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# The Critical Period of Hybrid Maize Varieties Against Weeds

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**Abstract**

The corn crop cannot be separated from the presence of weeds as crop disturbers. The presence of weeds often causes a decrease in yield and seed quality in corn crops. The yield reduction depends on the type of weed, density, duration of competition, and allelopathic compounds released by weeds. This study aimed to determine the age of the critical period of competition of hybrid varieties of corn plants against weeds, as well as corn grain production due to competition with weeds. The research was conducted in a group randomized design consisting of seven weed control treatments based on corn planting age and repeated three times. Observation parameters consisted of plant height, number of leaves, cob length, cob weight, and cob circumference. The observation results were analyzed followed by Least Significant Different (LSD) at 0.05 percent level. The test results showed that the critical period of competition of corn plants against weeds occurred at the age of 20-45 days after planting. The highest average corn cob weight occurred in the weed control treatment in the third week after planting which was 126.67 gr. There was a compatibility between corn plants and weeds in the form of competition for nutrients and growing space, which affects production

**Keywords:** critical period, hybrid corn NK 212, seed production, weed competition

## A. Introduction

Maize (*Zea mays* L.) is one of the world's staple food sources of carbohydrates. In addition, maize is one of the most economical agricultural commodities and has the opportunity to be developed. Apart from being an important component of animal feed, maize is also a raw material for the food industry, chemical industry, and pharmaceutical industry. Maize production has been increasing every year. However, a decrease in maize crop production can occur with the presence of plant disruptors such as pests and plant diseases and the presence of weeds in the crop.

The presence of weeds in maize crops causes competition for nutrients. The ability of plants to compete with weeds is determined by weed species, weed density, time and duration of competition, cultivation methods and crop varieties and soil fertility levels (Pranasari, Nurhidayati, and Purwani, 2012; Saitama, Widaryanto, and Wicaksono, 2016). Weeds are able to compete strongly with cultivated plants to fulfil their needs for nutrients, water, sunlight, air and growing space. In addition to competition, weeds also act as pathogen hosts for maize plants

(Sudarma, Suada, Yuliadh, and Puspawati, 2012; Maqbool, Tanveer, Ata, and Ahmad, 2006; Hussain, Ismail, Sadikun, and Ibrahim, 2009), and produce allelopathies (Oyerinde, Otusanya, and Akpor, 2009; Zarwazi, Chozin, and Guntoro. 2016).

Weed competition in maize depends on four factors: the stage of plant growth, the number of weeds present, the degree of water and nutrient stress, and the weed species. Weed interference with maize crops is mainly a matter of competition for light, water and nutrients (Sudarma *et al*,. 2012). Maize is particularly sensitive to competition during the critical period between stages $V_3$ and V8 ($3^{rd}$ and $8^{th}$ leaf stage of maize growth). Before the $V_3$ stage, weeds usually play an important role because weeds are larger than maize or the plant is under water stress. Maize needs a stadia period between $V_3$ and $V_8$ when weeds are less present. After $V_8$ stadia until ripening the maize plant usually has the ability to reduce sunlight reaching the weeds so that it is sufficient to suppress weeds (Lafitte, 1994).

According to Barus (2003) the presence of cultivation competition with weeds, it will result in several loss factors, among others; plant growth is inhibited so that the time to start production is longer, a decrease in the quantity and quality of production, and weeds will become a hotbed of pests and diseases and weed control requires expensive costs.

The losses caused by weeds to cultivated crops require studies related to competition between weeds and cultivated plants. Therefore, after gaining knowledge about the competition, efforts can be made to reduce the production losses of cultivated plants caused by weeds. Based on this, research will be conducted on the critical period of competition of hybrid maize varieties against weeds.

## B. Methodology

*1. Place and Time of Research*

This research was conducted in Motolohu Village, Randangan District, Pohuwato Regency. The research lasted for 3 months from September to December 2021. The selection of this location was carried out by purposive sampling, with the consideration that the area is a place where most of the corn farming sector.

*2. Materials and Tools*

The materials used include; Soybean seeds of Tanggamus variety, organic matter/compost (kirinyuh, gamal and rice husks), urea fertilizer, SP – 36, KCl, $EM_4$, Rhizobium, post-nickel mining soil and labels. While the tools used in this study were pots, projection paper, ruler, envelope, sieve (2 mm), oven, scales, planting tools and watering can.

