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## Evaluation of combination of pre emergence and post emergence herbicides with minitractor weeding in sugarcane

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### Abstract

Sugarcane (*Saccharum officinarum* L.) is a crucial C<sub>4</sub> crop in tropical and subtropical regions, representing approximately 80% of the world's sugar production and 35% of ethanol production. The delayed germination, slow initial growth, wider row spacing and good supply of nutrients of the crop provide favorable conditions for different weed species infestation in Sugarcane. The field experiment includes PE application of atrazine at 1.0 kg/ha 3 DAP+ POE application of metribuzin 1.5kg/ha on 25 DAP+ minitractor weeding on 50, 80,120 DAP. This was compared with the treatment Minitractor weeding five times on 30,60,90,120 &150 DAP and unweeded control. Dominant weeds were *Echinochloa* spp. (*E. crus-galli* and *E. colona*), *Dactyloctenium aegyptium*, *Eleusine indica*, *Brachiaria* spp. (*B. mutica* and *B. ramosa*) and *Digitaria sanguinalis* among grasses, *Eclipta alba*, *Chenopodium album*, *Physalis minima*, *Ageratum conyzoides*, *Parthenium hysterophorus* and *Portulaca oleracea* as broad-leaf weeds and *Cyperus* spp. (*C. rotundus* and *C. iria*) as sedges. At 60 DAP, 97% weed control efficiency was observed with PE application of atrazine at 1.0 kg/ha 3 DAP +EPOE application of metribuzin at 1.5 kg/ha 25 DAP + Minitractor weeding on 50,80 and 120 DAP. The weed dry weight was gradually reduced with minitractor weeding and observed with efficiency of 92-96%. At 150 DAP, the weed dry weight was 628g/m<sup>2</sup> with unweeded control. Yield was higher (148.57 t/ha) with the atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. A 7t/ha was reduced with minitractor weeding 30,60,90,120 and 150 DAP (141.16t/ha). Benefit cost ratio (2.4) was higher with atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. minitractor weeding 30,60,90,120 and 150 DAP has recorded a benefit cost ratio of 2.18 and 1.49 with unweeded control. Hence the integrated weed management capsule PE application of atrazine at 1.0 kg/ha 3 DAP +EPOE application of metribuzin at 1.5 kg/ha 25 DAP + Minitractor weeding on 50,80 and 120 DAP can be recommended for sugarcane.

**Keywords:** Sugarcane, atrazine, metribuzin, minitractor weeding, higher yield, economics

### 1. Introduction

Sugarcane (*Saccharum officinarum* L.) is a crucial C<sub>4</sub> crop in tropical and subtropical regions representing approximately 80% of the world's sugar production and 35% of ethanol production (Zegada Lizarazu *et al.*, 2010) <sup>[13]</sup>. As the second-largest producer of sugarcane after Brazil, India contributes around 430.50 million tons from 5.09 million hectares, with an annual productivity of 84.4 tons/ha (Alteri, *et al.*, 2017; Ram *et al.*, 2024) <sup>[1, 7]</sup>.

The delayed germination, slow initial growth, wider row spacing and good supply of nutrients of the crop provide favorable conditions for different weed species infestation in Sugarcane. In sugarcane, weed infestation is always a major problem reduces the yield of the crop (Ramesh and Rathika, 2016) <sup>[8]</sup>. The control of weeds during critical period of crop-weed competition (which is 120 days) especially initial 90 days is very important so as to avoid yield loss. The extent of yield loss may range from 10% to complete crop failure (Srivastava *et al.*, 2005) <sup>[12]</sup>. Being a long duration crop, it is heavily infested with a variety of weeds. Nearly 150 weed species including annuals, perennials and parasitic weeds have been reported in sugarcane fields in different parts of India. The major weeds reported in sugarcane field were of sedges (*Cyperus rotundus*), grasses (*Cynodon dactylon*, *Panicum* sp. *Dactyloctenium aegyptium*, *Imperata cylindrica*) and broad leaved weeds (*Trianthema portulacastrum*, *Convolvulus arvensis*, *Striga asiatica*, *Portulaca oleracea*, *Commelina benghalensis*, *Amaranthus viridis*) (Rathika *et al.*, 2023) <sup>[10]</sup>.

Cultural practices like ploughing, hand weeding and mulching are practiced to control the weeds. However, these methods are time consuming, labour intensive and expensive. Hand weeding is difficult due to non-availability of labour as well as high cost of weeding. Herbicides are easy to apply and aided in timely weed management. Both pre – mergence and post mergence herbicides are used in sugarcane to manage the weeds. In this project Atrazine at 1.0 kg/ha on 3 DAP, PE herbicides are used and post mergence herbicide namely metirbuzin at 1.5kg/ha was applied on 25 DAP. This was combined with minitractor weeding (50, 80,120 DAP) and was compared with minitractor weeding at 30 days interval 30,60,90,120 &150 DAP.

