Analysis of Factors Affecting the Growth and Development of Maize Crops (Zea Mays L) in Adiankoting Sipoholon and Paranginan Districts

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Abstract— *This study aims to determine the factors that affect the growth and development of corn plants (zea mays l.) in the sub-districts of Adiankoting, Sipoholon and Paranginan. This study uses the Statistical Package Social Sciences (SPSS) stastika formula consisting of each sub-district using 50 questionnaires from Adiankoting sub-district 50 questionnaires, from Sipoholon sub-district 50 questionnaires and from Paranginan sub-district 50 questionnaires, and the total amount to 150 questionnaires. This research was conducted by a direct field survey system and interviews with respondents or corn farmers in each of the 150 farmers, the results of this study indicate that in each sub-district there are different and some are the same in terms of altitude, land area, planting distance, age of farmers and others. The three sub-districts are dominated by male farmers, mostly only diparanginan more female farmers but maybe in other areas or in other villages there may also be many female farmers. I conducted this research during October to November 2021 where there is still strict health protocol supervision because corona has spread everywhere, so caution is needed. In the Adiankoting, Sipoholon and Paranginan sub-districts, the various types of fertilizers used and the way they are applied and pests and diseases are too many to attack in these areas.*

Keywords— ***Growth, Development, Zea Mays L***

I. INTRODUCTION

Maize is one of the food crops that is also an important class of cereals in the world economic sector. Apart from being a staple food, corn products are usually processed into animal feed, processed food ingredients and so on. In the historical record, the corn plant originated from southern Mexico and Latin America and then spread to Europe, India and finally spread throughout the world including Indonesia (Riwandi, et al., 2014).

The need for corn (Zea mays) consumption from year to year is increasing (Muis, et al. 2015). Corn is one of the important food crops in Indonesia and has a strategic role in the national economy, given its multipurpose function, as a source of food, feed, and industrial raw materials (Khairiyah et al., 2017).

In an effort to meet national maize demand and zero imports, since 2007 the government has implemented a program to increase maize productivity through Integrated Crop Management of maize (PTT maize). Currently, the government (Decree of the Minister of Agriculture Number: 1243/Kpts/OT.160/12/2014) continues the program with a special effort program to increase maize production through the Maize Integrated Crop Management Improvement Movement (Maize GP-PTT) and the Expansion of Planted Areas with Increased Maize Planting Index (PAT-PIP), which aims to increase production, farmers' income, and preserve the environment (MOA, 2015). The purpose of this study is to determine the factors that influence the growth and development of corn plants in Adiankoting sub-district, to determine the factors that influence the growth and development of corn plants in Sipoholon sub-district, to determine the factors that influence the growth and development of corn plants in Paranginan sub-district.

II.   REVIEW OF LITERATURE

Sweet corn plants belong to the grass family with the species Zea mays saccharata Strurt. The classification of sweet corn plants is as follows:

Kingdom   : Plantae

Division : Spermatophyta

Subdivision   : Angiosperms

Class   : Monocotyledonae

Order   : Poales

Fanili   : Poaceae

Genus   : Zea

Species : Zea mays saccharata Sturt (Rukmana, 2008).

Corn is a seasonal plant that has a tall, sturdy stem and usually a dominant single stem, although there may be some that contain buds (tillers). This plant has a stem height of between 60 and 300 cm. The position of the leaves is dystopic (two rows of single leaves that come out in an alternating position) with leaf midribs overlapping and the leaves are wide and relatively long.

Maize is a fibrous-rooted plant that consists of three types of roots: seminal roots, adventitious roots, and aerial roots. Seminal roots grow from the radicle and embryo. Adventitious roots are called supporting roots, which grow from the lowest book while aerial roots are roots that grow from books above the soil surface.

a.   Roots

Corn plant roots consist of 3 kinds of roots, namely seminal roots, adventitious roots and prop roots. The root system functions as a tool for sucking water and mineral salts contained in the soil, removing organic substances and compounds that are not needed and respiratory equipment. Prop roots function to keep the plant upright. Corn roots are included in fibrous roots that can reach a depth of 8 m although most are in the 2 m range. (Subekti, et al., 2007).

