Application of N fertilizer and *Mikania micrantha* weed extract on weeds population, growth and yield of sweet corn (*Zea mays zacharrata*)

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Abstract. The existence of weeds and low efficiency of nitrogen fertilization are obstacles in the sustainable production of sweet corn. Eco-friendly weed control efforts are needed and at the same time can increase the efficiency of nitrogen fertilization in sweet corn crops. The utilisation of *Mikania micrantha* weed extract as bio-herbicide has been shown to inhibit the growth of several types of weeds. This study aimed to determine the effect of decreasing of Nitrogen dosage and the application of *Mikania micrantha* extract to reduce weed populations, support growth and yield of sweet corn crops. The research was conducted at Experimental Farm of Agriculture Faculty Universitas Jenderal Soedirman in Purwokerto Central Java from June to August 2018. The experiment used completely randomized block design. The treatments consisted of two factors and three replication. The first factor is nitrogen dosage (N1 =100%, N2 = 50% and N3 25% N recommendation dosage) and second factor is concentration of weed extract (W1=10%, W2=20% and W3= 30 %) The results showed that dominant weeds were *Cynodon dactylon* and *Cyperus rotundus*. N dosage of 25% and 50% are able to provide the best sweet corn yield, weed extract concentrations of 10% and 20% suppress weed growth

1. Introduction.
Sweet corn is a valuable commodity that can be cultivated intensively because of had a lot of nutrition, high demand, and has good market opportunities. The government targets sweet corn production is 26 million tons, while production in 2015 has only reached 19.6 million tons [1]. Efforts to increase production have experienced many innovations and advancements. Traditional farmers use conventional technologies for sweet corn cultivation, so the yields are also more abundant. Increased production be reached by expanding land and increasing productivity.

Sweet corn plants are responsive to fertilization. Therefore, sufficient availability of Nitrogen (N) during the growth phase needs to be considered. If urea is applied on the surface and not put on the ground, loss of N to the air around 40% of N that has been applied. Based on the research of [2] who argued that the best results at 2 times the applications of Urea fertilizer giving gradually of Nitrogen fertilizer does not have a remarkable effect on the results if applied during the small leaf stage, but has a significant effect on N washing.

Cultivation process of sweet corn often destroyed by weeds. Weeds caused decline in yield of 24%, while diseases and pests were 16.4% and 11.2% respectively [3]. Weeds can reduce yield due to allelopathic compounds released by weeds. Various attempts have been made to control weed growth,
there are mechanical, technical, and chemical methods using herbicides. The use of synthetic herbicides has quite extensive negative impacts such as environmental pollution. The existence of this phenomenon is a reason to find alternative weeds control that are environmentally friendly. One of them is by utilizing the potential of chemical compounds derived from plants (allelochemicals) which can be used as bioherbicides (allelopathy) [4].

*Mikania micrantha* weed contains allelochemical compounds such as alkaloids, flavonoids, tannins, and essential oils that can affect seed germination and surrounding plant growth, which are released into the form of compounds evaporating from leaves or in the form of decomposition compounds in the soil. Based on research by [5], the leaf extract of *M. micrantha* can inhibit seed germination and growth of purple Maman weeds (*Cleome rutidosperma*) and Bahia grass (*Paspalum notatum*) at an extract concentration of 0.15 (g / ml). Giving extract of *M. micrantha* leaves 0.3 g/ml was able to inhibit growth such as plant height, root length, wet weeds weights, and dry weeds weights of *Mimosa pudica*. Increasing the extract concentration to 0.5 g/ml can inhibit the germination of *Mimosa pudica* weeds [6]. Therefore, research is needed to determine the effect of allelopathic substances *M. micrantha* weeds extract as weed control in sweet corn cultivation. This study aimed to determine: a) Effect of reducing N fertilizer dosage on weed populations and the growth and yield of sweet corn. b) effect of *Mikania micrantha* extracts on weed populations and growth and yield of sweet corn. c) interaction between the N fertilizer and *M. micrantha* extract on weed population as well as the growth and yield of sweet corn.

2. Material and Method

2.1 Place and Date
This research was conducted at the Experimental Farm of Agriculture Faculty, Jenderal Soedirman University with a height of 110 meters above sea level. During 3 months from June to August 2018.