2. Materials and Methods

The field experiment was conducted on 13.3.2024 in Field No12, SRS, Cuddalore. PE application of atrazine at 1.0 kg/ha was done on 3 DAP. POE application of metribuzin 1.5kg/ha was applied as per the technical programme on 25 DAP. After the metribuzin application, minitractor weeding was done on 50, 80,120 DAP. This was compared with the treatment Minitractor weeding was done at 30 days interval 30,60,90,120 &150 DAP. Earthing up using minitractor on 150 DAP is common in both the treatments. Weed dry weight, biometrical observation, yield attributes and yield were recorded and economics was worked out.

3. Results and Discussion

3.1. Weed flora in experimental sugarcane field

The weed flora observed in the experimental field is *Echinochloa colona*, *Leptochloa chinensis*, *Panicum repens* and among broad leaved weeds *Trianthema portulacastrum* and *Elcipta alba*.

Grasses dominates in replications I and III and was effectively controlled by metribuzin application. In II replication *Trianthema* and grasses population was equally observed. Dominant weeds were *Echinochloa* spp. (*E. crus-galli* and *E. colona*), *Dactyloctenium aegyptium*, *Eleusine indica*, *Brachiaria* spp. (*B. mutica* and *B. ramosa*) and *Digitaria sanguinalis* among grasses, *Eclipta alba*, *Chenopodium album*, *Physalis minima*, *Ageratum conyzoides*, *Parthenium hysterophorus* and *Portulaca oleracea* as broad-leaf weeds and *Cyperus* spp. (*C. rotundus* and *C. iria*) as sedges.

Lokhande *et al.* (2018) <sup>[3]</sup> reported that the major weed flora were of 60 percent broad leaf weeds and 40 percent grassy weeds. Among broad leaf weeds viz., *Euphorbia geniculata*, *Parthenium hysteorphorus*, *Digera arvensis*, *Merremia emerginata*, *Alternanthera sessilis*, *Lactuca runcinata*, *Portulaca oleracea*, *Chenopodium album* were found as dominant. While, among grassy weeds viz., *Cynodon dactylon*, *Brachiaria eruciformis*, *Cyperus rotundus* were found as dominant. The major weeds reported in sugarcane field comprised of broad leaved weeds (*Commelina benghalensis*, *Trianthema portulacastrum*, *Digera arvensis*, *Amaranthus viridis*, *Cleome gynandra* and *Ipomea* spp), grassy weeds (*Dactyloctenium aegyptium*, *Echinochloa colonum* and *Dinebra retroflexa*) and sedges (*Cyperus rotundus* and *Cyperus esculentus*) (Anitta Fanish and Ragavan, 2020) <sup>[2]</sup>. The major weed flora in sugarcane field were of grassy weeds viz. *Cynodon dactylon* and *Echinochloa crusgalli*, broad leaved weeds viz., *Parthenium hysterophorus* and *Trianthema portulacastrum* and sedge viz., *Cyperus rotundus* (Maurya *et al.*, 2020) <sup>[4]</sup>.

Table 1: Weed dry weight (g/m²) and Weed control efficiency (%) in different weed management practices

| Treatments                                                                                            | 15 DAP                                                                   | 30 DAP      | 60 DAP   | 90 DAP   | 120 DAP  | 150 DAP |
|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------|----------|----------|----------|---------|
|                                                                                                       | Dry weight (g/m²) and Weed Control efficiency inside the parenthesis (%) |             |          |          |          |         |
| Atrazine 1.0 kg/ha 3 DAP + Metribuzin1.5 kg/ha 25 DAP +Minitractor weeding (Thrice 50, 80 and120 DAP) | 0(100%)                                                                  | 30(88%)     | 15 (97%) | 50(92%)  | 20(96%)  | 25(96%) |
| Minitractor weeding five times (30,60,90,120 and 150 DAP)                                             | 92 (26.4%)                                                               | 120 (54.4%) | 140(69%) | 115(82%) | 100(80%) | 42(93%) |
| Un weeded Control                                                                                     | 125                                                                      | 256         | 458      | 625      | 625      | 628     |