b.   Stem

Maize stems are erect and easily visible like sorghum and sugarcane, but not like rice or wheat. The stems of the maize plant are branched with the number of internodes varying between 10-40 internodes. Maize plants are generally unbranched. The length of maize stalks generally ranges from 60-300 cm, depending on the type of maize. Maize stems are quite sturdy but do not contain much lignin. Corn stems have three main components: epidermis, vascular tissue and stem center (Subekti et al., 2007).

c.   Leaves

Corn leaves are perfect leaves. The shape is elongated, between the midrib and leaf blade there is a ligula. The leaf bone is parallel to the mother leaf bone. The leaf surface is smooth and some are hairy. Each stoma is surrounded by fan-shaped epidermal cells. This structure plays an important role in the plant's response to water deficit in leaf cells (Wirawan and Wahab, 2007).

d.   Fruit

Maize fruit consists of cobs, seeds and wrapping leaves. Maize seeds vary in shape, color and endosperm content, depending on the species. In general, maize has straight or winding rows of seeds that number between 8-20 rows of seeds. Corn kernels consist of three main parts: seed coat, endosperm and embryo (Rukmana, 2008). Corn seeds are located regularly, according to the location of the embryo flower consisting of plumula, radicle and acutelina. Seeds are round, tooth-shaped or flat according to the variety. Seed color also varies, including yellow, white, red, orange and red almost black. Contains starch protein and fat.

Corn plants are monocious plants. In a plant there are male flowers and female flowers that are located separately. Male flowers are located at the tip of the plant, while female flowers are along the middle of the corn stem and are in one of the leaf axils. Maize has separate male and female flowers (diklin) in one plant (monoecious). Each flower has a structure typical of flowers from the Poaceae tribe, called a floret. Male flowers grow at the top of the plant, in the form of a wreath (inflorescence). The pollen is yellow and has a distinctive aroma. Female flowers are arranged in cobs that grow between the stem and leaf midrib. In general, one plant can only produce one productive cob despite having a number of flowers. Female flowers grow on the side cob end of the stem originating from the leaf axils, usually at about mid-length of the main stem. The lateral (side) stems are very short because of their short internodes. On each book of the lateral stem, a leaf grows. Due to the close proximity of the books, the leaves close together, forming the kelobot that wraps around the developing cob. In certain cultivars, the development of tassels seems to affect the development of the cob stem (Rukmana, 2008).

e.   Climate

Maize plants are widely adaptable to the environment. In general, maize plants can grow in lowlands to highlands (+ 1300 m above sea level), with a temperature range between 130°C-380°C and full sunlight. In Indonesia, corn plants grow

and produce optimally in the lowlands up to 750 m above sea level. The ideal air temperature for seed germination is 300°C-320°C with soil water capacity between 25-60%. During growth, corn requires an optimum temperature between 230°C-270°C (Budiman, 2009). Maize plants are native to the tropics and can adapt to environments outside the region. Maize does not demand too strict environmental requirements. Corn plants require rainfall of around 100-140 ml/month. For this reason, it is necessary to observe rainfall in order to determine the planting time appropriately (Murni, et al., 2008). Corn plants should get full sunlight with an optimum temperature of 210-340 C. In older plants, especially towards the ripening of seeds, hot conditions and sufficient sunlight intensity are needed, and if high humidity will result in poor corn plant production, especially seed quality. Because during its growth period, sweet corn plants need sufficient sunlight to be able to produce seeds and form fruit properly (Nasution, 2019).

f.   Soil

Soil fertility is often linked to the state of the top soil. In this layer, the root system of plants usually develops well. For this reason, tillage before planting and tillage during maintenance play an important role in plant fertility. In tillage, the ratio of solid, liquid and air in the tillage layer makes the soil loose and favorable for plant root growth. Corn plants can grow well on all types of soil. But it will grow better on loose, humus-rich soil. Soil that is dense and can retain water is not good for planting corn because it grows poorly or will rot (Budiman, 2009). Soil acidity (pH) required for optimal growth of corn plants is between 5.6 - 6.2 but 6.8 is best. Soil acidity below 5.5 is not good for corn plant growth, the soil already needs to be limed (Hardiyanto, 2020). Soil slope has to do with water movement on the soil surface. It is also one of the requirements for plant life including corn plants. Soils with a slope of less than 8% can be planted with corn at this level of slope, which is very likely to cause soil erosion (Budiman, 2009).