2.2 Equipment and Material
The tools used in this research include hoes, sickles, seeder, buckets, sprayers, hand counters, Lux meters, SPAD, calipers, analytical scales, measuring cups, ruler, tape measures, camera, blender, and oven. The materials used in this research include seeds of sweet corn, N, P, K, fertilizer, acetone, aqua dest and weeds (*Micania micrantha*) which have been extracted by maceration method.

2.3 Design of experimental
This experimental used Completely Randomized Block Design with two factors. The first treatments tried was dosage of nitrogen fertilizer consisted of N1=3.125 g/plant (100% of recommendation dosage), N2 = 1.56 g/plant (50% of recommendation dosage) and N3 = 0.78 g/ plant (25% recommendation dosage) and second treatment was concentrations of *Micania micrantha* weed extract consist of W1=10 ml/l, W2=20 ml/l and W3=30 ml/l. Each unit of treatment was replicated 3 times. Variables observed were plant height, leave number, leaf greenery, weight of corn cobs, length and diameter of corn cobs, dry and fresh weight of plant corn, fresh and dry weight of plant roots, dry weight of weed and SDR (summed dominance ratio).

SDR Value of weed, is calculated by adding relative density values, relative frequencies and relative dominance divided by three

\[
\text{Relative density} = \frac{\text{absolute density of certain weeds}}{\text{absolute density of all groups}} \times 100% \\
\text{Relative frequency} = \frac{\text{absolute frequency of certain weeds}}{\text{absolute frequency of all groups}} \times 100% \\
\text{Relative dominance} = \frac{\text{absolute dominance of certain weeds}}{\text{absolute dominance of all groups}} \times 100% \\
\text{Summed Dominance Ratio (SDR)} = \frac{RD + RF + RD}{3}
\]
2.4 Data Analyzed
Data were analyzed using the F test, if there were significant differences then continued with Duncan Multiple Range Test at the $p$: 0.05 level.

3. Result and Discussion.
3.1. Weed population
Weed population can be seen from the Summed Dominance Ratio (SDR) value. The calculation of SDR values was counted when sweet corn plants are 40 days after planting.

### Table 1. SDR values of weeds observed 40 days after planting

| No | Name of weed                | W1N1 | W1N2 | W1N3 | W2N1 | W2N2 | W2N3 | W3N1 | W3N2 | W3N3 |
|----|-----------------------------|------|------|------|------|------|------|------|------|------|
| Broadleaf Group                  |      |      |      |      |      |      |      |      |      |      |
| 1  | Phylanthus urinaria         | 8.2  | 7.6  | 8.2  | 7.7  | 11.8 | 7.0  | 5.9  | 6.4  | 5.6  |
| 2  | Chenopodium polyspermum     | 12.1 | 6.7  | 5.8  | 5.6  | 4.7  | 6.6  | 5.0  | 6.3  | 7.4  |
| 3  | Ageratum                   | 17.6 | 14.2 | 11.2 | 8.3  | 10.1 | 9.5  | 20.1 | 13.1 | 11.3 |
| Conyzoides                        |      |      |      |      |      |      |      |      |      |      |
| 4  | Phyllanthus niruri         | 6.2  | 5.4  | 5.3  | 5.7  | 4.6  | 5.9  | 5.0  | 4.9  | 5.2  |
| 5  | Cleome                     | 8.3  | 6.8  | 13.2 | 9.0  | 8.8  | 4.5  | 5.4  | 13.3 | 6.5  |
| Amaranthus rutidospermae          |      |      |      |      |      |      |      |      |      |      |
| 6  | Amaranthus tricolor        | 5.2  | 3.8  | 8.6  | 5.1  | 11.2 | 9.9  | 5.8  | 8.3  | 5.0  |
| 7  | Richardia brasiensis       | 7.5  | 10.1 | 5.6  | 7.7  | 11.0 | 9.2  | 6.1  | 8.0  | 7.5  |
| Nutgrass Group                    |      |      |      |      |      |      |      |      |      |      |
| 8  | Cyperus rotundus           | 9.5  | 14.0 | 15.1 | 14.4 | 13.9 | 14.0 | 15.9 | 15.8 | 24.6 |
| Grass Group                       |      |      |      |      |      |      |      |      |      |      |
| 9  | Cynodon dactylon           | 13.7 | 20.8 | 14.3 | 21.4 | 13.8 | 14.4 | 20.3 | 11.5 | 15.9 |
| 10 | Paspalum conjugatum        | 5.7  | 5.9  | 6.2  | 7.5  | 5.4  | 11.6 | 5.5  | 6.1  | 5.7  |
| 11 | Eleucine indica            | 6.1  | 4.9  | 6.4  | 7.5  | 4.7  | 7.6  | 5.0  | 6.2  | 5.3  |
| TOTAL                          | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  |

