The relationship of the morphological characteristics of some varieties of soybean on the attack intensity of the pod borer (*Ettiela zinkenella* Treitschke) in two different cultivation techniques

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Abstract. Soybean is one of the secondary crops that are often planted by the farmer. One of the common pests that attack soybeans is the pod borer (*Ettiela zinkenella* T). One of the ways to control pests is by using varieties that are resistant to pod borer attacks. The research objectives were to examine the relationship between the morphological characteristics of soybean pods and to determine the handling with the lowest attack intensity. The experiment used a split plot design with two factors and three replications. The research material was the seeds of five soybean varieties, namely Detap-1, Dega-1, Anjasmoro, Biosoy, and Dena-1 which were planted in 2 different lands. The higher the trichome pods, the lower the attack intensity with a value of -68.321, if $X = 0$ then $Y = 64.081$ and for the $R^2$ value in the relationship, which is 0.2532. The longer the pod trichomes, the higher the attack intensity with a value of 0.0683, if $X = 0$ then $Y = 18.208$ and for the $R^2$ value in the relationship, which is 0.0007. The thicker the skin texture of the pods, the lower the attack intensity with a value of -68.321, if $X = 0$ then $Y = 64.081$ and for the $R^2$ value in the relationship, which is 0.2532. The harder the skin texture of the pods, the lower the attack intensity with a value of -0.0308, if $X = 0$ then $Y = 36.614$ and for the $R^2$ value in that relationship, 0.2355. The recommended technology treatment with Anjasmoro variety had the lowest attack intensity compared to other treatments.

Keywords: Soybean, Cultivation Techniques, Attack Intensity, *Ettiela zinkenella*, morphological

1. Introduction

Soybean is one of the secondary crops that are often planted by the farmer, people tend to plant soybeans with recommended and traditional techniques, planting with recommended techniques, namely planting soybean seeds with the same spacing in each planting hole, and planting with traditional techniques, namely soybean seeds planted without planting. Paying attention to spacing, planting methods using traditional techniques are carried out by spreading soybean seeds on a land. The use of these two techniques is adjusted to take into account the social, economic, cultural and agro-ecosystem of soybean planting locations [1-3].

The national community’s need for soybeans from 2014 to 2018 reached 2.3 to 2.5 million tons annually, this figure is higher than the total national soybean production which is only 1 million tons annually [4]. So soybean production needs to be increased.

Efforts to increase soybean productivity have problems, one of which is pest attack. One of the pests that most often attacks soybeans is the pod borer (*Ettiela zinkenella* I). Pod borer attacks on various soybean varieties ranged from 26% to 55% [5], therefore to reduce losses it is necessary to control the pod borer.

Pest control can be done by using varieties that have resistance to pod borer attacks, one of the resistance factors is morphology, plant morphological resistance is the response of plants using the shape and physical arrangement to defend themselves from attacks by the pod borer. Planting pest-resistant soybean varieties will reduce damage to crops and reduce the use of insecticides, thus providing economic, environmental and human health benefits [5].

The purpose of the study was to examine the relationship between the morphological characteristics of soybean pods and to determine the handling with the lowest attack intensity.
2. Materials And Methods

This research was conducted in Stanggor Village, West Praya District, Central Lombok Regency, from September to December 2020. The experiment used a split plot design with two factors and three replications.

- The first factor is planting technique:
  1. T1=Recommended technique: stabbing and spacing 40 x 15 cm.
  2. T2 = Traditional technique: soybean seeds are sown onto the land to be planted, without planting holes and not using spacing so that the spacing is irregular.

- The second factor is soybean varieties:
  1. Detap-1
  2. Dega-1
  3. Anjasmoro
  4. Biosoy
  5. Dena-1

The research material was the seeds of five soybean varieties, namely Detap-1, Dega-1, Anjasmoro, Biosoy, and Dena-1 which were planted in 2 different lands, the first land was planted using recommended techniques, and the second was planted using traditional techniques.

The morphology of the pods was observed at the age of 12 WAP which included trichome length, trichome density, pod shell thickness, and pod texture. For parameters of trichome length and trichome density were observed using a Meiji binocular microscope with an area of 100 x 100 dalamm2 at a magnification of 10 x 4, for parameters of pod shell thickness were observed using a micrometer screw, and for pod texture parameters were observed using a tenderometer. All data obtained were analyzed for variance, if the treatment had a significant effect, then it was continued with the honest Least Significance Different test (LSD) with a level of 5%. Regression and correlation analysis are used to examine how the influence and how strong the influence between parameters.