*3. Research Design*

This study used a group randomised design (RAK) consisting of 7 (seven) treatments, including: ($M_0$) : No weed control, ($M_1$) : Weed control carried out at the age of 7 days after planting (DAP), ($M_2$) : Weed control is carried out at plant age 21 DAP, ($M_3$) : Weed control is carried out at plant age 35 DAP, ($M_4$) : Weed control is carried out at the age of the plant 49 DAP, ($M_5$) : Weed control is carried out at plant age 63 DAP, and ($M_6$) : Weed control is carried out at the age of 77 DAP. Each treatment was repeated 3 (three) times so that there were 21 observation units.

*4. Procedure*

This research was carried out with the following steps:

a. Land Processing

Before planting, land clearing and tillage were carried out. This process aims to turn and loosen the soil so that plant growth becomes better. Furthermore, the land is plowed until the land (planting media) becomes loose. Then, beds measuring 2 m x 1 m were made, with a distance of ± 50 cm between beds. Each treatment was repeated 3 times so there were 21 plots.

b. Planting

Planting is the process of inserting seeds into the planting media holes. The planting distance to be used is 30 cm x 60 cm. The uniformity of the planting hole will determine the uniformity of the appearance of corn seedlings on the ground. Then the seeds are inserted into the hole as many as 2 seeds per hole.

c. Maintenance

Maintenance activities include watering, fertilizing and pest and disease control. Watering is done in the morning using a watering can. Fertilizers to be used are urea and ponska, fertilization will be done twice, the first fertilization will be done at the age of 10 DAP, and the second fertilization will be done at the age of 20 DAP. The dose to be used is 2 Kg ponska x 1 Kg urea then mixed until evenly distributed. Fertilizer is given by ditugal ± 5 - 10 cm, then covered with soil and the use of insecticides and fungicides. Pest management is carried out by mechanical means,

namely collecting and killing them directly while disease control is carried out by applying Amistar Top fungicide when symptoms of disease attack such as spotting and blight appear.

d. Weed Control

Weed control will be done physically mechanically. The aim is to physically damage the body parts of the weeds so that their growth is inhibited or even killed.

e. Harvesting

Harvesting of NK212 hybrid corn varieties is done at the age of 101 DAP. Corn harvesting is done when it meets the criteria: the clobber is brown, the hair is black and dry and shiny.

*5. Technique of Data Collection*

Variables that will be observed in this study; 1). Plant height (cm), measured from the base of the stem to the growing point of the plant, which will be measured every week from 7 HST until the release of male flowers, 2). Number of leaves, counted every week since 7 DAP, 3). Length of cob (cm), measured from the base of the cob to the tip of the cob, 4). Cob weight (gr), weighed after the skin is peeled, and 5). Cob circumference (cm), measured in a circle right in the middle of the cob.

*6. Data Analysis*

The data obtained were analyzed by variance analysis using the linear model equation according to Mattjik, Sumertajaya, Wibawa, and Hadi. (2011) as follows:

$\boldsymbol{Y_{ij} = \mu + \tau_i + \rho_j + \varepsilon_{ij}}$ ; Description I = treatment and j = group

Description:

$Y_{ij}$ = Observation value in treatment I group j

$\mu$ = Generalized mean

$\tau i$ = Effect of variety

$\rho_j$ = Effect of grouping or blocking

$\varepsilon_{ij}$ = Effect of error that spreads normally $(0,\sigma^2)$.

The data from the observation of the estimator parameters was analyzed for variance (Anova) at the 5% level to determine the effect of treatment. If there is a significant (significant) effect on the treatment, a different test is carried out using Least Significant Different (LSD) at a level of 5% (Sastrosupadi, 2000).

## C. Findings and Discussion

Observations include plant height (cm), number of leaflets (strands), cob length (cm), fruit diameter (cm), and fruit weight (gr). Observations of plant height and number of leaf blades were carried out weekly until the age of the plant was 7 weeks after planting (49 days), while cob length, fruit diameter, and fruit weight were carried out at the time of fruit harvesting.

*A. Plant Height (cm)*

Observations of plant height were made every week, namely when the plants were 1-7 weeks after planting. The average plant height increased every week as shown in Figure 1.