Remarks : W1=10 ml/l, W2=20 ml/l, W3=30 ml/l of *Micania micrantha* weeds extract. N1=100%, N2=50%, N3=25% of N fertilizer recommendation dosage.

The type of weeds obtained was 11 species. The most dominant weed with the highest SDR value was observed at 40 days, there is Cynodon dactylon which was dominant in 9 experimental plots, Cyperus Rotundus was dominant in 8 experimental plots, Ageratum Conyzoides was dominant in 6 experimental plots. For the best treatment on 40 days observation was 20 ml/l of *M.micrantha* weeds extract and 50% of dosage recommendation (W2N2).

Based on Table 1, the highest SDR value of Cynodon dactylon weeds was 20.8% in the weed extract treatment plot with 10 ml/l of *M.micrantha* weeds extract and 50% of N recommendation dosage (W1N2). Cynodon dactylon weed was also dominant in all experimental plots because it had a high
SDR value, especially in the treatment of 20 ml/l of weed extract with 100% of N recommendation dosage (W2N1) and 30 ml/l of weed extract with 100% of N recommendation dosage (W3N1).

The application of nitrogen with different doses has an effect on the increase of weed biomass in sweet corn cultivation as the effect of increasing the concentration of M. micrantha extract given.

**Table 2. Effect of N fertilizer dosage and extract of Mikania micrantha on dry weight of weeds.**

| Weeds extract (%) | A dry weight of weed (g) | N Fertilizer Dosage (%) | A dry weight of weed (g) |
|-------------------|--------------------------|-------------------------|--------------------------|
| 10                | 14.52 b                  | 100                     | 13.02 b                  |
| 20                | 15.64 b                  | 50                      | 21.17 a                  |
| 30                | 24.27 a                  | 25                      | 20.24 a                  |

Remarks: The average number followed by different lowercase letters on the column shows a significantly different effect based on p:0.05 level at DMRT.

Extract of *M. micrantha* has allelochemical content and other elements extracted from plant nutrients, so increasing the amount of extract, will increase nutrient supply which can also be used by weeds to grow and develop. It is very difficult and expensive to extract allelochemical extract from a type of plant and make it a product [7].

Decreasing Nitrogen dosage has an impact on increasing weed populations. Decreasing of nitrogen to 25% makes the supply of nitrogen in the soil decreases so that the main crops that cultivated become less competitive against weeds. Weed population increased rapidly in the generative phase, thus inhibiting the process of filling corn kernels. This can be seen in the variable weight of corn cobs which decreases with the reduction of nitrogen fertilizer treatment. [8] stated that in order to grow properly plants need nutrients N, P and K which are essential nutrients in which these nutrients play a major role in plant growth in general in the vegetative phase. In this search, wetiming of weeds removal were two times including after 25 days and 40 days, referred to Table 1. The treatments in this research about Nitrogen dosage and weeds extractions to control weeds and promoting plant’s growth. So, weeds removal timing are not considered in this research.

The most effective of *M. micrantha* weeds extract in suppressing weed growth at concentrations of 10% and 20% while at high concentrations the weed biomass produced is also higher. This is suspect caused by *M. Micrantha* weeds crevice has allelochemical compounds in the form of phenols, flavonoids, and terpenoids. These compounds at low concentrations can inhibit the growth of other plants so that they can be used as bioherbicides [9]. Based on research by [5], *M. micrantha* leaves can inhibit seed germination and growth of purple Maman weeds (*Cleome rutidosperma*) and bahiagrass (*Paspalum notatum*) at 0.15 (g/ml) of extract concentration.

