

Control of Sugarcane Shield Population (*Aulacaspis tegalensis*) Using Sugarcane Superior and Resistant Pest Varieties

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Received date: 18 September 2018, Accepted date: 15 November 2018, Online date: 20 December 2018

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ABSTRACT

The research on controlling sugarcane shield population (*Aulacaspis tegalensis*) using superior and pest resistant sugarcane varieties was carried out in the experimental garden of the Research and Development Division of PT Gunung Madu Plantations, Gunung Batin, Central Lampung, Indonesia during April 2015 – March 2016. The experiment used a complete randomized block design (RCBD) single factor, namely sugarcane RGM 99,370, RGM 97.8837 clones, GMP 1 GMP 2, GMP 3 and GMP 4 varieties, as treatment with four replications. Sugarcane shield observation (*Aulacaspis tegalensis*) was carried out starting from 4 months to 12 months old plants with a 15 day observation interval. The parameters of observation are the level of attack and the population of sugarcane shield. The data obtained were analyzed by linear regression and analysis of variance. The results showed that all clones and varieties planted were attacked by sugarcane shield with varying populations and intensity of attacks. The age of sugar cane, clones and sugarcane varieties has a significant effect on the level of sugarcane shield attack. GMP 3 and GMP 4 varieties are less preferred varieties of sugarcane shield compared to clones of RGM 99,370, RGM 97.8837, varieties of GMP 1 and GMP 2. The level of sugarcane shield attack of sugarcane variety GMP 3 and GMP 4 is relatively low, namely 16.11% and 18.90%. The development of sugarcane shield populations that attack is also low, on average 190.3 tails/stem and 179 tails / stem. GMP 3 and GMP 4 varieties are tolerant and resistant to sugar cane shield attack, showing no signs and symptoms of attack. The productivity of these two varieties is also very high at 119 tons / ha.

KEY WORDS

Aulacaspis tegalensis, clone, varieties

INTRODUCTION

Sugarcane productivity in Indonesia is still relatively low, ranging from 67.3 tons/ha with a rendemen sugar of 7.89 percent (Anonymous. 2011). In 2014 the rendemen was only achieved 7.0 percent (Agustine, 2014). The low productivity and rendemen of sugar cane, in addition to being caused by sugarcane varieties, the level of soil fertility, rainfall is also caused by pests and diseases (Hakim, 2010; Ghana, 2011; Rocha, et al., 2012; Saeed & Sun, 2013).

One important factor that has the potential to reduce sugarcane plantation production in Indonesia is pest attack. Sunaryo & Hasibuan (2003) reported that the main types of sugarcane pests are shoot borer (*Scirpophaga nivella*), glittering sugarcane stem borer (*Chilo aurichilius*), sugar cane mice and sugarcane shield (*Aulacaspis tegalensis*).

Lately, attacks by sugarcane shield are increasingly rampant. Attacks occur in all sugarcane varieties with mild to severe attacks. Attacks on sugar cane plantations in PT Gunung Madu Plantations tend to increase, one of the

causes is thought to be because various age sugar cane plants are available continuously throughout the year. Chemical control is relatively difficult because of the presence of lice attached to the midrib stem. In addition, leaf midribs that are not "clipped" encourage the breeding of sugarcane shield (Saefudin, 2014).

Sugarcane shield attack plants since the plant is four months old, the population continues to increase until near harvest. Sugarcane shield population is growing rapidly when the plants are 6-10 months old (Research & Development PT GMP, 2014; Caballero, et al., 2017). For sugarcane plants that are susceptible to stunt growth are relatively small and can cause death. Plants that were attacked initially did not show specific symptoms, only after the sugarcane shield attack population increased showed symptoms of yellowing leaves, then browned and dried. Severe attacks were seen with yellow or brown spo-spots on the leaves of sugarcane plants (Research & Development PT. GMP, 2014; Bowling, et al., 2016).

Economically the sugarcane shield attack has not been taken into account, but with an increase in sugarcane shield attack since the plants sugar cane is four months old until nearing harvest, it is certain to reduce sugar yield. Sugarcane shield lice are reported as important pests of sugarcane, the population and intensity of attacks are very high (Ben-Dov & Miller, 2018; Caballero, et al., 2017).

Sugarcane is an important sugar-producing commodity that has strategic value and has to be increased in production (Indarwanto, et al., 2010). To increase production in addition to expanding plantations, it is also carried out by reducing yield losses. One obstacle to increasing production is the presence of sugarcane shield flea attacks (*Aulacaspis tegalensis*). Sugarcane shield lice attack the stem which is covered with leaf midribs which makes it difficult to control using pesticides. Control that is expected to be effective is to use sugarcane resistant varieties against sugarcane shield attack with high productivity.

