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# Evaluation of Non Selective Post Emergence Herbicides against Complex Weeds at Metahara Sugar Estate: Verification Trial

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**Abstract**

Four candidates of non-selective post-emergence herbicides were evaluated against complex weed management at Metahara sugarcane estate. The evaluation was done based their efficacy and the experiment was laid in RCBD with three replications. The experiment was evaluated using irrigated condition for 50 and 60 days. The result of the experiment revealed the three candidates provides good efficacy to control the grass weed for more than 40days. The efficacy of broad weed was varies from weeds to weeds. The test herbicides provide good control for broad weed namely Biden pilosa, Chenopedium, ageratumconzoids, Xanthium species and Amaranthus weeds. The efficacy of sedge grass was not seen well in this evaluation because the population level of this weed very from zero to very low number in the plot area. The overall efficacy of the candidate herbicides were good trust agro state 360 SL with efficacy control of 86.49%, followed Linkosate 48 with efficacy level of 82.98% and Getrid 480 SL with 81.23%. Based on overall and species based efficacy the three namely, Trust agro state 360 SL, Linkosate 48 SL and Getrid 480 SL non- selective post emergence herbicides at Metahara were effective to control citrus fields, mango orchard and other non-farms likes canal clearing with supplementing manual method for uprooting some weed species likes field bind weed and parthenium weed particularly according to their order. In future research activity it is better to evaluate the different rates against specific weed management weeds like field bind, parthenium and Euphorbia weeds for better effectiveness.

**Keywords:** Metahara; Arjo; Fruit farm; Abadir; Orchard; Non-selective Herbicides

## Introduction

Herbicides are used extensively for weed control in crop production systems throughout the world. The Ethiopian sugar estates have been using non-selective herbicides in order to control weeds at harvest road, irrigation canals, reserve wires, citrus and mango orchards as well as to reduce tillage operations. However using of herbicides intensively for longer periods can affect the effectiveness of herbicides due to development of resistance by the weed species [1]. Herbicide resistance is an induced inherent ability of some plant species to survive and reproduce after receiving a lethal dose of herbicide [2]. Similarly others say that in plants, herbicide resistance is developed either by random mutation or it is self-induced by genetic engineering. In contrast herbicide tolerance can be defined as the inherent ability of plant to survive and reproduce with herbicide treatment at a normal use rate [3]. Thus, searching for alternative and most effective herbicides from efficacy and cost advantage point of view is indubitable.

Moreover, in order to use a pesticide at a commercial scale, the sugar industry has to follow the National Pesticide Registration and Control Proclamation No 674/2010. As per the Proclamation, for a pesticide to be registered and to be used at commercial level, its efficacy for the control of the intended pests should be tested or verified through domestic research by a research organization. In order to make sugarcane pesticide testing more systematic and well-organized the former Ethiopian Sugar Corporation (ESC) has developed Guidelines for Pesticide Testing and established a Pesticide Research Committee (PRC) for follow up and proper implementation of the Guideline. Accordingly, two chemical companies applied four candidates to ESC Research Development Center, Pesticide Research Committee (PRC) for the evaluation of Linkosate 75.7 SG, Trust sate 360 SL, Linkosate 48 SL and Getrid 480 SL in order to be registered by Pesticide Advisory Committee of the Ministry of Agriculture as the new products for commercial use. The PRC decided the above-mentioned herbicides to be tested for verification. The objective of this study was therefore, to verify and select effective non-selective post-emergence herbicides for the control of annual and perennial weeds on the orchard, harvest road and Fallow field of the sugarcane plantations of Ethiopia.