### 3.2 Effect of N Fertilizer Dosage on Growth and Yield of Sweet Corn

Decreasing dosage of N fertilizer effects on growth and yield of sweet corn in some variables. The results presented in Table 3. Application of N fertilizer gave significantly affect on variable plant height, fresh and dry weight of plant and weight of corn cobs, however, it did not affect leaf greenery, leave A number, length, and diameter of corn cobs, fresh and dry weight of plant roots

Reduction dosage of nitrogen affects decreasing plant height and weight of sweet corn cobs. Decreased up to 25% of dosage recommendation affect in decreased plant height by an average at 19.44 cm (9.73%) and decreased weight of cob by an average at 30.33 g (13.77%). According to [10] plants response to nitrogen elements is to accelerate plant growth, increase plant height and stimulate growth. [11] added that good plant growth and high yields require adequate supply of N. Plants need to be fertilized with appropriate dosage so that the nutrient balance in the soil, and plants can grow and thrive well and provide optimal yield.
Table 3. Effect of N Fertilizer Dosage on Growth and Yield of Sweet Corn

| Dosage of N | PH (cm) | LG (Unit) | LN (sheet) | WC (g) | LC (cm) |
|-------------|---------|-----------|------------|--------|---------|
| 100 %       | 199.83 a| 43.95     | 11.08      | 220.28 a| 19.96   |
| 50%         | 189.65 ab| 41.10     | 11.86      | 212.55 a| 19.65   |
| 25%         | 180.39 b| 43.32     | 11.33      | 189.95 b| 20.96   |
| C.V.        | 3.69    | 3.38      | 1.28       | 9.20   | 9.10    |

| Dosage of N | DC (cm) | FWP (g) | DWP (g) | FWR (g) | DWR(g) |
|-------------|---------|---------|---------|---------|--------|
| 100 %       | 4.90    | 304.52 a| 116.47 a| 72.43   | 21.97  |
| 50%         | 4.93    | 322.51 b| 118.15 ab| 54.35   | 26.79  |
| 25%         | 4.99    | 329.70 b| 121.30 b| 48.41   | 21.29  |
| C.V.        | 4.94    | 12.92   | 13.00   | 19.29   | 20.60  |

Remarks: PH: Plant height, LG: Leave greenery, LN: Leave number, WC: Weight of corn cobs, LC: Length of corn cobs, DC: Diameter of corn cobs, FWP: Fresh weight of plant corn, DWP: Dry Weight of plant corn, FWR: Fresh weight of roots, DWR: Dry weight of root. The average number followed by different lowercase letters on the column shows a significantly different effect at p:0.05 level of DMRT.

On the side condition decreasing the dosage of nitrogen in sweet corn plantations to 25% has effect on increasing fresh and dry plant biomass. This shows an increase in the efficiency of nitrogen use by plants in vegetative phase. The efficiency was supported by other growth variables, there are leaf greenery, leaf number, length and diameter of corn cobs, fresh and dry weight of plant roots which were no indication of a decrease. According to [12] increased efficiency in using nitrogen in corn plants is very important not only economically but also its impact on the environment. Using of appropriate cultivation practices to produce healthy plants will increase efficiency on application of N fertilizer.

Entering the seed filling phase, sweet corn plants in the treatment of reduced fertilizer up to 25% no longer have sufficient quantities of nitrogen supply, so there decreasing in weight of cobs variable even though the diameter and length of the corn cobs do not decrease. Corn plants require sufficient nitrogen supply during phase of seed filling to get maximum photosynthate. As reported by [12] that corn plants still respond to nitrogen fertilization during phase of fertilization. Based on the elemental nature of nitrogen is mobile, fertilization with frequency is needed more often even in low doses. [13] stated that a combination of fertilization for long period of time contributed increasing production of biomass (leaves, seeds, and cobs) of corn plants. According to results of the research by [14] that giving urea 3 and 4 times is better than 2 times.