Sugar cane plants at PT. Gunung Madu Plantations have various varieties and clones that have different characteristics. Some are resistant to pests but their production and rendement are low. Conversely, there are those who are less resistant to shield bugs but their production and rendement are relatively high. Usually this kind of character is interesting to research and reproduce. For example GMP 1 variety which is susceptible to sugarcane shield pests but has a higher production potential compared to GMP 2 varieties, clones RGM 99.370 and RGM 97.8837 (Research & Development PT GMP, 2014).

From this phenomenon, research on sugarcane varieties was carried out with the aim to obtain resistant varieties, not favored by sugarcane shield (*Aulacaspis tegalensis*) and high productivity. The sugarcane variety produced is expected to be very useful to increase sugar production both locally and regionally.

MATERIALS AND METHODS

The study was conducted in the experimental garden of the Research and Development Division of PT Gunung Madu Plantations (PT GMP), Gunung Batin, Central Lampung, Indonesia, during April 2015 – March 2016. The study site is an experimental garden that has long been used for the study of sugarcane varieties and clones. These varieties include GMP 1, GMP 2, GMP 3, GMP 4, GMP 21, GMP 23. Clones RGM 99.370, RGM 97.370, SN 287, SN 316 and many others.

Four varieties (GMP 1, GMP 2, GMP 3 and GMP 4) and two sugar cane clones (RGM 99.370 and RGM 97.8837) were chosen as research objects because they have specific characteristics. Each clone and variety is planted in each block. Experimental land consists of 4 blocks, which are within 1,000 meters and each block area is 12 hectares.

The design of the experiment used a complete factor randomized block design (RCBD) which was a clone / sugarcane variety as a treatment with four replications. Sugarcane plants are not "clipped" so that they represent the plants on the plantation. Cane shield lice observations were carried out starting from 4 months to 12 months with a time interval of 15 days (Vicentini, et al., 2015)

The method of observing sugarcane shield lice as follows, the sugar cane sample is cut down further by using "hand counter" shield lice attached to the stem segments are calculated then the stem that is still covered with midribs is clipped. If the population is very high sometimes there is something attached to the leaf midrib. All sugarcane shield colonies found both in the midrib and on the sugarcane stem segments are calculated and then added together. The recording of sugarcane shield populations for each variety and clone is separated based on observation time (Tago, et al., 2014). The data obtained were analyzed by linear regression and analysis of variance.

RESULTS AND DISCUSSION

The results of field observations of sugarcane shield populations on each stem showed varied results for each clone, variety and age of plants. In general, all varieties of plants and sugar cane planted are attacked by sugarcane shields. Sunaryo & Hasibuan (2003) reported that a sugarcane shield attack begins when the plant is 6 months old when the midrib begins to stretch from its stem. The attack continues to increase in line with

increasing age and the formation of plant stem segments. As age get older, the stems grow more and reach their peak population when the plants are around 10.5 months old or after they are formed.

The results of multiple linear regression analysis showed that the more influential on the development of sugarcane shield population is the age of the plant, t count = 5.218 with a probability of P = 0.0001. While the number of segments t count = - 0.795 with the probability P = 0.440, does not show a real effect. There is a positive correlation between the sugarcane shield population and plant age (r = 0.803).

Table 1: Average of segment and sugarcane shields per stem

Observation	Age (month)	Segment	Sugarcane shield (tail/stem)
1	4.0	2.17	0.00
2	4.5	3.00	0.00
3	5.0	5.31	0.00
4	5.5	10.20	0.00
5	6.0	17.09	0.16
6	6.5	17.73	0.28
7	7.0	21.20	0.42
8	7.5	21.57	19.94
9	8.0	24.22	136.89
10	8.5	24.72	147.70
11	9.0	27.66	402.90
12	9.5	27.99	412.90
13	10.0	31.21	1414.38
14	10.5	32.56	1430.94
15	11.0	33.54	830.30
16	11.5	33.50	837.37
17	12.0	33.63	864.99

Saefudin (2012) early proved that sugarcane shield populations reduce the stem weight and rendemen of sugarcane. The population of 1 - 25 heads / stem decreases the weight of about 0.15 kg / stem and 0.6% rendemen. If the population is 100 - 500 per stem the weight reduction is 0.29 kg per stem and the rendemen drops 1.0 - 1.29%. The loss is greater if the sugarcane shield population is more than 1.000 tails / stem, which is a decrease of about 2.46%.