To determine the intensity of pod borer attack, the formula for Attack Intensity according to Gatut and Muchlilsh (2008) [6].

\[ I = \left( \frac{a}{b} \right) \times 100\% \]

where:
- \( I \) = Attack Presentation (%)
- \( a \) = Number of affected pods
- \( b \) = Total Number of Pods

3. Results and Discussion

3.1. Characteristics of pod morphology and attack intensity of pod borer pests

Based on the research conducted, the density of trichome pods ranged from 884.55 m2 (10*4)1025.92 m2 (10*4). The traditional planting technique treatment with anjasmoro variety (884.55 m2 (10*4)) had the most dense trichomes compared to other treatments and the treatments tested had no effect on trichome density. The length of the trichome pods ranged from 64.46 m (10*4) – 80.54 m (10*4). The recommended planting technique treatment with Dena-1 variety (80.54 m (10*4)) had the longest trichome compared to other treatments and the length of the pod trichome was influenced by the interaction of the two treatments tested. The thickness of the skin of the pods ranged from 0.54 mm - 0.64 mm. The recommended planting technique treatment with the Detap-1 variety (0.64 mm) had the thickest pod skin compared to other treatments and the pod shell thickness was independently influenced by the varietal treatment. The skin texture of the pods ranged from 255.89 gr – 533 gr. The traditional planting technique treatment with Detap-1 variety (533 g) had the hardest pod skin texture compared to other treatments and the pod skin texture was influenced by the interaction of the two treatments tested. The intensity of pod borer attack ranged from 18.17% - 42.28%. The planting technique treatment by farmers with Dega-1 variety 42.28% had the highest pod borer pest attack intensity compared to other treatments and the attack intensity was independently influenced by the varietal treatment. The ideal morphological characteristics of the pods will be able to reduce the intensity of the pod borer pest attack.
The different morphological characteristics of the pods in the tested treatments can affect the oviposition preferences of the pod borer. [6] reported the same thing, the difference in characteristics of soybean pods can affect pest preferences.

| Varieties   | KT (µm) | PT (µm) | KKP (mm) | TKP (gr) | IS (%) |
|-------------|---------|---------|----------|----------|--------|
| T1 Average  | T2 Average | T1 Average | T2 Average | T1 Average | T2 Average | T1 Average | T2 Average |
| Detap-1     | 903.21  | 985.06  | 944.14   | 68.48 b  | 72.86 ab | 70.67   | 0.64       | 0.63       | 0.64 a   | 496.6 a | 533 a | 514.50 | 19.64 | 25.57 | 22.61 bc |
| Dega-1      | 1024.41 | 1063.67 | 1044.04  | 64.46 b  | 70.70 ab | 67.58   | 0.59       | 0.57       | 0.58 ab  | 366.56 b | 304.78 b | 335.67 | 25.11 | 42.28 | 33.70 ab |
| Anjasmoro   | 1025.92 | 884.55  | 955.24   | 69.67 ab | 74.67 ab | 72.17   | 0.57       | 0.58       | 0.57 ab  | 341.56 b | 322.89 b | 332.22 | 18.17 | 23.65 | 20.91 c |
| Biosoy      | 1024.45 | 976.95  | 1000.70  | 69.73 ab | 73.83 ab | 71.78   | 0.62       | 0.57       | 0.60 ab  | 365.89 b | 258.89 b | 312.39 | 33.55 | 38.15 | 35.85 ab |
| Den-1       | 916.66  | 998.44  | 957.55   | 80.54 a  | 73.11 ab | 76.83   | 0.54       | 0.54       | 0.54 b   | 335.33 b | 255.89 b | 295.61 | 34.12 | 41.14 | 37.63 a |

The line numbers followed by the same letter are not significantly different at the 5% BNJ level. T1 = Recommended Technique, T2 = Traditional Technique, KT = Trichome Density, PT = Trichome Length, KKP = Pod Skin Thickness, TKP = Pod Skin Texture, IS = Attack Intensity, tn = Not Significant according to LSD 5% test.

3.2. The Relationship between Trichoma Density and Intensity of Pod Borer Pests

Based on the regression and correlation analysis showed the effect of pod trichome density on the intensity of the pod borer pest attack, namely the addition of a value to the X factor (Trichoma Density) will affect the addition of the value to the Y factor (Attack Intensity) with a value of 0.068, if X = 0 then Y = -38.62 and for the R2 value in that relationship, 0.1655 or the relationship between trichome density and the intensity of pod borer attack has a strength of very weak (Figure 1).

The density of pod trichomes is one of the defense systems against the pod borer pests. The relationship between the density of pod trichomes and the intensity of attack showed a positive result, the denser the pod trichomes, the lower the intensity of the attack of the pod borer [5]. The results of research showed the same results, the density of trichomes affected the intensity of pod borer attack, the denser and more pods trichomes caused the attack intensity to be lower [7]. The density or density of trichomes did not have a significant effect on the intensity of pod borer pest attack. This statement is in accordance with the results of the study which showed that the density of trichomes had a weak effect on the intensity of pod borer attack, namely 16.5% [8].