3.2. Weed Dry weight and Weed Control Efficiency

At 15 DAP, the weed dry weight was 0g/m² in atrazine applied treatment Pre-emergence herbicides like atrazine and oxyfluorfen, followed by post-emergence applications of glyphosate, have proven effective in controlling weed growth in sugarcane fields (Rajbir *et al.*, 2024) <sup>[5]</sup>. and initially 26.4% reduced weed dryweight was recorded in minitractor weeding treatment when compared with unweeded control. At 30 DAP, atrazine +metribuzin applied plot has

recorded 30g/m² and was observed with 88% WCE whereas minitractor weeding has recorded 54% weed control efficiency. At 60 DAP, 97% weed control efficiency was observed with PE application of atrazine at 1.0 kg/ha 3 DAP +EPOE application of metribuzin at 1.5 kg/ha 25DAP + Minitractor weeding on 50,80 and 120 DAP. The weed dry weight was gradually reduced with minitractor weeding and observed with efficiency of 92-96%. At 150 DAP, Unweeded control has recorded weed dry weight of 628g/m².

Table 2: Biometrical observation in different weed management practices

| Treatments                                                                                            | Biometrical observation at 90 DAP |       |               |
|-------------------------------------------------------------------------------------------------------|-----------------------------------|-------|---------------|
|                                                                                                       | Plant height (cm)                 | LAI   | No of tillers |
| Atrazine 1.0 kg/ha 3 DAP + Metribuzin1.5 kg/ha 25 DAP +Minitractor weeding (Thrice 50, 80 and120 DAP) | 206.67                            | 0.472 | 6.9           |
| Minitractor weeding five times (30,60,90,120 and 150 DAP)                                             | 202.65                            | 0.458 | 5.6           |
| Un Weeded Control                                                                                     | 158.67                            | 0.419 | 2.0           |

Table 3: Yield attributes and Cane yield (t/ha) as influenced by different weed management practices

| Treatments                                                                                            | Yield attributes and cane yield (t/ha) |                       |                 |                  |                  |              |
|-------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------|-----------------|------------------|------------------|--------------|
|                                                                                                       | No of internodes                       | Internode length (cm) | Cane girth (cm) | Cane length (cm) | Cane weight (kg) | Yield (t/ha) |
| Atrazine 1.0 kg/ha 3 DAP + Metribuzin1.5 kg/ha 25 DAP +Minitractor weeding (Thrice 50, 80 and120 DAP) | 20                                     | 10.99                 | 10.34           | 169.90           | 1.650            | 148.57       |
| Minitractor weeding five times (30,60,90,120 and 150 DAP)                                             | 18                                     | 9.97                  | 9.96            | 163.83           | 1.266            | 141.16       |
| Un Weeded Control (without weeding)                                                                   | 19                                     | 8.17                  | 9.62            | 137.10           | 1.136            | 80.68        |

**Table 4:** Quality parameters as influenced by different weed management practices

| Treatments                                                                                               | Brix(%) | Pol(%) | Purity (%) | CCS(%) |
|----------------------------------------------------------------------------------------------------------|---------|--------|------------|--------|
| Atrazine 1.0 kg/ha 3 DAP + Metribuzin 1.5 kg/ha 25 DAP + Minitractor weeding (Thrice 50, 80 and 120 DAP) | 19.81   | 18.65  | 94.14      | 13.28  |
| Minitractor weeding five times (30,60,90,120 and 150 DAP)                                                | 18.65   | 17.63  | 94.73      | 12.58  |
| Un Weeded Control (without weeding)                                                                      | 17.26   | 14.74  | 85.40      | 10.02  |

**Table 5:** Economics of different weed management practices

| Treatments                                                                                               | Yield (t/ha) | Gross income (Rs./ha) | Gross cost (Rs./ha) | Net income (Rs./ha) | B:C  |
|----------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------------|---------------------|------|
| Atrazine 1.0 kg/ha 3 DAP + Metribuzin 1.5 kg/ha 25 DAP + Minitractor weeding (Thrice 50, 80 and 120 DAP) | 148.57       | 5,19,995              | 2,16,200            | 3,03,795            | 2.40 |
| Minitractor weeding five times (30,60,90,120 and 150 DAP)                                                | 141.16       | 4,94,060              | 2,27,000            | 2,67,060            | 2.18 |
| Un weeded Control (without weeding)                                                                      | 80.68        | 2,82,380              | 1,90,000            | 92,380              | 1.49 |

**Table 6:** Comparison of cost involved in Minitractor weeding and Hand weeding

| Minitractor weeding                           | No of labourers | / one time |             |
|-----------------------------------------------|-----------------|------------|-------------|
|                                               |                 | Rs.        | Rs.         |
| Line weeding in between plants @Rs 440/labour | 10              | 4400       | 22,000      |
| Minitractor weeding                           |                 | 3000       | 15,000      |
|                                               |                 | Total      | Rs. 37000/- |
| Hand weeding                                  | 30              | 13200      | 66,000      |
|                                               |                 | Total      | 66,000      |
|                                               |                 | Saving     | Rs. 29,000  |