## Materials and Methods

### Description of the Study Area

**Metahara sugar estate**: is located at a distance 200 km to the east of Addis Ababa between longitude of $8^0$N and Latitude $39^052^`$E at elevation of 950 m.a.s.l. It receives mean maximum and minimum temperatures are $32.76^o$C and $17.5^o$C, the maximum temperature ranges from $29.95^0$C in November to $36.19^o$C in June and minimum temperature ranges from $12.88^o$C in December to $21.28^o$C in June. Mean Annual rainfall is 539.7mm ranging from monthly 7.1mm in December to 129.3mm in August. Mean Relative humidity is 57.69% ranging from 50.83% in January to 60.73% in November. Mean daily Sunshine hours are 8.28 ranging from 7.4 hours in July to 9.13 hours in November. Mean Wind speed measured at 2m height is 2.81m/s. Mean daily pan evaporation is 6.8mm/day ranging from 6.2mm/day in December to 8.1mm/day in June.

### Experimental Methods

The experiment was executed in 2018/19 cropping season in already established citrus and mango orchards of Metahara sugar

estate. The target pest is complex weed (grass, broad weed and sedge grass). The test herbicides were applied as post-emergence application (herbicide applied when the weed emerged and reached 3-5 leaf stage). The herbicides were applied manually by using knapsack sprayer with spraying volume of 25 capacities. The evaluation was done at 10 days interval for the consecutive 50 and 60 days after spray. All other cultural practices of the site were the same as recommended, except the weed control practice.

### Design and Treatments

The experiment was conducted using randomize complete design with three replications. A plot area of 5m*8.7m (43.5m²) was used. Roundup Ready® system based on glyphosate herbicide was used as a standard check. At Metahara sugar estate Round up is currently used non -selective post emergency herbicide to control the complex weed in the peripheral area of sugar cane fields and fruit orchards.

### Data Collection Methods

Data on number of individual weed species in each quadrant sample were collected until 50 and 60 days after application. The experiment was conducted in irrigated condition. But, data collected at 50days was not included for the data analysis because of poor data quality. The weed population count was made along the two diagonals (in an "X" pattern) of the plots from five points using 0.25m * 0.25m quadrants at every 10 days interval for two months after herbicides application. A total of five quadrants were used for data collections. Efficacy of the candidate herbicides was determined quantitatively by percent weed control in the treated plot in comparison with that of untreated plot as used in Taye (1991) indicated below.

Percent weed control = Weed count on unweeded treatment –weed count on treated * 100

Weed count on unwedded treatment

### Data analysis

Data were subjected to ANOVA using the MIXED procedure in SAS, with herbicide treatment

Means were separated using LSD MEANS at the 5% level of significance. Data from the non- treated control were not included in the analysis to improve variance homogeneity.

### Results and Discussions

### Effect of Non –Selective Post-emergence Herbicides on Grass Weed Management

The analysis of variance indicated reveals that herbicides on the basis of their percent of weed control showed that there is a significant difference among the tested herbicides at probability level of (P≤5%). At 10 after spraying the highest efficacy of (87.32%) was recorded from Trust agro state 360 SL, but significantly not different from Linkosate 48, Getrid 480 and standard check for the grass weed. Linkosate 48% and Getrid 480 provide an efficacy control of 83.2 and 79.2% for grass weed respectively. At this phase most grass weed showed loss of pigment (white or yellowness) and stoppage of growth. The least and significantly different from the other four herbicides was recorded for Linkosate 75.57G. At 20 days after the herbicides application, Trust agro sate 360 SL, Linkosate 48 and Getrid 480 SG had a statistically similar performance in comparison with that of the standard herbicide round with an efficacy of 100% for grass weed from these four herbicides. However, Linkosate 75.57 G showed significant difference from the other four herbicides.

This showed that differences were existed between the four herbicides and Linkosate 75.57 G was less effective for grass weed control. At these phase of evaluation the response exhibited by the susceptible weeds to specific herbicides were pigment loss, stoppage of growth and distorted (malformed) and most of grass weed were injured and the effect was become clearly observed at 20DAS and also new growth was continued for plot sprayed with Linkosate 75.57G. However, at 20 days after spraying non- significant differences was not recorded for all the candidate herbicides including the standard check. While the least significant difference was recorded from Linkosate 75.57G non- selective post emergent herbicides.