The density of trichomes has not been able to become a strong defense tool for soybean pods, presumably because the pod borer pest that attacks the larvae is larvae, when the larvae come out of the eggs they will immediately sink into the pods, the very small size of the larvae causes the density of the trichomes to be unable to hold the larvae into in pods. The same thing, trichomes were only able to withstand attacks from pests whose mouthparts were pinched or sucked, for pod borer pests the trichome defense system had no significant effect [3].

![Figure 1. The Relationship between Density of Pod Trichome and Attack Intensity.](image-url)
3.3. The relationship between trichome length and attack intensity of pod borer pests

Based on the regression and correlation analysis showed the effect of pod trichome length on the intensity of the pod borer pest attack, namely the addition of a value to the X factor (Trichoma length) will affect the addition of the value to the Y factor (Attack Intensity) with a value of 0.0683, if \( X = 0 \) then \( Y = 18.208 \) and for the \( R^2 \) value in the relationship, which is 0.0007 or the relationship between pod trichome length and the intensity of pod borer attack has a strength of 0.07\% (Figure 2). The relationship between the length of the pod trichomes and the intensity of attack showed positive results, the longer the pod trichomes the higher the intensity of the pod borer pests.

Pod trichomes are part of the defense system against pests that can hinder the penetration process of pod pests. This statement is different from the results of the research conducted, because the length of the trichome does not apply to resist the attack of the pod borer [9]. Trichomes are only able to withstand attacks from pests whose mouthparts poke or suck, for pod borer pests the trichome defense system has no significant effect [8]. Long pods trichomes are an ideal medium for imago of pod borer pests to lay their eggs because eggs laid on long trichomes will prevent predators from preying on these eggs, so the percentage of eggs that hatch is very high. The same thing, Trichomes can be an ideal place for some pests to place eggs so they are not easily damaged due to environmental disturbances [6]. Trichomes are needed to place eggs as well as protect them from predators or parasite [10].

\[ y = 0.068x + 18.20 \]
\[ R^2 = 0.0007 \]

Figure 2. The relationship between length of trichome with attack intensity.

3.4. Relationship between pod skin thickness and pod borer attack intensity

Based on the regression and correlation analysis showed the effect of pod shell thickness on the intensity of pod borer pest attack, namely the addition of a value to the X factor (pod shell thickness) will affect the reduction in the value of the Y factor (Larva Population) with a value of -68.321, if \( X = 0 \) then \( Y = 64.081 \) and for the \( R^2 \) value in the relationship, which is 0.2532 or the relationship between pod skin thickness and the intensity of pod borer attack has a strength of very weak (Figure 3).

The relationship between the thickness of the pod shell and the intensity of the attack showed a negative result, the thicker the skin of the pod, the lower the intensity of the attack of the pod borer. Pod shell thickness had a strong relationship with attack intensity, the higher the pod shell thickness, the lower the attack intensity. So it can be concluded that pod shell thickness is an important defense for soybean pods [9,11].
3.5. Relationship between pod skin texture and pod borer attack intensity

Based on the regression and correlation analysis showed the effect of pod skin texture on the intensity of the pod borer pest attack, namely the addition of a value to the X factor (pod skin texture) will affect the reduction in the value of the Y factor (Larva Population) with a value of -0.0308, if X = 0 then Y = 36.614 and for the R2 value in that relationship, 0.2355 or the relationship between pod skin texture and the intensity of pod borer attack has a strength of weak (Figure 4).

Based on the regression and correlation analysis showed the effect of pod skin texture on the intensity of the pod borer pest attack, namely the addition of a value to the X factor (pod skin texture) will affect the reduction in the value of the Y factor (Larva Population) with a value of -0.0308, if X = 0 then Y = 36.614 and for the R2 value in that relationship, 0.2355 or the relationship between pod skin texture and the intensity of pod borer attack has a strength of 23.55%. From these statements, it can be concluded that an important factor in pod defense against pod borer pests is pod skin texture.

From these statements, it can be concluded that an important factor in pod defense against pod borer pests is pod skin texture.

4. Conclusion

The relationship between the morphological characteristics of the pods and the intensity of attack by the pod borer was that the closer the pod trichomes were, the lower the attack intensity. The longer the pod trichomes, the higher the attack intensity. The thicker the skin of the pod, the lower the attack intensity. The harder the skin texture of the pods, the lower the attack intensity. The recommended technology treatment with Anjasmooro variety has the lowest attack intensity compared to other treatments, so it has the opportunity as a priority treatment in the implementation of soybean planting.
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