1.24 | 1.28 |
| Unweeded control | 20.06 | 19.10 | 19.58 | 13.80 | 13.46 | 13.63 | 20.74 | 20.11 | 20.42 |
| LSD (p=0.05) | 1.23 | 1.11 | 0.81 | 0.41 | 0.41 | 0.28 | 1.21 | 1.18 | 0.83 |

both the years of investigation and pooled results. Uptake of nutrients by weeds were comparatively higher in pendimethalin and atrazine alone application compared to rest of herbicidal treatments. Similar results were obtained by Rao *et al.* (2007) in sorghum.

It was conceded that either two hand weeding and interculturing at 20 and 40 DAS or pre-emergence application of atrazine 0.5 kg/ha followed with one hand weeding and interculturing at 20 DAS should be adopted for better weed management in sorghum.

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