

## I. INTRODUCTION

### 1.1 Background

Cabbage (*Brassica* spp.) is a widely cultivated vegetable crop in Indonesia that is divided into two main types, namely annuals and biennial types. Annual cabbage is widely cultivated because it can flower in the tropics and produce seeds. This is in contrast to biennial cabbage, which cannot flower in the tropics, so the provision of seedlings only comes from shoot cuttings, which causes the quality of seedlings to decrease (Amril *et al.*, 2003; Singh *et al.*, 2010). According to Hidayat *et al.* (2008), biennial cabbage species that have been cultivated in Indonesia for generations, such as singgalang cabbage (slopes of Mount Singgalang, West Sumatra), garung cabbage (Wonosobo, Central Java) and babat cabbage (slopes of Mount Merbabu, Central Java). The cultivation of this biennial cabbage in Indonesia is very limited to the area described above, so hybrid varieties of cabbage decrease and press their existence.

Singgalang cabbage (*Brassica oleracea* var. *capitata* L.), one of the local cabbages of West Sumatra, has been cultivated for a long time by farmers in the area around the slopes of Mount Singgalang. The three variants are biaso, batang hitam, and sengan (Afdi *et al.*, 2005). Singgalang cabbage has a distinctive flavor widely used in West Sumatra's culinary specialities. However, its existence is decreasing due to not many farmers cultivating it. The decline in farmers' interest in cultivating singgalang cabbage is due to less productivity when compared to introduced cultivars. On the other hand, according to (Shrestha & Shakya, 2004), local cultivars have higher potential than introduced cultivars, including being more adaptive to the

local climate and tolerant of environmental stresses (Sanchez and Ruiz-tores, 2017). In addition, the lack of farmers to cultivate singgalang cabbage is also caused by the retention of pests and diseases and the conversion of land functions for annual cabbage planting. Therefore, efforts to maintain the existence of the singgalang cabbage variant as a typical vegetable of West Sumatra are significant and should be attempted, one of which is through tissue culture techniques and *in vitro* storage so that its existence will be maintained in the future.

Tissue culture techniques have been widely used to propagate large numbers of plants under aseptic environmental conditions (Engelmann,2011). Tissue culture techniques for mass propagation purposes have been widely developed, including in cabbage species (Pavlovic *et al.*, 2010; Gerszberg, Hnatuszko-Konka & Kowalczyk, 2015; Srikanth *et al.*, 2016; Gambhir, Kumar & Srivastava, 2017; Al-Swedi, Al-Juthery & Alawadi, 2019; Rahman, Ahmed & Chowdhury, 2021). In the research Gerszberg *et al.* (2015) used Murashige-Skoog (MS) base medium with the addition of 6-Benzylaminopurin (BAP) in shoot propagation of eight *Brassica oleracea* var. *capitata* L. cultivars. Rahman *et al.* (2021) also used BAP to regenerate shoots *in vitro* on MS media for *Brassica oleracea* var. *italica* plants with supplemented 1.5-4.5 mg.L<sup>-1</sup> BAP. In research (Pavlovic *et al.*, 2010) using MS media with supplemented 1 mg.L<sup>-1</sup> BAP on shoot multiplication.

Attempts to sustain singgalang cabbage involve not just the application of tissue culture methods but also the utilization of *in vitro* storage to conserve the cabbage for prolonged viability. Two *in vitro* preservation approaches employed in

tissue culture are a) growth suppression (slow or minimal growth) and b) cryopreservation or preservation at ultra-low temperatures (Day and Stacey, 2007).

In germplasm storage, tissue culture techniques play a pivotal role in the conservation of genetic diversity through the employment of growth inhibition methodologies (Gianni & Sottile, 2015; Trejgell, Kaminska & Tretyn, 2015; Chauhan, Singh & Quraishi, 2019). The preservation of genetic diversity is further facilitated by minimal growth strategies. Minimal growth techniques are essential for extending the length of the subculture cycle (Maurie *et al.*, 1998). The subculture cycle will affect the length of storage. In the context of *in vitro* preservation utilizing minimal growth techniques, this entails the reduction of incubation temperatures and the modification or manipulation of the culture medium, thereby altering the availability of nutrients (Chen & Dribnenki, 2004). In the research conducted by Ghanbar T *et al.* (2016) and Islam *et al.* (2017), it is recommended to employ ½ MS media for rooting. The research findings of Azad *et al.* (2005) indicate that optimal root formation in *P. amurense* occurs under a higher concentration of (MS) media as opposed to ½ MS and ¼ MS, whereas in the case of *Embelia ribes* ½ MS is demonstrated to be the most effective medium for rooting (Dhavala and Rathore, 2010).

Based on the aforementioned description, research on the *in vitro* propagation of Singgalang cabbage is necessary, with a modification of Murashige and Skoog media for preservation purposes. Given the limited planting area and the declining public interest in cultivation, the existence of this cabbage may be diminished and lost without efforts to preserve and reproduce it, particularly through *in vitro* culture

techniques. This research is crucial for the future to maintain and preserve the existence of Singgalang cabbage, which is a superior local cabbage variety in West Sumatra.

### **1.2 Formulation of Research Problem**

The formulation of research problem to be answered as follows:

1. What is the effect of MS media with the addition of BAP on shoot initiation from nodal explants in singgalang cabbage ?
2. What is the effect of MS modified media on root induction from shoot explants on singgalang cabbage for preservation purposes?

### **1.3 Research Objectives**

The objectives of the research are :

1. To determine the effect of MS media with the addition of BAP on shoot initiation on nodal explants in singgalang cabbage.
2. To determine the effect of MS media modification on root induction from shoot explants in singgalang cabbage for preservation purposes.

### **1.4 Research Benefits**

This research is expected to provide:

1. Scientific information related to *in vitro* propagation of singgalang cabbage through shoot initiation and root induction on modification of MS media.
2. Preservation techniques for singgalang cabbage are essential for future conservation and breeding programs, particularly through tissue culture methods.