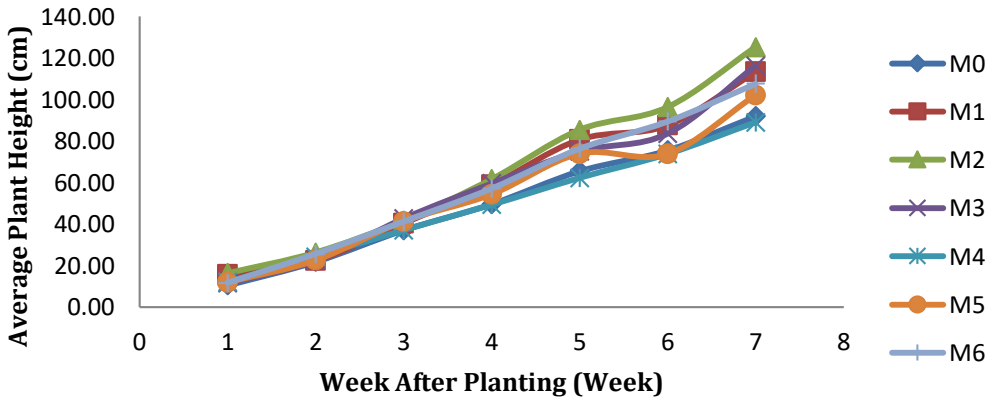


**Figure 1. Graph of The Average Increase in Corn Plant Height (cm)**

Figure 1 shows that there was an increase in plant height during observation in each treatment. Corn plants at the age of 1 week after planting showed that bed $M_2$ gave the highest average plant height (16.35 cm) compared to other beds. However, the results of the analysis of variance of the average plant height in the first week did not show significant differences. The $M_5$

treatment in the 6th week after planting decreased by about 0.16 cm, the decrease in plant height occurred due to pest attacks and weed competition with the main crop.

The average height of corn plants in this study was shorter than other corn plants. This occurred because during growth, plants were attacked by pests in the vegetative stage and there was competition between weeds and corn plants. In addition to pest attack and sugarbeet competition, this growing season the Gorontalo region experienced a long dry season. The critical period of corn plants competing with weeds occurs on days 20 and 45, then also the critical period of corn plants occurs on days 80 to 150 after planting (Sembodo 2010). When there is competition between weeds and cultivated plants, the weeds will release allelopathic substances. Allelopathic substances are chemicals released by weeds against the main crop that cause the morphology of the leaves to be filled with brown and white spots, stunted plant height, and abnormal root length.

*B. Number of Leaves*

Observations of the number of leaves were made at the age of 1-7 weeks after planting. The graph of the increase in the number of leaves in each treatment can be seen in Figure 2.