GMP 1 and GMP 2 varieties averaged a high percentage of per-rod attack rates of 34.57% and 27.22%. GMP 3, GMP 4 varieties, clones of RGM 99.370, RGM 97.8837 respectively 20.19%, 18.73%, 16.11% and 18.90%. In the eleventh month until nearing the harvest, the average attack rate per stem tended to decline, presumably there was a process of controlling natural sugarcane shield by predators. When sugarcane is aged, the leaf midrib is getting easier to open so that the predators and parasitoids are easier to reach the sugarcane shield hidden behind the leaf midrib.

The difference in attack rates is thought to have influenced the nature of varieties or sugarcane clones. Clones / varieties sugarcane that are sticky / closed such as GMP 1 variety and GMP 2 attack rates tend to be high. GMP 1 variety sugarcane shield attack continues to increase and reaches its peak in the tenth month. Almost all segments are attacked by sugarcane shield, the attack rate reaches 99.35%. Carry on contrast GMP 3 and GMP 4 varieties, clones of RGM 99.370 and RGM 97.8837 whose sheaths were not attached or easily exposed the level of sugarcane shield attack was relatively low.

Table 2: Percentage of segment attack sugarcane shield to variety and clone

Age (month)	Variety				Clone	
	GMP 1	GMP 2	GMP 3	GMP4	RGM 99.370	RGM 97.8837
4.0	0	0	0	0	0	0
4.5	0	0	0	0	0	0
5.0	0	0	0	0	0	0
5.5	0	0	0	0	0	0
6.0	0.39	0.66	0.52	0.39	0.91	0.77
6.5	0.79	0.90	1.16	1.02	1.03	0.80
7.0	14.00	20.61	13.11	10.02	21.84	18.53
7.5	12.70	15.70	11.64	10.99	15.97	14.21
8.0	43.98	52.08	21.72	22.66	22.82	24.23

8.5	52.76	49.81	21.44	20.15	18.47	21.98
9.0	52.45	33.42	17.26	27.42	30.10	30.33
9.5	56.58	43.02	22.32	30.75	30.00	24.69
10.0	99.35	43.65	35.62	30.57	32.77	49.86
10.5	71.60	54.64	18.86	32.31	31.36	21.83
11.0	53.68	36.88	45.90	58.85	42.95	37.07
11.5	58.40	59.40	36.64	39.59	43.11	41.84
12.0	71.07	51.95	27.69	36.62	51.90	32.24
Average	34.57 a	27.22 ab	20.19 b	18.73 b	16.11 b	18.90 b

Description: The mean followed by the same letter is not significantly different in the 5% DMRT analysis

GMP 1 variety which is the result of breeding from the Research and Development Division is maintained because of the relatively high production potential of 115 tons / ha. Higher than GMP 2 variety, the clone of RGM 99,370 and clone of RGM 97.8837 were 111 tons / ha, 104 tons / ha and 112 tons / ha. GMP 3 and GMP 4 varieties are relatively resistant varieties and have very high production of 119 tons / ha and high sugar rendement above 8%.

The newly tested clone, namely RGM 99.370 and RGM 97.8837, are categorized as some moderate resistant to sugarcane shield but have a very high rendement of more than 9.0 percent. Production of RGM 99,370 and RGM 97.8837 was 104 and 112 tons / ha. Clone sugar cane still needs to be developed by increasing resistance to sugarcane shield. Both of these sugar cane clones are still considered to be irresistible to sugarcane shield attack even though the sugarcane shield population reaches hundreds of tails.

GMP 3 and GMP 4 varieties are attacked by sugarcane shield with a low population or less than 200 per stem. Both of these varieties do not show signs or symptoms, plant growth remains normal. On the other hand, GMP 1 and GMP 2 varieties show obvious signs or symptoms, namely the leaves begin to turn yellow, brown and dry. GMP 1 sugarcane varieties, showed signs and symptoms when the plant was 8 months old and there was death in 10 month old plants.

Sugarcane shield begin to attack when the plant is four months old (Ravuiwasa, et al., 2012; Ho, et al., 2014; Research & Development PT GMP., 2014). Observations on sugarcane plants aged 4 - 5.5 months, the sugarcane shield population is still 0 tails / stem. When the 6 month old plant began to be found sugarcane shield e even though the population is still very low and only found in a few samples.