### 3.3. Biometrical observation at 90 DAP

Plant height was reduced with weed infestation. Plant height was 202.65 with minitractor weeding 30,60,90,120 and 150 DAP which was lesser with atrazine applied plots (206.67 cm) since there is initial competition between crop and weeds up to 30 DAP in minitractor weeding. LAI was 0.458 and 0.472 respectively with minitractor weeding 30,60,90,120 and 150 DAP and PE application of atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. Among different herbicidal treatments, pre-emergence application of metribuzin 1.4 kg/ha fb 2,4-D 1.6 kg/ha at 45 days after ratoon initiation (DARI) was found most effective by recording the lowest weed population and dry weight thus showed highest weed control efficiency (Rajender *et al.*, 2014)<sup>[6]</sup>. Number of tillers were 6.9 with PE application of atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP and 5.6 with minitractor weeding 30,60,90,120 and 150 DAP.

### 3.4. Yield attributes and Yield

Yield recorded with unweeded control was 80.68 t/ha with reduced cane length (137.10), cane weight (1.136) and cane girth (9.62 cm). Cane length (169.9cm), Cane girth (10.34cm) and cane weight (1.650 kg) and yield (148.57 t/ha) was higher with atrazine at 1.0 kg/ha 3 DAP+EPOE application of metribuzin at 1.5 kg/ha 25 DAP + Minitractor weeding on 50,80 and 120 DAP. A 7t/ha was reduced with minitractor weeding 30,60,90,120 and 150 DAP (141.16t/ha).this was in accordance with the finding of Sreedevi *et al.*, 2023 that among all the treatments, weeding operation using mini tractor with rotavator recorded highest yield (85 t/ha) with corresponding high weeding efficiency (84%). Thus, intercultural operation with rotavator drawn mini tractor can be recommended in sugarcane crop under wider row spacing to reduce cost of cultivation and for higher yield. Among the herbicidal treatments, pyrazosulfuron-ethy + metribuzin + 2,4-D sodium salt WDG (3000 g/ha) recorded significantly higher millable cane yield (119.5 t/ha) as compared to other treatments due to lower weed biomass (42.7 and 47.0 g/m<sup>2</sup> at 45 and 75 DAP, respectively) and higher weed control efficiency at 45 and 75 DAP (86.4 and 85.5% at 45 and 75 DAP, respectively) (Ramesha *et al.*, 2018)<sup>[9]</sup>.

### 3.5 Quality parameters

Commercial cane sugar percentage was higher (13.28%) with the atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP and unweeded control has recorded 10.02%. Brix (%), Pol (%) and Purity (%) was with no difference for all the treatments.

### 3.6 Economics

The gross income was Rs. 2,16,200 and Rs. 2,27,000 was for atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP and minitractor weeding 30,60,90,120 and 150 DAP respectively. There was increased in cost due to minitractor weeding but this was lesser with hand weeding and the comparison was given in Table 6. Benefit cost ratio (2.4) was higher with atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. minitractor weeding 30, 60, 90, 120 and 150 DAP has recorded a benefit cost ratio of 2.18 and 1.49 with unweeded control.

### 4. Conclusion

The delayed germination, slow initial growth, wider row spacing and good supply of nutrients provide favorable conditions for different weed species infestation in Sugarcane. In sugarcane, weed infestation is always a major problem reduces the yield of the crop. At 60 DAP, 97% weed control efficiency was observed with PE application of atrazine at 1.0 kg/ha 3 DAP +EPOE application of metribuzin at 1.5 kg/ha 25 DAP + Minitractor weeding on 50,80 and 120 DAP. The weed dry weight was gradually reduced with minitractor weeding and observed with efficiency of 92-96%. At 150 DAP, the weed dry weight was 628g/m<sup>2</sup> with unweeded control. Yield was higher (148.57 t/ha) with the atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. A 7t/ha was reduced with minitractor weeding 30,60,90,120 and 150 DAP(141.16t/ha). Benefit cost ratio (2.4) was higher with atrazine at 1.0 kg/ha +EPOE application of metribuzin at 1.5 kg/ha + Minitractor weeding on 50,80 and 120 DAP. minitractor weeding 30,60,90,120 and 150 DAP has recorded a benefit cost ratio of 2.18 and 1.49 with unweeded control. Hence the integrated weed management capsule PE application of atrazine at 1.0 kg/ha 3

DAP +EPOE application of metribuzin at 1.5 kg/ha 25 DAP + Minitractor weeding on 50,80 and 120 DAP can be recommended for sugarcane.

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