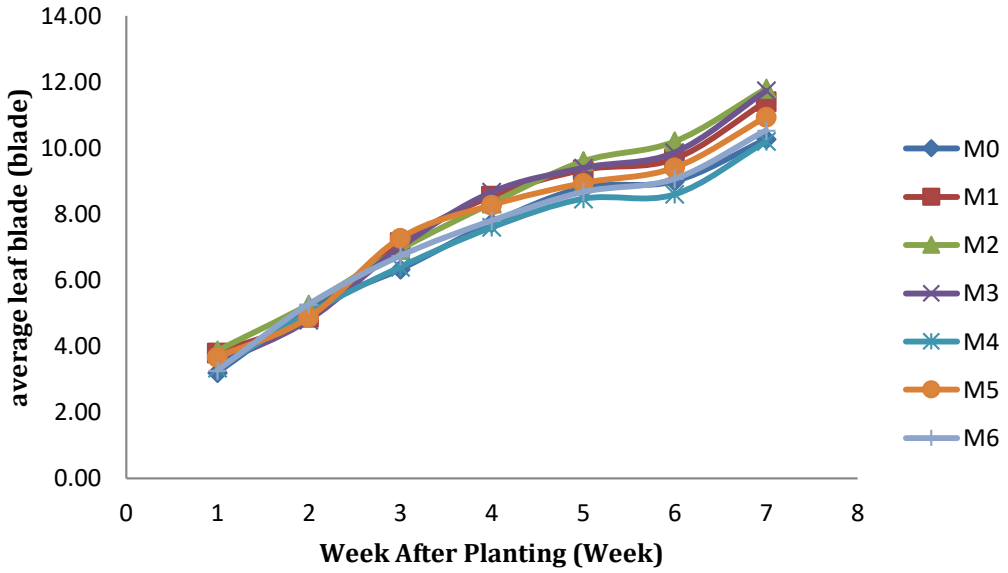


**Figure 2: Graph of The Average Number of Leaves (Leaf Blade)**

Figure 2 shows that the average number of leaves at 1 MST observation was highest in the $M_2$ treatment (3.87 leaves) and showed significant differences in each treatment. The average number of leaves in each treatment showed an increase every week, but the observation of 3-7 weeks after planting did not show a significant difference. This may occur due to competition between corn plants and weeds. The dominant weed in corn plants is *Cyperus rotundus*. This type of weed is intraspecies which affects the growth of corn plants (Padang, Purba, and Bayu. 2017). In addition to weed competition with corn plants, salinity also affects the rate of leaf growth by reducing the rate of cell enlargement in leaves so that growth and changes in plant structure are smaller (Pranasari et al., 2012).

The results of the analysis of variance showed that the treatment at 1-2 weeks after planting had a significant effect on the leaf blade of corn plants, but the results of the BNT (Least Significant Difference) test did not show significant differences. The results of the analysis of variance showed that the treatment of weed control at 1-2 weeks after planting was not significantly different on the number of leaves of corn plants.

*C. Cob Weight (gr)*

Cob weight was observed at the time of harvesting. The average weight of corn cobs in each treatment can be seen in Figure 3.

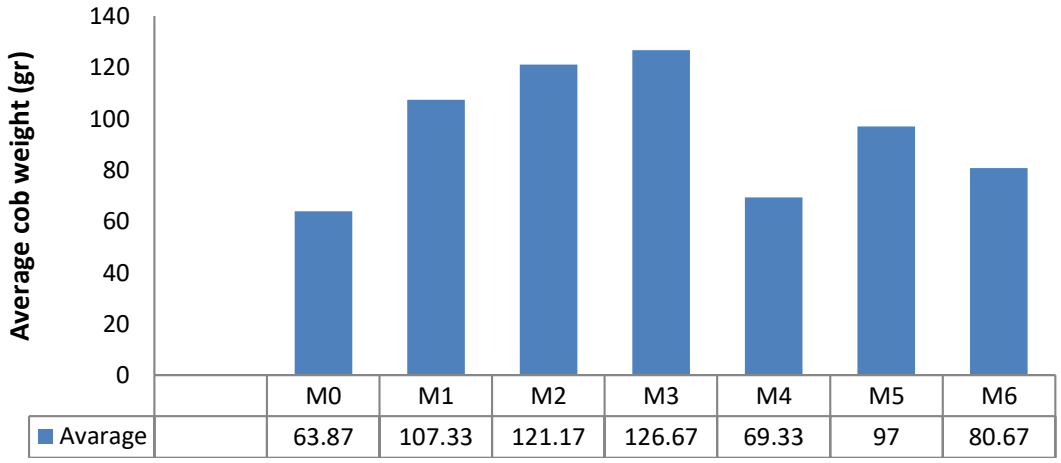


**Figure 3. The Average Weight of Corn Cobs**

Figure 3 shows the average cob weight of 95.15 g. $M_3$ treatment showed the highest average cob weight (126.67 g), while the lowest average weight occurred in $M_0$ (63.87 g). This is due to competition between weeds and the main crop. This is in line with the research of Pranasari *et al*. (2012) who reported that the decrease in photosynthesis influenced by drought conditions caused by salinity with decreased turgor pressure causes closed stomata resulting in the supply of $CO_2$ for photosynthesis is reduced, so that the rate of photosynthesis decreases and photosynthate decreases. Photosynthate distributed throughout the body also decreases, eventually affecting the dry weight of the plant.

*D. Cob Length (cm)*

The observation of cob length showed different averages based on weed control treatment. The diagram of the average cob length of each treatment can be seen in Figure 4.