*NB: Means followed by the same letter along columns are statistically non-significant at 5% probability level according to Lsd mean separation

One month after (30 DAS) the highest efficacy for grass weed control was 100% for trust agro-sate 360 followed by Linkosate 48, Getrid 480 and Round Up with the efficacy of 98, 92.33 and 98.33 % respectively. Finally, at 40days after spraying the highest suppression (100%) of weeds was observed in plots treated with trust agro-state 360 as compared to standard check (88%) and this efficacy was par with Linkosate 48 which had an efficacy control of 97.33% for grass weed even at 40 days after application. However, the efficacy of Linkosate 48SL and Getrid was started show decreases slowly from 100% efficacy as the time of evaluation increased. Almost similar result is reported by [4] as the length of growing season increase the efficacy of herbicide is going to reduced.

The three herbicides namely Trust agro-sate 360, Linkosate and Getrid 480 were consistently effective in controlling grass weeds until 40 days after application no more increments in grass number and new growth were recorded for the three herbicides including the standard check (**Table 2 and Figure 1**). This result is also agreed with the previous finding of [5] on the consistency of herbicides on weed control until 40 days. However, growth of grass weed was continuous increased and new growth was continuously assessed from Linkosate 75.75 G herbicide that inferior in the controlling both weed types.

### Effect of Non-Selective Post-emergence Herbicides on Broad leaved Weed Management

The control of broadleaf weeds with different non –selective post emergent herbicides varied among treatments (**Table 3 and Figure 2**). In general, the initial broad weed control at 10 days after spraying was high for trust agro sate 360 SL, Linkosate 48 SL, Getrid 480 SL and
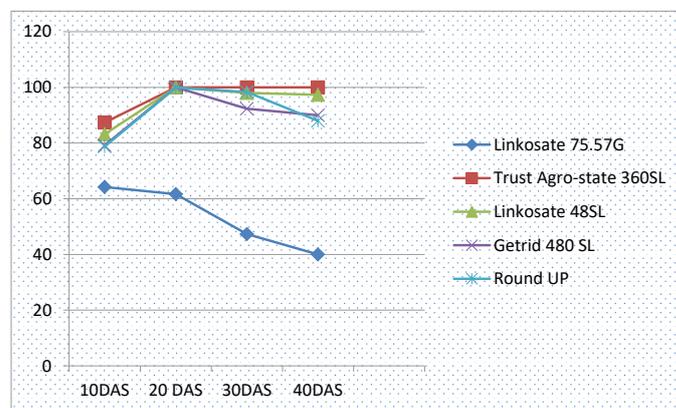


**Figure 1:** Days of after application and efficacy of five non-selective post emergence herbicides for citrus grass weed management at Metahara sugar

**Table 1:** List of Treatments.

| S/N | Herbicides | Common name (a.i) | Formulation | Rate/plot (87 m²) |
|---|---|---|---|---|
| 1 | Linkosate 75.57 G | Glyphosate-ammonium 75.7 % | Glyphosate-ammonium75.7% | 26.1 mg |
| 2 | Trustsate 360 SL | Glyphosate 36% | Glyphosate 360g/lSL | 43.51 ml |
| 3 | Linkosate 48 SL | Glyphosate-ammonium 48% | Linkosate 48% SL | 43.51ml |
| 4 | Getrid 480 SL | Glyphosate IPA SALT | Glyphosate 480gai/lt SL | 26.1ml |
| 5 | Round Up SL | Glyphosate | | 43.51 ml |

