Contribution of pod borer pests to soybean crop production (case in Pondidaha, Konawe District, Southeast Sulawesi)

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Abstract. Soybean (Glycine max L.) is one of the most important crops which production continues to be improved in all areas of soybean cultivation centers in an effort to maintain the availability of soybean foods, including Southeast Sulawesi. The purpose of this study was to analyze the contribution of pod borer pests to soybean crop production. Methods of direct observation were made on observed variables, including species and population of pest pod borer, intensity, and crop production. The result that found four types of pod borer pests are Nezara viridula, Riptortus linearis, Etiella zinckenella, and Leptocorisa acuta, each with a different population and contribution to the intensity of pod damage. The result of path analysis showed that directly population of N. viridula (61.14) and E. zinckenella (66.44) gave positive contribution in increasing pod damage, by 0.332 and 0.502 respectively, while the negative contribution was shown by population of R. linearis and L. acuta. Damage of the pod causes increased production of low soybean is only about 0.202, therefore required appropriate control techniques to control pod borer pests populations in soybean crops.

1. Introduction

Soybean (Glycine max) is a strategic commodity and plays an important role for the life of society and economy of Indonesia. Soybean is the raw material for making tofu, tempe, soybean sauce, and tauco as a processed food product that is always consumed almost by all layers of society in Indonesia, both in the village and in the city. The productivity of soybean crop in Indonesia is about 1.2 ton ha⁻¹, still far below the potential yield that can reach 2.0-2.5 ton ha⁻¹ [1]. In addition to the growing planting area and the lack of interest of farmers to plant soybean, weather disturbances such as La Nina, low productivity and loss of yield due to pest and disease damage are the main causes of low soybean production in Indonesia.

Damage to pests and diseases in soybean plants is a stress biotic environment that greatly affects the response of plants to fertilization is the absorption of nutrients to be not optimal. As a result, soybean production becomes low due to loss of yield due to pest damage. In the production process, the pest problem cannot be ignored, because it will affect the production qualitatively and quantitatively and able to reduce production by 20.7%, even causing crop failure, if not control.

Main pests commonly found and able to cause crops are Ophyomia phaseoli [2], Spodoptera litura [3], Phaedonia inclusa, Etiella zinckenella [4], Riptortus linearis and Nezara viridula [5-6]. Data and information on how big pest destructive pests soybean contribute to the loss of production is still limited, therefore research on the amount of pest the destructive contribution to soybean crop
production becomes important to do. Related to this matter, this research aims to analyze the contribution of pest destructive pods to soybean plant production.

2. Materials and methods
This research was carried out on farm land owned at Belutu Village, Pondidaha Sub-districts, Konawe Districts, Southeast Sulawesi. The study used the method of direct observation on soybean crop fields. The research sampling plots in observations plot are determined diagonally as many as five plots with the size of each plot is 1.5 m × 1.5 m, so that in one observation plot there are 12 soybean plants as sample plants. Observations were made since the plants were two weeks after planting (WAP) to 9 WAP with one-week of observation interval.

The observed parameters, includes (a) Types of insect pests: calculated all types of pests that damage pods contain in the plant sample. (b) Insect pest population: calculated all pest populations found in sampel plant. (c) I ntensity of pod damage. To calculate the intensity of damage use the formula [7]

\[ I = \frac{n}{N} \times 100\% \]

\[ I = \text{intensity of damage} \]
\[ n = \text{the number of pods that stricken} \]
\[ N = \text{total number of pods observed} \]

3. Results and discussion

3.1. Results
3.1.1. Types of pest populations, the intensity of damage to pods, and crop production.

Based on the results of the study found three types of destructive pest insect are Nezara viridula, Riptortus linearis, Leptocorisa acuta as pods sucking pest and Etiella zinckenella as pod borer pests. The intensity of pod damage caused by four types of pest insects varies as shown in Figure 1.

![Figure 1. Population, the intensity of damage, and soybean production](image)

Figure 1 shows that the average population of N. viridula as 61.14 individuals, R. linearis 20.14 individuals, E. zinckenella 66.49 individuals, and L. acuta 86.49 individuals. It is seen that the population of L. acuta, is higher, while R. linearis is the lowest. Four pest destructive pods, the attack caused the average pod damage of 18.26%. The average soybean production is quite low, at 0.10 ton ha⁻¹.
3.1.2. Influences of pest population against the intensity of damage and production.
Naturally in the field there was a relationship between insect pest destructive pod populations with the level of pod damage and soybean crop production. The third component of the relationship can be explained through the path diagram of the SEM-PLS (structural equation modelling-partial least square) whose results are shown in Figure 2.