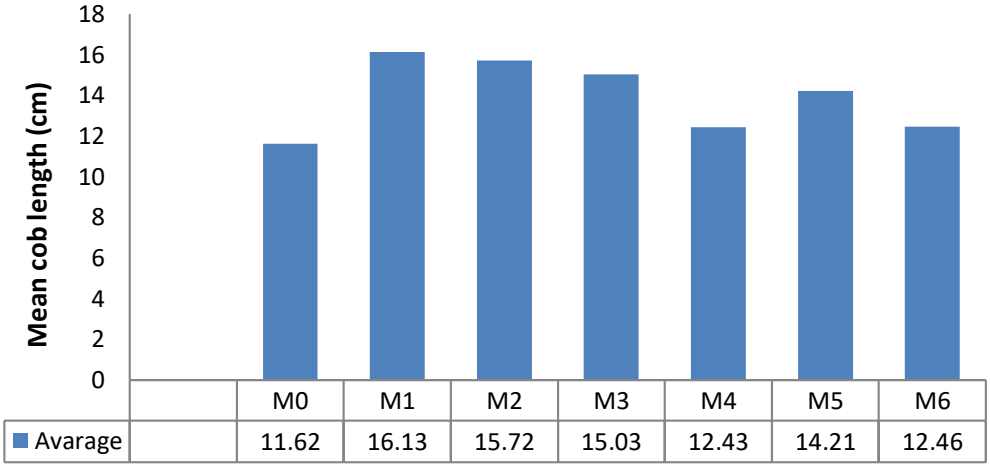


**Figure 4. Diagram of Cob Length (cm) of Corn Hybrid Variety NK 212**

Figure 4 shows that the highest average cob length occurred in the $M_1$ treatment (16.13 cm) while the lowest occurred in the $M_0$ treatment (11.62 cm). This is thought to be because the first week of control provides an opportunity for plants to develop well and get the right light for photosynthesis compared to other treatments. So that the photosynthate produced is greater which supports leaf growth and translocation of photosynthate results in more seeds. This is in accordance with the opinion of Bilman (2001), that the rate of net assimilation depends on the level of sunlight to the plant. The distribution of solar radiation on the canopy determines the rate of dry matter production per unit leaf area during vegetative growth. The presence of mutual shading between corn plants and weeds will reduce the net assimilation rate.

*E. Cob Circumference (cm)*

Cob circumference observations were made at harvest time by separating the corn cobs from the cob. The diagram of cob circumference for each treatment is presented in Figure 5.