GMP 3 and GMP 4 varieties are varieties that are less preferred by sugarcane shield, a population average of 190.3 tails / stem and 179 tails / stem. Clones of RGM 99.370 and RGM 97.8837 are somewhat favored by sugarcane shield lice with a population average of 365.2 tails / stem and 255.2 tails / stem. GMP 2 varieties are favored by sugarcane shield with an average population of 489.5 tails / stem, while GMP 1 with an average population of 814.4 tails / stem.

GMP 3 and GMP 4 varieties are relatively resistant to sugar cane shield attack and show the development of pest populations that are not too fast. GMP 3 and GMP 4 varieties do not show signs and symptoms of sugarcane shield attack. The growth and development of sugarcane stems both varieties are normal without any obstacles, this variety in addition to resistant is also considered tolerant of sugarcane shield attack.

On the contrary, GMP 1 variety is very favored by sugarcane shield lice so that the development of the shield flea population is very fast. The development of the flea population almost attacks all stem segments. As a result of clearly visible signs and symptoms, the leaves turn yellow, brown, dry, stems shrink and plant death occurs due to sugar cane shield attack.

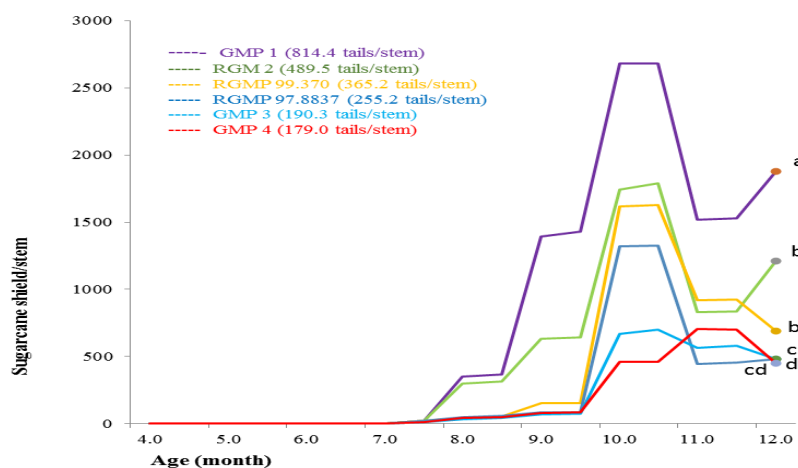


Figure 1. Development of sugarcane shield

GMP 2 variety is also same favored by sugarcane shield, population development is not as fast as GMP 1. The signs and symptoms of attack are not very clear. Some plants show symptoms of yellowing, drying but the stem is still normal. Plant growth is also not disturbed, length and number of segments are also normal. GMP 3 and GMP 4 varieties are not preferred and are resistant to sugar cane shield attack because they have easy to open midrib characters. Midribs that are easy to open provide an opportunity for predators or parasites to reach the presence of sugarcane shield so that their proliferation is hampered by predators and parasitoids. Sugarcane shield population dynamics occur starting from 6 months old plants (Watson, G. & Marler, 2014; Wei, et al. 2016; Zhang, et al. 2013; Research & Development PT GMP. 2014). In 6 month old sugarcane plants, sugarcane shield have been found with a very low population, which is an average of 0.11 - 0.19 tails / stem. The sugarcane shield population continues to increase until the plant is 10.5 months old, the highest population in GMP 1 variety is 2,678.42 tails / stem and the lowest is GMP 4 variety is 461.81 tails / stem. Furthermore, the sugarcane shield population tends to decrease until before cutting or sugarcane plant 12 months old.

The development of sugarcane shield population has been a difference since sugar cane plants are 7.5 months old, there are varieties and clones whose development is very fast otherwise found varieties and clones which are less preferred by sugarcane shield. GMP 1, GMP 2 varieties and clone of RGM 99,370 population were higher compared to RGM 97.8837 clone, GMP 3 and GMP 4 varieties. When sugarcane plants aged 8 - 9 months increased sugarcane shield population on GMP 1 and GMP 2 varieties was faster than with RGM 99,370, RGM 97.8837, GMP 3 and GMP 4.

Death of plant parts occurs in sugarcane crops GMP 1 and GMP 2 varieties in plants aged 10 - 11 months. The highest number of sugarcane deaths in GMP 1 variety and followed by GMP 2 variety. Sugarcane clones of RGM 99.370 and RGM 97.8837, the signs and symptoms of sugarcane shield attack are not clear, both varieties are tolerant to sugarcane shield pest attack (Saefudin, 2012). GMP 3 and GMP 4 varieties tend to be resistant and there are no signs and symptoms of sugarcane shield attack. For clones of RGM 99.370, RGM 97.8837, GMP 3 and GMP 4 varieties did not occur due to the death of sugar cane shield attack.

