Incidence of *Soybean mosaic virus* on soybean in Southeast Sulawesi

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**Abstract.** There are several mosaic diseases commonly found on soybeans in Indonesia, including Southeast Sulawesi, which are thought to be caused by viruses. Mosaic disease caused by *Soybean mosaic virus* (SMV) is considered as important disease. The purpose of this study was to determine the incidence of mosaic diseases, to detect SMV and to identify potential insect vectors. Field survey were conducted in several soybean production areas including Konawe, South Konawe and Kolaka. Virus detection was carried out by serological techniques using DAS-ELISA. Based on symptom observation, mosaic disease was found in all locations with incidence ranged from 38.46 to 64.00%. Variation of mosaic symptoms were recorded, involving yellow mosaic, mosaic with vein clearing, leaf cupping, curling, thickening and some chlorosis. According to DAS-ELISA, only 2.92 to 8.00% of field samples gave positive reaction to SMV antibody. This result indicated that other viruses might be associated with mosaic disease. Common virus insects vectors were found in the field, namely *Aphis gossypii*, *Empoasca paraterminalis*, and *Bemisia tabaci*.

**1. Introduction**

Soybean (*Glycine max* (L.) Merril) is an important plants in Indonesia, especially for its function as a source of vegetable protein. Consumers' demand for soybeans from year to year continues to increase to be processed into various food. Unfortunately, domestic soybean production has not been able to meet consumer needs. One of the factors that become constraint in soybean production is infection by pathogens, including *Soybean mosaic virus* (SMV) [1]. Infected young plants will show severe mosaic symptoms, infected leaves are narrower than healthy leaves. In addition, along the leaf vein showing dark green symptoms, the edges of the leaves experience leaf rolling. Plants infected at the beginning of growing stage will show shortening internodes [2], while infected seeds will have a radial brown stripe [3].

A special effort (UPSUS) by the Ministry of Agriculture in 2014 was promoted to achieve self-sufficiency in soybeans; and this caused almost all districts in Southeast Sulawesi were encouraged to grow soybeans. This program can increase the chances of the spread of SMV in various planting locations, this is because SMV is a seedborne virus, and the seeds used are mostly from outside
Southeast Sulawesi which is not yet known whether the seeds are virus free or not. SMV infection in soybean plants in Southeast Sulawesi has been reported previously [4], but information on its spread is still very rare.

Therefore, it is necessary to conduct field surveys and detection of soybean plant samples using serological techniques so that more accurate information can be obtained about the presence of SMV in several soybean plantations in Southeast Sulawesi. Furthermore, control strategy can be recommended to suppress disease spread in the field.

2. Methods
Field observation was conducted in several soybean growing areas in Southeast Sulawesi (Konawe, South Konawe, and Kolaka Districts). Field samples for visual symptom observation was taken systematically, i.e. 10% of plant population from each location was collected through diagonal sampling method. Field samples was then used for virus identification at Plant Quarantine Serology Laboratory of Class II Agriculture Quarantine Institute Kendari, Southeast Sulawesi. Virus detection was conducted by DAS-ELISA with SMV as virus target. DAS-ELISA was carried out following the protocol from SMV Complete Kit (Agdia). Quantitative analysis of ELISA was done by measuring optical density at a wavelength of 405 nm using ELISA reader. The reaction was considered positive when the absorbance value of the sample is twice as large as the absorbance value of the negative control.

Disease incidence was determined using the following formula, for 2 phases, i.e. based on visual symptom in the field and ELISA results :

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

With, DI = Disease incidence

n = Number of symptomatic plants in the field or number of ELISA positive reaction

N = Total number of field samples observed or total number of samples tested by ELISA

Direct collection of insect vector was also done during field survey and identification was done based on its morphology, then the identification result were referred to the identification book [5,6]. Identification was carried out at the Central Laboratory for Agricultural Quarantine Standards Testing, Rawamangun, Jakarta.

3. Results and discussion
The most common symptom by infection of SMV on soybean is mosaic, vein clearing, chlorosis and malformation. This virus infection may cause high yield loss which reaches 8 to 50% in sub-optimum condition [7, 8]. Mosaic symptoms was observed during field survey in 3 locations; the variation of mosaic symptoms including yellow mosaic, mosaic with vein clearing, mosaic with curly leaf, leaf cupping and thickening, and chlorosis. These symptoms were not necessary related to SMV infection, because similar symptoms can be caused by infection of other viruses or pathogens, pest attacks, and the presence of nutritional imbalances [9]. In addition, differences in varieties and variations in plant age during infection can also cause variations in disease symptoms. This is probably due to differences in host resistance levels, environmental factors, virus types and strains, farming practices, and vectors [3, 10]. Therefore, to prove that soybean plants were positively infected by SMV, it is necessary to detect viruses in the laboratory.

The result of DAS-ELISA showed that only a small proportion of composite samples that were positively infected with SMV. It was shown in Fig. 1 that in general, the percentage of disease incidence was lower in 4 sampling locations (ranging from 2.92 - 8.00%) compared to observations of external symptom variations found in soybean plants of Argomulyo, Anjasmoro, Dena-1, and Ring-1 (ranging from 38.46 - 64.00%). This proved that not all mosaic symptom variations found in positive soybean plant samples are caused by SMV. Positive variations in mosaic symptoms caused by SMV are shown in Fig. 2.
The results showed that SMV had infected soybean plants in different sampling locations, namely Lamomea and Sumbersari Villages, Konawe Selatan District, Belatu Village, Konawe District, and Ranomentaa Village, Kolaka Regency. The spread of the virus in the field is strongly influenced by the presence of insects that are thought to be SMV vectors. Three species of insects, i.e. *Aphis gossypii*, *Bemisia tabaci*, and *Empoasca paraterminalis* (Fig. 3) was found in the field. It was reported that SMV in the field was mainly transmitted by *A. glycine* and *A. craccivora* in a non-persistent manner, whereas experiment in greenhouse conditions indicated the potency of *A. gossypii* as the vector [11-13]. Whitefly *B. tabaci* is known as the vector of *Begomovirus* (Geminiviridae) on soybean and there have been no reports of *E. paraterminalis* as virus vector on soybean. SMV is also seed transmitted which may become the main inoculum in the field since farmers could not get access to virus-free soybean seeds [14].
The host range of SMV is also quite extensive which causes other plants to act as reservoirs of the virus when the main host is not available in the field. These plants including from the family Fabaceae (including Leguminosa), Amaranthaceae, Chenopodiaceae, Passifloraceae, Schropulariaceae and Solanaceae. Leguminosa is the main host of SMV [15, 16].

4. Conclusion
Mosaic symptoms were spread widely in all locations although only 2.92 to 8.00% were associated by SMV. Therefore, further identification for other viruses is needed to reveal the real problem of virus infection in the field. Three species of insects, i.e. A. gossypii, E. paraterminalis, and B. tabaci was found in the field and they are all known as insect vector for many important viruses.

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