I. INTRODUCTION

1.1 Background

Ameliorant is a natural material both organic or inorganic added to the soil to increase the physical and chemical character of soil (Subatra, 2013). The supplementation of ameliorant is purposed as a nutrient source, decrease soil acidity and as a source of binding or absorbing cations that are washed to other areas due to water regulation. Ameliorant consists of organic ameliorant and inorganic ameliorant. Organic ameliorant produced from organic material, such as straw (Yulianto, Wiwin, and Nurul, 2017), chicken manure (Adriany, Pramono, and Setyanto, 2016), oil palm ash, rice hush ash (Aryanti, Yulita, Annisava, 2016) and also plant and animal groups. Inorganic ameliorant produced from the utilization of inorganic material, such as zeolite (Nurjaya, Emona and Sri, 2006), dolomite (Maftu'ah, Azwar, Abdul and Benito, 2013), gypsum (Purwaningrahayu and Henny, 2016), K_2O (Purwaningrahayu and Abdullah, 2018).

Cuttlefish (*Sepia* spp.) is one of the organisms potentially as an ameliorant. The recent research conducted by Meilianti (2017) found that cuttlefish shells in the form of solid waste are not mature and have not been optimal. Cuttlefish shells contain calcium carbonate, sodium chloride, calcium phosphate, and magnesium salt with the calcium contained in calcium carbonate around 84,68%. Calcium carbonate ($CaCO_3$) is one of ameliorant source which could decrease soil acidity (Arini, 2011).

Setyowati and Chairuddin (2016) reported that all material containing Ca elements can be used as an ameliorant material to neutralize the soil acidity by

adding Ca element and decrease Al. Shell waste also has the main ingredients in Ca compounds in the form of calcium carbonate ($CaCO_3$). The supplementation of shell powder into peat soil can raise the pH of soil. Cuttlefish shell powder contains inorganic compounds ($CaCO_3$) that have the potential as a source of ameliorant. Cuttlefish has a percentage of 3.54±0.11 water content, 0.32±0.19 fat, 4.78±0.23 protein, 5.29±0.02 carbohydrates, and 89.61±0.26 ash which is an element of calcium carbonate aragonite (Henggu, Ibrahim, Suptijah, 2019).

Recent studies of Setyowati, Putra and Saidi (2017) stated that the supplementation of cuttlefish shell powder to the soil with different doses 0 ton ha^{-1}, 2 ton ha^{-1} (6.25 gr/polybag), 4 ton ha^{-1}(12.5 gr/polybag), 6 ton ha^{-1} (18.75 gr/polybag), 8 ton ha^{-1} (25.0 gr/polybag) can affect the growth of *Brassica* sp. The best dose of cuttlefish shell powder to help plant growth is 2 ton ha^{-1} soil (6.25 gr/polybag). In line with this, Setyowati and Chairuddin (2016) reported that the supplementation of cuttlefish shell powder to the soil with different doses (3.8 ton ha^{-1}, 1.9 ton ha^{-1} soil) can affect the growth of spinach and raise the pH of soils. The supplementation of cuttlefish shell powder can be used as an alternative material of ameliorant to enhance plant growth.

Ameliorant from the utilization of cuttlefish shell powder can be applied to upland rice (*Oryza sativa* L.) as one of the food crops in Indonesia. Based on 'Serikat Petani Indonesia' (2017) data, rice production has increased to 81.38 million tons of dry grain from 79.17 million tons in 2016. The amount of imported rice has increased to 2.2 million tons from January to November 2018 from 305.75 thousand tons from January to December 2017 (BPS, 2019). The total consumption of rice by

the people in Indonesia from 2015-2016 was recorded at 38.1 million tons based on FAO data recorded in 'Pusat Data dan Sistem Informasi Pertanian' (2016). In 2017, SPI also predicted the consumption of rice in Indonesia recorded as many as 33,47 million tons. The amount of imported and consumption of rice in Indonesia show that Indonesia needs more production of rice to fulfill the demand.

One of the solutions to solve this problem is by utilizing a large area of marginal land in Indonesia, one of which is Ultisol land, which is dry land that suitable for agriculture with an area of 52% from the total of 148 million ha (Swastika *et a*l., 2007). This research used the upland rice as the tested plant, which is the rice that appropriates to be planted in the dry land. The problem encountered by farmers in upland rice cultivation is the time for upland rice growth. Based on 'Badan Litbang Pertanian' (2010) data, the age of upland rice plants is 124 days with a potential yield is 6.08 tons/ha.

Based on the explanation above, the research about Effect of Cuttlefish (*Sepia* spp.) Shell Powder as Ameliorant on Growth and Yield of Upland Rice *Oryza sativa* L. (cv. 'Unsoed 01') is needed to determine the effect and effective doses of *Sepia* spp. shell powder as ameliorant on growth and yield of upland rice.

1.2 Problem Formulation

Problem formulation in this research were:

1. How effective was the supplementation of *Sepia* spp. shell powder as an ameliorant on soil pH?
2. How effective was the supplementation of *Sepia* spp. shell powder as an ameliorant on the growth and yield of upland rice?

1.3 Research Objective

This research focused on two main purposes of the effectiveness of *Sepia* spp. shell powder as an ameliorant on the growth and yield of upland rice:

1. To determine the effect of supplementation of *Sepia* spp. shell powder as an ameliorant on soil pH.
2. To determine the effect of supplementation of *Sepia* spp. shell powder as an ameliorant on the growth and yield of upland rice.

1.4 Outputs

Benefits of this research were:

1. Contributing for the knowledge about the potential of the cuttlefish shell powder as an ameliorant on increasing soil pH, enhancing the plant growth and production.
2. Providing cuttlefish shell powder as an ameliorant for local farmers in Indonesia.
3. As a recommendation to the government of Indonesia to optimize the potential of cuttlefish shell powder as ameliorant to enhance the use of peat soil and increase the production number of crop sector in Indonesia.