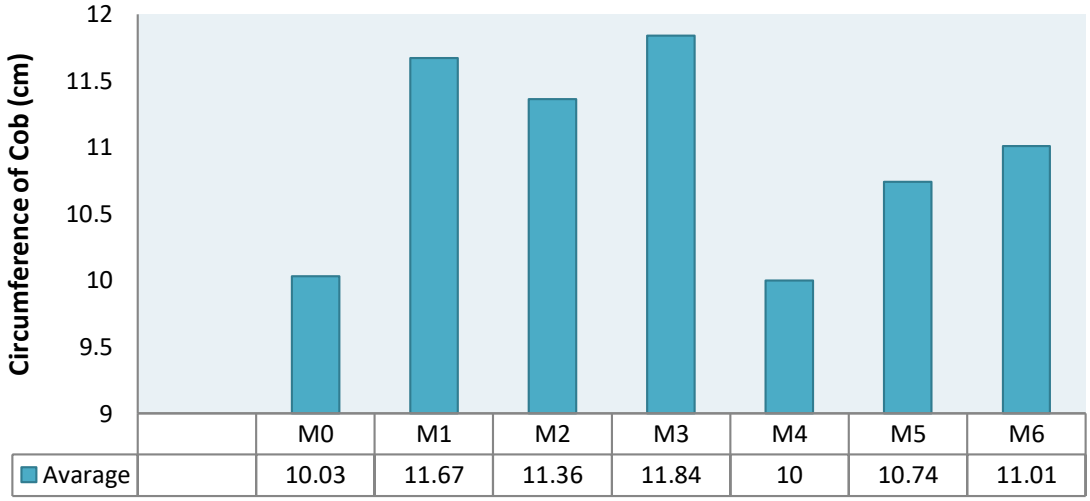


**Figure 5. Diagram of Cob Circumference (cm) of Maize Hybrid Variety NK 212**

Figure 5 shows that the highest average cob circumference occurred in $M_3$ at 11.84 cm, and the lowest in $M_4$ at 10.00 cm. The highest cob circumference in $M_3$ is possible because the competition between corn plants and weeds occurs at the age of 6 weeks after planting, this is in line with the research of Suryaningsih, Joni, and Darmadi. (2015) which states that when there is competition between weeds and cultivated plants, the weeds will release allelopathic substances, seen in the observation of corn at the age of 6 weeks after planting, due to the addition of weeds so that allelopathic substances are also increasing. Allelopathic substances cause stunted corn marked by incomplete corn growth, including loss of leaf green substance (chlorosis) marked by yellowish leaves and tissue death (necrosis) marked by brown leaves. This affects the decrease in photosynthesis so that photosynthate is reduced and distribution throughout the body also decreases. Finally, it will affect the dry weight of the plant and the circumference of the cob (Sudarma *et al*., 2012).

*F. Weed Identification*

Based on observations on the experimental field, the identification of several

The types of weeds found in corn crops are *Cyperus rotundus* weeds which are classified as weeds while *Amaranthus spinosus*, *Phylanthus urinaria*, Linn., *Physalis peruviana*, Linn., *Acalypha indica* L, and *Portulaca oleracea* are classified as broadleaf. Meanwhile, other weeds such as spinach thorns, meniran, ciplukan, cat-whiskers, sikejut leaves, purslane, and purslane are the most common broadleaf weeds found in corn fields. The following are the types of weeds that have been identified in maize fields (Figure 6).


**Figure 6. Species Characteristics of Various Weeds that Compete with Maize Crops; a). Thorn spinach (*A. spinosus*), b). Teki (*C. rotundus*), c). Meniran (*P. urinaria*, Linn.), d). Ceplukan plant (*P. angulata* L.), e). Kucing-kucingan (*A. indica* L.), f). Purslane (*P. oleracea*).**

*a. Amaranthus spinosus* (Amaranthaceae)

Thorn spinach is included in the Kingdom Plantae, Division Magnoliophyta, Class Magnoliopsida, Order Caryophyllales, Family Amaranthaceae, Genus Amaranthus, Species *Amaranthus spinosus* L. (Barus, 2003). Spinach thorns include plants that have soft or wet stems, the height can reach 1 metre. A distinctive sign of spinach duri plant is on the stem, precisely at the base of the petiole there are thorns, so people know as spinach duri. Spinach thorns include wild plants among bushes, roadsides or empty land that is not maintained. This plant is easy to grow in lowlands up to an altitude of 1,400 m above sea level. Thorn spinach is easy to grow with its small seeds (Barus. 2003; Pujiwati. 2017).

*b. Cyperus rotundus* (Cyperacea)

Teki is included in the Divisiono Spertophyta, Class Monokotiledoneae, Order Cyperales, Family Cyperacea, Genus Cyperus, Species *Cyperus rotundus* (Moenandir, 1988). Weeds of the teki group have stems that are generally triangular, sometimes also round and usually not hollow. Leaves arranged in three rows, do not have leaf tongues (ligula). Mother stalk wreaths are not bookish. Flowers are often in spikelets (spica), usually protected by a single protective leaf. The fruit does not open. This weed is quite fierce and widely spread (Moenandir, 1988).

This weed is almost always around cultivated plants, because it has a high ability to adapt to various soil types. This weed is a perennial weed with in-ground parts consisting of roots and tubers. Tubers first form at three weeks after initial growth. The bulbs form slender roots and bulbs again, and so on (1 m2 10 cm deep = 1,600). Tubers are not resistant to drying out, and after 14 days in the sun, they lose their growth capacity. The stem is triangular. Leaves at the base of the stem consist of 4-10 leaflets, the midrib is covered with soil. The leaflets are striped and green and shiny. Flowers have three stamens, bright yellow anthers, and a brown three-pronged stalk. Teki can grow widely especially in dry tropical areas, ranging in altitude from 1-1000 m above sea level, and rainfall between 1500-4000 mm per year (Moenandir, 1988).

*c. Phylanthus urinaria*, Linn. (Phyllantthaceae)

Meniran is included in the Kingdom Plantae, Division Magnoliophyta, Class Magnoliopsida, Order Euphorbiales, Family Phyllantthaceae, Genus Phyllanthus, Species *Phylanthus urinaria*, Linn. Meniran is a common weed that grows wild in humid and rocky places such as roadsides, ditches and abandoned lands. The plant grows upright as high as 30-50 cm. Meniran is a seasonal plant that grows a lot at the beginning of the rainy season (Sukma and Yakub, 2002).