**Table 2:** Efficacy of the test Herbicides on Grass Weed Management.

| S/N | Treatments | % weed control | | | |
|---|---|---|---|---|---|
| | | 10DAS | 20 DAS | 30DAS | 40DAS |
| 1 | Linkosate 75.57G | 54.2b | 61.65b | 47.33c | 40d |
| 2 | Trust Agro-state 360SL | 87.38a | 100.0a | 100a | 100a |
| 3 | Linkosate 48SL | 83.2 a | 100a | 98.00a | 97.33ab |
| 4 | Getrid 480 SL | 79.21a | 100a | 92.33a | 87c |
| 5 | Round UP | 78.76a | 99.92a | 98.33a | 88bc |
| | LSD (5%) | 10.67 | 8.69 | 8.37 | 9.40 |
| | CV (%) | 7.67 | 4.83 | 8.88 | 5.77 |
| | R2 (%) | 78.8 | 82.2 | 97.5 | 95 |
| | Grand mean | 78.64 | 95.35 | 87.19 | 83.86 |

**Table 3:** Efficacy of the test Herbicides on Broad leaved Weed Management.

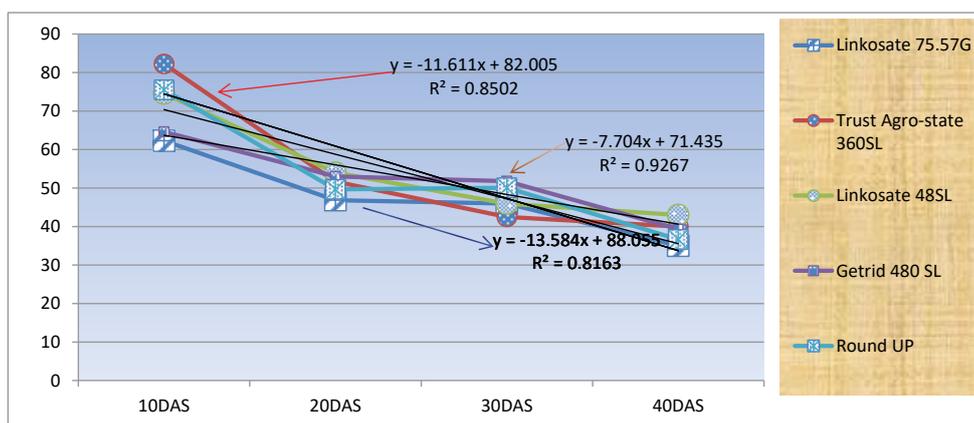| S/N | Treatment | % weed control | | | |
|---|---|---|---|---|---|
| | Treatments | 10DAS | 20DAS | 30DAS | 40DAS |
| 1 | Linkosate 75.57G | 62.27b | 46.83a | 45.97b | 43a |
| 2 | Trust Agro-state 360SL | 82.22a | 51.67a | 42.49b | 35c |
| 3 | Linkosate 48SL | 74.54a | 54.a | 45.95b | 40Ba |
| 4 | Getrid 480 SL | 64.6b | 53a | 51.77a | 39.33ba |
| 5 | Round UP | 75.50a | 49.67a | 50.08a | 36.67bc |
| | LSD (5%) | 8.54 | 7.96 | 3.92 | 3.92 |
| | CV (%) | 6.15 | 8.26 | 4.41 | 5.37 |
| | R2 (%) | 82.5 | 41.4 | 82.9 | 77.56 |
| | Grand mean | 71.83 | 51.00 | 47.25 | 38.8 |



**Figure 2:** Estimated relationship between days after application and efficacy of five non-selective post emergence herbicides on broad weed.

Round up respectively until 20 days after spraying, and then declined thereafter **(Table 1 and Figure 2)**. During the first 10 days after application the highest and significant result was recorded for trust agro-state 360 SL, Round up and Linkosate 48 SL and non- significant result was found between these three herbicides and herbicide efficacy were 82.22%; 75.50 and 74.54 respectively at (P≤5%) level for broad weed types specifically for Xanthium spp, Chenopedium and biden pilosa, ageratum conzoids while the lowest efficacy was also recorded for Linkosate 75.57G herbicide.

