Distribution and frequency paraquat resistant populations of 
*Eleusine indica* on cornfield in Karo Regency

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**Abstract.** Karo Regency as the largest corn production centre in North Sumatra Province is at risk of having a high frequency of paraquat-resistant populations of *Eleusine indica*, this is due to the continuous use of paraquat for a long time. This study aims to determine the distribution and frequency paraquat-resistant population of *E. indica* on cornfield in Karo Regency. Sampling was conducted in March - July 2019. Weed seed samples were taken from six Sub-districts that have the largest corn production in Karo Regency. Resistance tests were conducted in August - September 2019 at the weed resistance research laboratory in the Faculty of Agriculture, Universitas Sumatera Utara. Weed seeds from 72 suspected paraquat-resistant populations and 1 paraquat-sensitive population were planted each with 10 plants / pots and arranged using a Randomized Block Design in four replications. The paraquat dose used is the recommended dose of 600 g.b.a./ha. The application is carried out using an electric knapsack sprayer with teejetnozle and a spray volume of 320 L per hectare. The results of this study indicate that there are 70 populations (97.2%) of the paraquat-resistant category, 1 sample (1.4%) of the paraquat-resistant developing category and 1 population (1.4%) of the paraquat-sensitive category.

1. **Introduction**
Palm oil is the most important annual crop that is cultivated in Indonesia. Indonesia has the largest palm oil area in the world with an area of ± 14.3 million hectares in 2017 [1]. Weed control plays an important role in oil palm cultivation. The presence of uncontrolled weed could reduce oil palm production both quality and quantity.

Weed control may account for 17 to 27 percent of the total upkeep cost in immature or mature oil palm. Chemical method is the most popular method to control weed in modern-cultivated plantation especially weeds growing in the circle weeding of immature and mature oil palm trees. Several herbicides are commonly used in oil palm such as glyphosate, paraquat, glufosinate, and metsulfuron methyl. Herbicides are continually applied three to four times each year.

Weed control using the same mode of action of herbicide for a long period of time could lead to evolution of resistant population. Recently, it has been reported that glyphosate-resistant *Eleusine indica* population has been detected in oil palm plantations in Serdang Bedagai Regency with 42 populations out of 47 populations (89.36%), in Batubara Regency with 10 populations out of 13 populations (83.33 %), and in Deli Serdang Regency with 12 populations out of 23 populations (56.52%) [2][3][4]. None of the plantation managements aware that the herbicide-resistant weed population has occurred in their plantation fields.
Farmers in Karo Regency especially in around Tigabinaga Sub-district are recognized as the corn growers and the area is known as the corn centre area of the North Sumatra Province [5]. Farmers commonly spray their cornfields with paraquat herbicide for weed control prior to corn planting and at one and a half month after planting. They usually use paraquat, a contact herbicide.

Recently, several farmers reported that goosegrass (E. indica) could not be controlled satisfactorily as it used to be so it was indicated to have resistance. This is supported by studies that confirm the existence of 2 populations of E. indica that are resistant to paraquat from 27 population samples taken from corn fields in the Tigabinanga Sub-district, Karo Regency [6]. The aim of this study was to inventory the paraquat resistant E. indica population in the cornfields in Karo Regency.

2. Materials and methods

2.1 Seed collection

Seeds of E. indica were collected from various corn fields in Karo Regency. Mature seeds were recognized from colour change and ease to fall down. Seeds of each population were put into envelope and labelled. All seeds were germinated in pots containing potting soil. At 2 leaf-stage seedlings were transplanted into pots containing potting soil. Each pot contained 10 plants. Plants were maintained outdoor before and after spraying.

2.2 Herbicide application for screening

Plants at 4-5 leaf stage were sprayed with paraquat at recommended rate of 600 g.a.i per hectar with 320 L of spray volume using electric knapsack sprayer with teejetnozle. Each population consisted of four pots so made forty plants per population.

Plant survival was evaluated at three weeks after spraying. Plants were categorized as resistant population if there were 20 percent of plant survival and susceptible when plants survived not more than two percent [7].

3. Results and discussion

Of the 72 E. indica populations tested, there were 70 (97.2%) paraquat-resistant population, 1 (1.4%) paraquat-resistant developing population and 1 (1.4%) paraquat-sensitive population. Based on survival it was found clearly that there were 98.6% of the population of E. Indica had developed resistance to paraquat. The finding of this resistance is very high.