3.3 Effect of Weed Extract Concentration on Sweet Corn Growth and Yield

The effect of *M. micrantha* weed extract concentration affected plant height, the weight of corn cobs and dry weight of plant. Data analyzed presented in Table 4. Table 4. Showed that application of weed extract has a significant effect on dry weight of plant but not significantly on fresh weight of plant, fresh and dry weight of root. The highest dry weight of plants at the W1, treatment of 10% extract which is 142.46 g, this presumably because the treatment in W1 is most effective in suppressing weed growth as in Table 4. With the suppression of weed growth, corn plants will be more optimum in absorbing nutrients which ultimately plants have more photosynthate results. [5] stated that the content of creeping weeds allelopathy can inhibit the germination and development of purple maman weeds and bahiagrass. The higher concentration of creeping weed extracts the ability to inhibit it will increase [15].

Application of weed extract did not significantly affect plant growth variables which included leaf greenery and leaf number and yield variables which covered weight of cob, length of cob, the diameter of cob, fresh weight of plant, fresh and dry weight of root. This is because the treatment of weed extract can suppress weed growth in this research. So that absorption of nutrients in the vegetative and generative phases does not much different between treatments. *M. micrantha* weed extracts affect allelochemical activity in inhibiting the development of weed seeds in corn plantations. So that in this research corn plants can utilize nutrients optimally [16].
Table 4. Effect of Weed Extract Concentration on Sweet Corn Growth and Yield

| Weeds Extract (%) | PH (cm) | LG Unit | LN sheet | WC (g) | LC (cm) |
|-------------------|---------|---------|----------|--------|---------|
| 10                | 194.19  | 44.07   | 11.42    | 217.28 | 20.26   |
| 20                | 186.14  | 42.41   | 11.31    | 203.52 | 20.00   |
| 30                | 180.54  | 41.89   | 11.56    | 201.99 | 20.31   |
| C.V.              | 3.69    | 3.38    | 1.28     | 9.20   | 9.10    |

| Weeds          | DC (cm) | FWP (g) | DWP (g) | FWR (g) | DWR (g) |
|----------------|---------|---------|---------|---------|---------|
| 10             | 4.94    | 337.20  | 142.46  | 71.71   | 22.79   |
| 20             | 4.88    | 305.06  | 101.48  | 47.93   | 22.12   |
| 30             | 4.99    | 314.47  | 111.99  | 55.55   | 25.12   |
| C.V.           | 4.94    | 12.92   | 13.00   | 19.29   | 20.60   |

Remarks: PH: Plant height, LG: Leave greenery, LN: Leave number, WC: Weight of corn cobs, LC: Length of corn cobs, DC: Diameter of corn cobs, FWP: Fresh weight of plant corn, DWP: Dry Weight of plant corn, FWR: Fresh weight of roots, DWR: Dry weight of root. The average number followed by different lowercase letters on the column shows a significantly effect at p:0.05 level of DMRT.

Weed extract has an effect on decreasing some indicators of growth and yield of sweet corn plants. Alelochemistry contained in the extract of mikania apparently also works on sweet corn plants. Giving of *M. micrantha* extract up to 30 ml/l of concentration by giving various dosages of nitrogen fertilizer can reduce plant height, weight of cobs and dry weight of sweet corn plants. Similar results were also obtained from [17] that leaf extract of *M. micrantha* at 20% of concentration was able to reduce wet weight of corn plants. Growth of corn plants inhibited by allelopathy of tuber puzzles extract as the results of [18] on the components of plant height, leaf area, and dry weight of plant. *M. micrantha* extract is also indicated to inhibit the growth of shallots [19].

Some indicators of sweet corn growth showed significantly decreased because allelochemical in *M. micrantha* extract inhibits metabolism of sweet corn plants so that the formation and development of cells are not optimal. According to [20] allelopathy and weed competition reduce the percentage of germination, inhibit the time of seed emergence, reduce number and area of leaves and leaf chlorophyll content, reduce activity of enzyme nitrate reductase, nitrogen absorptions, and crude forage, photosynthesis and forage production of corn. Furthermore according to [21] allelochemical compounds contained in creeping weeds leaf extract suspected can disrupt activity of the hormones auxin, cytokinin, and gibberellin. The effect of allelopathy on plants is known to be specific. Even plant that has very strong allelopathy cannot inhibit all plant growth from other species [22].

4. Conclusion
Fertilization of 50% N was not significantly different from 100% N, hence gave the best result on the weight of fresh cobs i.e 212.55 g per cob. Application of 20 ml/l *M. micrantha* weeds extracts concentration as bioherbicide can suppress weed growth.

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