g.   Maize Pests and Diseases

Plant-disrupting organisms or pests are a problem in the cultivation of maize. Armyworms are one of the pests that often plague agriculture in Indonesia, including corn crops. Currently, there is a new type of armyworm that is currently endemic in the world, namely Fall Armyworm (FAW) or Spodoptera frugiperda. The pest belongs to the order Lepidoptera, family Noctuidae. Spodoptera frugiperda attacks food crops such as corn, rice and wheat. This pest is one that is difficult to control, because its imitators spread quickly, even including strong fliers that can reach a considerable distance in one week. If assisted by the wind, it can reach 100 km. The pest has spread rapidly from the Americas in 2016, to the African continent and spread in Asia to Thailand in 2018 (Harahap, 2018). Armyworms (Spodoptera litura) belong to the order Lepidoptera. This pest is polyphagous, making it rather difficult to control. Symptoms of armyworm (Spodoptera litura) attack begin at the larval stage, where young larvae damage the leaves and leave traces of the upper epidermis (transparent) and leaf bones. Advanced larvae damage the leaf bones, and cause the plant to run out of leaves. This rapid and uncontrollable attack has led to the need for intensive control (Marwoto and Suharsono, 2008).Litura larvae attacks can cause significant losses to farmers. Symptoms of attack are usually caused by the presence of caterpillars or larvae of this pest. The larvae will damage the leaves and attack simultaneously and in groups. The larvae/caterpillar attack will leave remnants of the upper epidermis of the leaves, so that the leaves become transparent and only the leaf bones are left behind. To overcome the pest is still using chemicals where we know the adverse effects on the environment and the phenomenon of resistance in insect pests due to the use of insecticides has increased the attention of experts to research on the utilization of pathogens to control plant pests. Insect pathogens are relatively specific and their effects are much smaller than those caused by chemicals on the environment or non-target organisms (Christina, 2013). Corn stalk borer (Ostrinia furnacalis) is one of the pests of corn plants that can be found in almost all parts of Asia including in Indonesia where this insect spreads in Papua, Sulawesi, Nusatenggara and Sumatra. Female insects lay their eggs under the surface of the main leaves of corn plants when the plants are two weeks old. The female insect is capable of laying 300-500 eggs. The larvae of this insect can damage almost all parts of the corn plant with the characteristics of the attack, namely small holes in the leaves, slit holes in the stems, the base of the cob to damage the corn cob. This pest can be controlled by spraying insecticides and releasing

natural enemies such as larval predators, ants and cocopeat (Adnan, 2009). The corn cob borer (Helicoverpa armigera Hbn.) consists of a female H. armigera imago that lays its eggs on the corn hairs when the cob has started to come out. The female imago can produce up to 730 eggs. The female imago will lay eggs on the corn silk and will enter the corn cob and eat the seeds that are undergoing development so that it can reduce the quality and quantity of corn cobs. Signs of cob borer attack on maize are characterized by transverse holes in the leaves of vegetative stadia plants. The hair of the corn cob is cut off, the tip of the cob has graze marks and often has larvae. Control that can be done is by technical culture such as perfect tillage which will damage pupae formed in the soil and can reduce subsequent pest populations. The use of insecticides made from active ingredients such as dimehipo, monocrotophos, karbofuran, effectively suppresses the attack of corn cob borers. Insecticide application is recommended when one egg cluster per 30 plants has been found. Liquid or spray insecticides are only effective in the egg and larval phase of instrars I-III, before the larvae enter the cob. (Adnan, 2009). Rust diseases in corn can be grouped into southern corn rust, common corn rust, and tropical corn rust, this fungal disease affects corn plants after milk ripening. When weather conditions are significant, it has an impact on the development and spread of the disease. The symptoms of this disease are small elongated circles on the leaf surface. The spread of this disease is caused by spores that are blown by the wind and then spread and infect the leaf surface. Control for this type of disease can be done by spraying fungicides containing mankozeb and pyraclostrobin, in addition to sanitation can also help prevent the development of disease (Puspawati and Sudarma, 2016). Downy mildew is a disease of corn caused by several species of fungi such as Peronosclerospora maydis, P. phillipinensis, and P. sorgi which are distributed in Java, Sulawesi and North Sumatra. Transmission of this fungus is aided by wind that occurs in the afternoon where the fungus will fall on the leaf surface and in the growing point area and then infect the corn plant until it dies. Symptoms of this disease can be seen from the presence of chlorotic color extending parallel to the leaf bone and on the lower surface of the leaf there is a white color like flour (Talanca, 2013).