Based on the results of the questionnaire given to farmers, it is known that in general corn farmers in Karo Regency use paraquat for a long time, which is over 10 years (Table 1). This is in line with research which states that the use of the same type of herbicide for years or repeatedly during the growing season to control one type of weed that is not interspersed with other herbicides can result in herbicide resistance [8].

It is surprising that farmers in the Karo Regency are not aware of this phenomenon and continue to implement paraquat in the area. It is therefore necessary to advocate for farmers not to continue the same herbicide action in the same field.

Table 1. Samples of E. indica population for resistance testing, period of time being sprayed with paraquat before seeds were collected

| No. | Sample code | Field location | Period of herbicide usage (years) | Survival (%) |
|-----|-------------|----------------|-------------------------------|--------------|
| 1.  | ETB01       | Tigabinaga      | >10                           | 100          |
| 2.  | ETB02       | Tigabinaga      | >10                           | 100          |
| 3.  | ETB03       | Tigabinaga      | >10                           | 100          |
| 4.  | ETB04       | Tigabinaga      | >10                           | 97.5         |
| 5.  | ETB05       | Tigabinaga      | >10                           | 97.5         |
|   | EMT  | Location | Value | Percentage |
|---|------|----------|-------|------------|
| 6. | ETB06 | Tigabinanga | >10 | 92.5 |
| 7. | ETB07 | Tigabinanga | >10 | 77.5 |
| 8. | ETB08 | Tigabinanga | >10 | 87.5 |
| 9. | ETB09 | Tigabinanga | >10 | 100 |
| 10. | ETB10 | Tigabinanga | >10 | 82.5 |
| 11. | ETB11 | Tigabinanga | >10 | 82.5 |
| 12. | ETB12 | Tigabinanga | >10 | 97.5 |
| 13. | ETB13 | Tigabinanga | >10 | 100 |
| 14. | ETB14 | Tigabinanga | >10 | 97.5 |
| 15. | ETB15 | Tigabinanga | >10 | 92.5 |
| 16. | ETB16 | Tigabinanga | >10 | 92.5 |
| 17. | ETB17 | Tigabinanga | >10 | 85.0 |
| 18. | ETB18 | Tigabinanga | >10 | 77.5 |
| 19. | ETB19 | Tigabinanga | >10 | 100 |
| 20. | ETB20 | Tigabinanga | >10 | 100 |
| 21. | ETB21 | Tigabinanga | >10 | 67.5 |
| 22. | ETB22 | Tigabinanga | >10 | 100 |
| 23. | ETB23 | Tigabinanga | >10 | 100 |
| 24. | ETB24 | Tigabinanga | >10 | 100 |
| 25. | ETB25 | Tigabinanga | >10 | 100 |
| 26. | ETB26 | Tigabinanga | >10 | 100 |
| 27. | ETB27 | Tigabinanga | >10 | 100 |
| 28. | ETB28 | Tigabinanga | >10 | 100 |
| 29. | ETB29 | Tigabinanga | >10 | 100 |
| 30. | ETB30 | Tigabinanga | >10 | 100 |
| 31. | ETB31 | Tigabinanga | >10 | 100 |
| 32. | ETB32 | Tigabinanga | >10 | 100 |
| 33. | ETB33 | Tigabinanga | >10 | 100 |
| 34. | EMT01 | Munte | >10 | 97.5 |
| 35. | EMT02 | Munte | >10 | 100 |
| 36. | EMT03 | Munte | >10 | 97.5 |
| 37. | EMT04 | Munte | >10 | 97.5 |
| 38. | EMT05 | Munte | >10 | 100 |
| 39. | EMT06 | Munte | >10 | 100 |
| 40. | EMT07 | Munte | >10 | 100 |
| 41. | EMT08 | Munte | >10 | 100 |
| 42. | EMT09 | Munte | >10 | 100 |
| 43. | EMT10 | Munte | >10 | 100 |
| 44. | EMT11 | Munte | >10 | 100 |
| 45. | EMT12 | Munte | <10 | 0 |
| 46. | EMT13 | Munte | >10 | 22.5 |
| 47. | EMT15 | Munte | >10 | 100 |
| 48. | EJH01 | Juhar | >10 | 97.5 |
| 49. | EJH02 | Juhar | >10 | 100 |
| 50. | EJH03 | Juhar | >10 | 100 |
Conclusions
Cornfields in Karo Regency have been facing a serious resistant weed problem as 98.6% the areas we found that *E. indica* have developed paraquat resistance.

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Acknowledgements
This research was funded by the DRPM Ministry of Research, Technology and Higher Education Republic of Indonesia Fiscal Year 2019.