Figure 2. Diagram of the path analysis (path diagram) using the PLS-SEM (SmartPLS Student v. 3.2.3)

Figure 2 shows that the intensity of pod damage in the field as influenced by pest destructive population *N. viridula, R. linearis, E. zinckenella, L. acuta* of 7.6% (R2 = 0.076), while the remaining 92.4% influenced by other factors in the field. This illustrates that the large extent of the pod damage in the field is not only influenced by pest destructive population, but can also be influenced by other factors such as climate factors, the control measures undertaken by farmers, natural enemy conditions, and plant resistance level.

The intensity of damage to pods may affect crop production amounted to 4.1% (R2 = 0.041), while the rest of 95.9% is affected by other factors, meaning damage to pods of the plant are not the main cause of high to low crop production of soybean. Crop production was also much influenced by the potential of genetic engineering, plant cultivation, soil fertility, and soil water availability.

Based on the results of path analysis it was found that from four types destructive pest found in the field, only the population of *N. viridula and E. zinckenella* could potentially can increase the intensity of pod damage directly. Every increase of 1% of the population of both the pest, then the extent of the damage potentially pods have elevated each of 0.332 and 0.502%. The results of path analysis also indicated that soybean production only increased by 0.202% caused by the destruction of soybean pods. Indirectly, this is caused by the activity of the fourth type of pest destruction pods. Plants basically still tolerate pod damage by *R. linearis* and *L. acuta* attacks because only *N. viridula* and *E. zinckenella* alone have the potential to increase pod damages so that can still produce despite small increases.

3.2. Discussion
Based on research results, the highest population was *L. acuta*, followed by *E. zinckenella, N. viridula*, and lowest *R. linearis*. The four types of pest destruction pods, the attack only causes the average pod damage of 18.26%. The population of *N. viridula* and *E. zinckenella* contributed positively to the
intensity of pod damage, meaning that both pests have the potential to increase the intensity of pod damage, while L. acuta and R. linearis contribute negatively to the intensity of pod damage, meaning that it does not contribute to increased intensity pod damage. Although the population of L. acuta is the highest, its contribution to low pod damage is due to soybean crop is not the main host. Leptocorisa oratorius Fabricius, (Hemiptera: Alydidae), syn Leptocorisa acuta is an insect that becomes an important pest on cultivated plants, especially rice [8]. This suggests that pest insect populations will not always cause great damage.

The high damage of plants by plant pest organisms is influenced by the population as well as the destructive ability of the organism. R.linearis is an important pest of soybean crop, but its population is quite low compared to other pests, this is thought to be caused by the predatory population of Dolichoderus sp. is abundant enough to eat eggs R. linearis. Dolichoderus sp., Solenopsis geminata, and Paederus sp. is a predator of R.linearis eggs [9]. Some types of insects can cause very serious damage even though the population is slightly natural [10].

The population of E. zinckenella 66.49 individuals contributed to the highest damage of pods of 0.502 compared with the pest destruction of N. viridula pod 61.14 individuals which was only 0.33. Soybean is the main host for E. zinckenella pest, whereas N. viridula has many alternative hosts and soybean is not its main host. The main host plant of E. zinckenella besides soybean was the Crotalaria sp.[11]. N. viridula has a wide range of host plants, in addition to attacking food crops also attack fruit crops, vegetables, and some weeds [12]. Damage of soybean pod is basically not solely caused by insect pest activity alone although it is known that insect pest is the main cause of crop damage, but the stress of plant environment also contribute significantly to insect pests and plants.

4. Conclusions

Base on the research concluded that (1) four pest destructive pests were found, each with the following population averages: N. viridula 61.14, R. linearis 20.14, E. zinckenella 66.49, and L. acuta 86.49 individuals. (2) Intensity of pod damage in field was 18.26% influenced by pest destructive population (N. viridula, R. linearis, E. zinckenella, L. acuta) 7.6% (R2 = 0.076), while the rest 92.4% is influenced by other factors in the field. (3) Intensity of pod damage can affect crop production by 4.1% (R2 = 0.041), while the rest of 95.9% is influenced by other factors.

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