III. RESEARCH METHODOLOGY

This research was conducted with a field survey system and interviews with respondents or corn farmers guided by a list of questions that have been prepared according to the research objectives in North Tapanuli and Humbang Hasundutan Districts. This research was conducted in three sub-districts in North Tapanuli and Humbang Hasundutan, including Adiankoting, Sipoholon and Paranginan sub-districts. This research was conducted from OCTOBER 2021 to NOVEMBER 2021. With the altitude of the place in Adiankoting District 400-1300 meters above sea level, in Sipoholon District 400-1300 meters above sea level and in Paranginan District 600-1700 above sea level.

IV. RESULT AND DISCUSSION

Based on the statistical results that have been carried out on the research questionnaire on corn farmers who are the identity of the respondents, namely gender, and age. Respondents in this study were 50 maize farmers. In this study, the characteristics of farmers who were respondents were the gender and age of farmers in Adiankoting, Sipoholon and Paranginan sub-districts. These characteristics can indirectly affect land cultivation, land area, pests found, maintenance and control carried out in Adiankoting, Sipoholon and Paranginan sub-districts. Respondents in this study were 50 farmers organized by maize farm ownership status. Gender is the difference between women and men biologically since a person is born. Farmer gender can indirectly affect maize farming. Where in this study showed the number of male farmers as many as 27 people and 23 women in Adiankoting sub-district. The number of male farmers was 32 people and 18 women in Sipoholon sub-district, while the number of male farmers was 20 people and 30 women in Paranginan sub-district. In fact, it is often found that field labor is generally dominated by men. According to Lionberger (1960), age in the productive category tends to be easier to accept new innovations and more open to technological advances. Age is information about a person's date, month and year of birth. Age information contains a measure of the length of a person's life in years. Age can influence a person in making a decision. Age can also be one of the benchmarks for the success of farming activities. Farmers who have a productive age will usually work better and more optimally than farmers who are no longer productive. The number and percentage of farmer respondents in the age group of 15 - 64 years are classified as a productive group of people to work because in this age range they are considered capable of producing goods and services. Productive age is one of

the success factors in farming activities. According to Hasyim (2006) and Ryan et al. (2018), farmers with productive age will work better and more optimally than non-productive farmers. However, older farmers can understand field conditions better. This is in accordance with the opinion of Novia (2011) who states that older farmers usually have relatively less understanding, but have advantages in recognizing the condition of the farmland. The processing of maize fields in Adiankoting, Sipoholon and Paranginan subdistricts is divided into two parts, namely processing and not processing. Those who do the processing by means of tractors and bulldozing the soil. Land cultivation greatly affects the growth and development of the corn plant in each farmer's land. Where land processing is very useful as loosening the soil so as to create spaces and pores that allow the soil to get air aeration. Helps to mix plant residues, soil organic matter, and nutrients more evenly.Kill weeds mechanically. Drains the soil before planting seeds. This is a positive effect in wet climates. When done in the fall, tillage helps to weaken the soil throughout the winter through freezing and thawing mechanisms that can occur many times throughout the winter. This helps prepare the planting for spring. However, tillage can also dry out the soil before seed planting. This is a negative impact in arid climates as the soil loses nutrients such as nitrogen and its ability to store water. Reducing the rate of water absorption increases soil erosion. Ploughing reduces the cohesion between soil particles, thus accelerating erosion. With reduced water absorption rates, there is a risk of surface water runoff carrying residues of fertilizers and pesticides used in the previous planting period. Reduced soil organic content. Reduces the number of beneficial soil organisms such as microbes, earthworms, ants, and so on. Destroys soil aggregates. Risk of soil compaction in unplowed areas. Crop residues that are destroyed and left in the soil can attract unwanted organisms and insects and potentially disrupt production, as well as attract diseases. The agricultural sector is a sector that supports the lives of most people. The agricultural sector needs to be developed along with the increase in population and the development of technology that can increase agricultural production. In addition, the agricultural sector plays a role in meeting the needs of the population, increasing farmers' income, providing industrial raw materials, providing business opportunities and employment opportunities, and supporting national food security. The goal of farmers in farming is to obtain high production at low cost. Agricultural development needs better attention, even though the priority on industrialization policy has been dropped, but the agricultural sector can have the ability to generate increased income (Sudarman, 2001). In agriculture, the production