GMP 1 variety of sugar cane are most preferred by sugarcane shield, then GMP 2 variety, clones RGM 99.370 and RGM 97.8837. GMP 3 and GMP 4 varieties are relatively unpopular with sugarcane shield. Physically GMP 3 and GMP 4 varieties do not show any symptoms of sugarcane shield attack. For sugarcane varieties GMP 1, before harvesting the stems that are attacked by sugarcane shield shrink and dry out. GMP 2 variety, the attack was not too severe even though there were several stems that dried up due to the attack of sugarcane shield. RGM 99.370 and RGM 97.8837 clones are relatively tolerant and there are no trunks that die due to shield lice attacks. GMP 3 and GMP 4 varieties are most resistant to attack by sugarcane shield, this variety shows no symptoms of yellowing leaves or dried stems.

The spread of sugarcane shield in the field tends to be evenly distributed for each variety, but the level of population development of each variety and clone at a certain age is different. The highest population increase in GMP 1 and lowest varieties in GMP 4. The peak of the sugarcane shield population in all varieties and clones occurs at 10 - 11 months of plant life, then the population decreases, it is thought that there are natural enemies that suppress sugar cane shield populations. parasitoid.

The average population of sugarcane shield in various varieties and clones is presented in Figure 1. GMP 1 variety are the most preferred varieties by sugarcane shield with a population for 12 months on average 814.4 tails / stem followed by GMP 2 variety on average 489.5 tails / stem, RGM 99,370 clone averaged 365.2 tails / stem. Clone RGM 97.8837 averaged 255.2 tails/stem and GMP 3 variety are less favored by sugarcane shield

with an average cumulative population of 190.3 head per stem and the lowest 179 tails/stem is GMP 4 variety. Among the six varieties and clones in this experiment, the least preferred sugarcane shield is GMP 4 variety. Saefudin (2012) early proved varieties or clones that are less preferred by sugarcane shields are those whose midribs are easy to open. This is thought to be related to the existence of natural enemies both predators and parasitoids. Midribs that easily open predators or parasitoids easily reach the presence of sugarcane shield compared to closed ones. Clone RGM 99,370, the midrib was slightly opened compared with RGM 97.8837 whose midrib opened the level of preference of the sugarcane shield population was significantly different. The four varieties and two sugarcane clones tested found that two varieties, GMP 1 and GMP 2, were favored by sugarcane shields and showed specific signs and symptoms of sugarcane shield attack, that is yellowish, brownish, dried and stunted stem growth. At the time of sugar cane plants aged 10 - 11 months there was death. Clones of RGM 99.370 and RGM 97.8837 do not show symptoms of specific sugarcane shield attack although the cutaneous population is relatively high. GMP 3 and GMP 4 varieties have no signs and symptoms of sugarcane shield attack and the sugarcane shield population is relatively low.

The lowest preference of sugarcane shield against GMP 3 and GMP 4 is in line with the statement of Saefudin (2012), namely varieties that have midribs easily open the dislike of sugarcane shield and resistance to sugarcane shields are categorized as "resistant." Judging from the production of GMP 3 and GMP 4 varieties including high, 119 tons / ha exceeding GMP 1 and GMP 2, which is only 115 tons / ha and 111 tons / ha. Both of these varieties, GMP 3 and GMP 4 are very suitable to be developed to suppress the population and sugarcane shield attack.

CONCLUSION

1. All sugar cane plants from four varieties (GMP 1, GMP 2, GMP 3, GMP 4) and two clones (RGM 99.370 and RGM 97.8837) were attacked by sugarcane shield with different levels of attack. GMP 3 and GMP 4 varieties are the lowest varieties of sugarcane shield attack.
2. The age of sugar cane, clones and sugarcane varieties has a significant effect on the level of sugarcane shield attack
3. GMP 3 and GMP 4 varieties are less favored by sugarcane shield with an average population of 190.3 tails / stem and 179 tails / stem. Both varieties are resistant to sugarcane shield attack and the productivity is the highest of 119 tons / ha.

ACKNOWLEDGMENTS

The authors thank Mr. Tri Agus Suranto, Mr. Saefudin and other staff of Divisi Research & Development PT. Gunung Madu Plantations Central Lampung, Indonesia for their assistance in the field.

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