This type of weed is herbaceous, upright, annual, 0.5-1 m, stem: One-level branching, green, glabrous, Leaves: Single, stalked, ovate, elongated round, obtuse rounded base, pointed obtuse rounded tip, bright green top, 0.5-2 cm x 0.25- 0.5 cm, Male flowers: Located in leaf axils of base branches 1-4,2-3 flowers, peduncle 0.5-1 mm, jewellery lobes inverted ovate, bright red, Female flowers: Located in leaf axils of terminal branches, pedicels 0.75-1 mm, jewellery lobes rounded-tiered, green, 125-1.5 mm, Stamens: Anthers opening horizontally, Pistil: Single, 3-9 chambers, Fruit: Smooth, diameter 2-2.5 mm, stalk 1.5-2 mm, thickened at the end (Sukma and Yakub, 2002).

*d. Physalis angulata* L. (Tubiflorae)

Ceplukan weed has a complete classification as follows Divisiono Spermatophyta, Class Dicotyledoneae, Family Tubiflorae (Solanales, Personatae), Order Solanaceae, Genus Physalis, Species *Physalis angulata* L. (Sembodo, 2010).

Ceplukan is an annual weed, erect, often strongly branched, 0.1 to 1.00 m tall. In Java this plant commonly grows from lowlands to approximately 1550 masl (especially below 1200 m) in fields that are not watered, lightly shaded or irradiated as weeds in fields and gardens, in bushes, on roadsides. Stem sharply ribbed, hollow. Leaf blade elongated ovate lanceolate, with pointed tip, flat-edged or not, flower stalk erect, petals 5-slit, corolla broad bell-shaped light yellow with green base. The fruit is elongated round, when ripe yellow, edible (Sembodo, 2010).

*e. Acalypha indica* L. (Euphorbiaceae)

Cat-weed is included in the Kingdom Plantae, Division Spermatophytes, Class Dicotyledoneae, Order Euphorbiales, Family Euphorbiaceae, Genus Acalypha, Species *Acalypha indica* Linn. (Setiawan, Utari, and Oktarini. 2005).

Cats are annual, erect, branched weeds with rough longitudinal lines, and fine hair. In addition, this plant has single leaves, long-stemmed, and scattered. The leaf blade is ovate to lanceolate, thin, with a pointed tip and base, serrated edges and green in colour. The plant also has compound, unisexual flowers that emerge from the leaf axils, are small, and in a spikelet-shaped arrangement. The fruit is square, round and black. Seeds are long round, brown in colour. The root is taproot, dirty white in colour (Setiawan *et al*., 2005).

*f. Portulaca oleracea* (Portulaceae)

Purslane is included in the Division of Spermatophyta, Class Monocotyledoneae, Order Portulacales, Family Portulaceae, Genus Portulaca, Species *Portulaca oleracea*. Purslane is a seasonal weed with propagation in the form of seeds, and is associated with 45 types of crops (Moenandir, 1993). This type of weed is a succulent, fleshy stem stretched and reddish in colour, and round in shape. Length ± 10-50 cm, where old internodes are hairless. Leaves are partial, scattered, opposite, short-stemmed, leaf tips bend inward, rounded or blunt, box-shaped fruit and many seeds, oval seeds shiny black colour, the surface is covered with slightly wrinkled skin (Moenandir, 1993; Holm, Plucknett, Pancho, and Herberger. 1977; Andalusia 2018).

This weed at the beginning of its growth is slow and becomes fast after 15 days and at the end of the 4th week 10 leaves are formed. Flowers are formed throughout the season in the tropics (life cycle 3-5 months) under shaded conditions will grow stretched and upright, and form flowers. The optimum temperature required is 15-35o C where flowers and seeds are produced very well. Conversely, under high light intensity purslane can wilt (Moenandir, 1993).

## D. Conclusion

The critical period of competition of maize plants against weeds at the age of 20 - 45 days after planting (DAP) and had no significant effect on all observed variables, namely plant height, number of leaves, cob length, cob circumference and cob weight. Maize plant growth is stunted by the presence of weeds, there is a struggle for nutrients, light, water, sunlight, growing space between weeds and the main crop so that yield and production decrease.

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