factor of land has the most important position, as evidenced by the amount of services received by land compared to other factors. The area of land planted will affect the number of crops that can be planted which in turn can affect the amount of vegetable production produced. If the farmer's land area is large enough, then the economic opportunity to increase production and income will be greater (Soekartawi et al., 2002). Land area for wetland farmers is one of the factors that influence the increase in yield income. Villagers whose main activity is farming depend on their land. Thus, the area of land owned is one of the clues to the amount of income received. If the land area increases, the income of farmers will also increase and vice versa if the land area used is small or narrow, then the income earned by farmers will also decrease because the rice planted is small. So, the relationship between land area and farmer income has a positive relationship (Isfrizal & Rahman, 2018). In addition to land area, working capital is essentially an amount that continues to exist in sustaining a business that bridges the time between expenditures to obtain materials or services and the time of receipt of sales. In addition, it is the most important aspect in the activities of a business. Without having capital, a business will not be able to run even though other conditions for setting up a business are already owned. Capital is a factor that determines the amount of production and income. Lack of capital in farming will cause the use of production facilities to be very limited which in turn will affect production and income (Karyanto, 2008). Capital in farming can be classified as a form of wealth in the form of money or goods used to produce something either directly or indirectly in a production process (Soekartawi, 2006). In addition to land area and capital there is the amount of production. According to Soekartawi (2006) agricultural production is influenced by various factors including commodity types, land area, labor, management capital, climate and socio-economic factors of producers. For more details, Soekartawi (2006) states that the factors that affect production can be divided into two groups, namely: (1) biological factors, such as agricultural land with various levels of fertility, seeds, varieties, fertilizers, medicines and others. (2) Socio-economic factors such as production costs, prices, labor, education level, income and others. Suratiyah (2006) states that if the demand for production is high, the price at the farm level will also be high, so that with the same costs' farmers will get higher income. Conversely, if farmers have succeeded in increasing production, but prices fall, farmers' income will also fall. Planting distance can affect yield, because different plant populations will produce different plant growth. Increasing the planting distance to a certain level, the yield per unit area can increase while the yield per plant can decrease. Plant disturbing organisms found in the corn

fields of farmers in Adiankoting, Sipoholon and Paranginan subdistricts are crickets, fleas, crickets, walangsangit, aphids, Grayak caterpillars, crickets, dwarf, yellow stems, burnt leaves, not growing perfectly yellowed leaves, skinny stems2 and yellowed leaves. Maintenance carried out by farmers using various types of chemical and organic fertilizers such as NPK, UREA, Biogrent Organic Fertilizer, KCL, TSP. the types of insecticides used to control pests and diseases of corn crops are decis, antracol, Fosthin, Antracol, Mantap, Fosthin, Dithane, Tronton, Trivia, Mantap, Koge, Fierg EC, Synergy, Fenite. The obstacles in the field that I encountered were that the road access was still damaged a lot, the corona was still there at that time, not all the farmers we wanted to research accepted our interviews to get the research results. This research was conducted in three sub-districts of Adiankoting, Sipoholon, Paranginan, the reason I chose this place was because the place was quite close and I didn't want to get covid for sure if it was far away, and also in the three sub-districts it was pretty much planting corn.

V.   CONCLUSION

In research conducted in three districts, namely in Adiankoting, Sipoholon and Paranginan, there are factors that affect the growth and development of corn plants, namely:

1. Land cultivation is not done
2. Lack of land clearing
3. The presence of pests and diseases in corn plants
4. The use of many types of insecticides
5. Planting distance is too tight

So, it can be concluded according to the data in the field that there are still many diseases of corn plants in Sipoholon District compared to Adiankoting District, Paranginan District. Where the productivity of corn plants is more in Paranginan District even though the land area is more in the sub-district of Sipoholon, this is because the knowledge of growing corn is more advanced in the sub-district of Paranginan.

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