The candidate herbicides were greatly reducing the total number

of broad weeds in first day after spraying **(Table 3 and Figure 2)** and become non-significant after 20DAS and number of broad weeds increased at 20DAS.None of the evaluated non-selective post emergent herbicides provides effective control from broad weed for various weed species mainly field bind weed, parthenium and euphorbia because they started to form new growth from the green shoot or stool and new growth also appeared from the soil (soil bank) after 20DAS. This leads to increase the number of weeds per meter square as compared to number weed counted during 10 days after spraying.

Similar research finding was reported on a long term, single

**Table 4:** Mean efficacy of post emergence non – selective herbicides for weed management at Metahara sugar estates.

| S/No | Treatments | Means |
|---|---|---|
| 1 | Linkosate 75.57G | 67.02b |
| 2 | Trust Agro-state 360 SL | 86.49a |
| 3 | Linkosate 48 SL | 82.98a |
| 4 | Getrid 480 SL | 81.23a |
| 5 | Round Up | 80.18a |
| | Lsd (5%) | 11.02 |
| | Cv(%) | 2.34 |
| | R-square | 75.59 |
| | Mean | 79.73 |

applications of glyphosate in sugar beets did not result in adequate weed control efficacy [6] in glyphosate-tolerant sugar beet. Single applications of glyphosate might less effective for weed species that emerge after herbicide application [7]. Weed control effect varied among weed species present.

Control of the perennial Convolvulus arvensis L. and Parthenium hysterophorus weed were around 80% for trust agro sate 360 SL, Linkosate 48 and Getrid 480 until 10 days after the application on the leaves of the plant parts. At 20 DAP the new growth was observed from shoot (stem) field bind weed, Parthenium hysterophorous and Euphorbia. Then, after the efficacy of the evaluated herbicides were started to decreases. This result was agree with a finding of Baylis 2000 who report the low sensitivity of C. arvensis for glyphosate herbicides and the late emergence of this species after weed control operations had been completed. All the promising herbicides including the standard check were provides 100% control broad weeds types namely Chenopedium, different amaranthus types, xanthium, Biden pilosa and ageratum conzoids weed types [8].

The overall efficacy of the candidate herbicides were good trust agro state 360 SL with efficacy control of 86.49%, followed Linkosate 48 with efficacy level of 82.98% and Getrid 480 SL with 81.23%. However, statically the four herbicides were not different. Only the statically different and least overall efficacy was recorded from Linkosate 75.57G (Table 4).

## Effect of Non –Selective post-emergence Herbicides on Sedge Weed Management

Population of sedge grass was very less as compared to other weed types in the experimental areas and we couldn`t see the effect of non-selective herbicides on this weed species at Metahara sugar estates.

In addition to post emergent application, the non-selective herbicides are also used in agricultural fields as pre-emergent application before crops are sown to control weeds and their root systems to facilitate the growth of crops for different purpose like minimizing the tillage operation and

## Conclusion and Recommendation

Five different herbicides including standard check were evaluated as non-selective post emergency for the control of complex weed management at Metahara Sugar Estate. Based on their weed control efficacy the four herbicides Trust agro sate 360 SL, Linkosate 48 SL and Getrid 480 SL including the standard check Glyphosate were selected at Metahara as good candidates for grass weed species dominated citrus fields, non- farm lands and sub lateral area weed management.

The above candidate herbicides were effectively controlling grass when used as post emergency application for more than 40days after spray. However, their efficacies of control for broad weed types, all the tested herbicides were not effectively control the field bind only the above ground parts was killed, just after one –two weeks the new growth was started from the shoot or from the stool of this weeds.

Based on their efficacy the three herbicides Trust agro-state 360SL at 5lt/ha, Linkosate 48 SL at 5lt/ha and Getrid 480 SL at 3lt/ha were recommended as non-selective post emergent herbicides in Citrus field, Mango orchard and fallow land at Metahara sugar Estates. So the estates can select and use based on their current cost and availability of herbicides. It may good new rate and Tank mix will be evaluated for those weeds (Field bind weed, Euphorbia and parthenium) tolerating effect of herbicides currently evaluated.

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