International Journal of Agriculture and Plant Science
www.agriculturejournal.in
Online ISSN: 2664-7664, Print ISSN: 2664-7656
Received: 10-04-2025, Accepted: 11-05-2025, Published: 26-05-2025
Volume 7, Issue 3, 2025, Page No. 43-46

Effect of Atrazine 300 g/L and 10 g/L Topramezon herbicide mixture on weeds, growth, and yield of sweet corn (*Zea mays saccharata* Sturt)

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Abstract
Sweet corn is an important carbohydrate-producing food crop in the world besides rice. Sweet corn has high economic value in the market and a relatively faster production period. To increase sweet corn production in Indonesia, one of which is the growth of weeds. Therefore, this study aims to control weeds that grow in sweet corn cultivation land using a mixture of herbicides Atrazin 300 g/l and Topramezon 10 g/l and determine the influence of the growth and yield of sweet corn plants. This experiment was carried out from September 2024 to December 2024 at the Greenhouse of the Faculty of Agriculture, Padjajaran University, Jatinangor District, Sumedang, West Java Province. The experiment used a Group Random Design (RAK) with seven treatments and four replicates. The trial consisted of five mixed treatments of herbicides Atrazin 300 g/l and Topramezon 10 g/l with doses A : 1.5 l/ha, B : 2.0 l/ha, C : 2.5 l/ha, D : 3.0 l/ha, E : 3.5 l/ha, F : Manual Weeding, G: Control. The results of the study showed that the application of a mixture of herbicides Atrazin 300 g/l and Topramezon 10 g/l at a dose of 2.0 l/ha was able to suppress total weed growth and affect the growth and yield of sweet corn plants and did not cause phytotoxicity to sweet corn plants.

Keywords: Phytotoxicity, weeds, herbicides, sweet corn

Introduction

Sweet corn (*Zea mays saccharata* Sturt) is one of the important carbohydrate-producing food crops in the world, besides wheat and rice (Fitria, 2018) [6]. In Indonesia, sweet corn plants are also included in supporting food crops. Even sweet corn is increasingly popular and widely consumed because it has a sweet taste compared to regular corn. Corn production from 2017 to 2019 continues to increase in line with increasing demand. The average national corn production in 2017 was 23.58 million tons, an increase of 20.22% from 2016 of 19.61 million tons, and production in 2018 increased by 6.42 million tons or 10.39% to 26.03 million tons in that year (BPS, 2019) [2].

Corn is widely cultivated in Indonesia, one of the aspects of corn cultivation that is very important in Indonesia is weed control. Weeds are plants whose presence is undesirable in cultivation, and is even one of the biotic factors that rival plants in the fight for light, growing space, and absorption of nutrients and water so that it can cause a decrease in crop yields. If the presence of weeds in corn plants is not controlled, it can reduce yields by up to 75%, even in dry land, it can thwart the total harvest because in addition to competing with corn plants in utilizing growing facilities such as water, nutrients, and sunlight (Ngawit and Fauzi, 2019).

Weed control can be done by physical or mechanical means. However, physical and mechanical control is less efficient if the cultivation land is large enough. Control efforts that are considered more effective in controlling are by using herbicides (Sembodo, 2010) [13]. Herbicides are chemicals used to control weed growth because herbicides can inhibit weed growth (Kurniadie. *et al*, 2019) [7]. However, according to Duke *et al*. (1991) [5], the continuous use of similar herbicides for a long time can lead to weed resistance. One alternative that can be done to reduce weed resistance is to mix several herbicide active ingredients (EFSA, 2014).

Herbicide mixing has been carried out for a long time with the aim of expanding the spectrum of weed control, reducing weed resistance to one of the herbicides thus preventing the occurrence of weed vegetation that leads to homogeneity. By mixing two or more herbicide active ingredients, the use of one type of herbicide with high doses can be avoided. When herbicide is mixed, several types of active ingredients accumulate in the weed body and interact. The response shown by weeds to the application of the mixed herbicide will be different than when a single herbicide application is carried out.

Atrazin is an herbicide that belongs to the triazine group that can be applied both pre-growth and post-growing. The herbicide Atrazin has a way of working by inhibiting electron transfer in photosystem II. With the inhibition of electron flow, there is a buildup of high-energy electrons in the plant body that can damage the cell membrane (Turner, 2018) [14]. Meanwhile, the herbicide topramezone works by inhibiting the enzyme HPPD (*p hydroxy-phenyl-pyruvate dehydrogenase*) so that it causes impaired synthesis and function of chloroplasts. As a result, weeds affected by this herbicide will experience *bleaching* symptoms which then cause their growth to be inhibited. Topramezone belongs to the aromatic herbicide ketone of *the pyrazolyl group* as an inhibitor of carotenoid biosynthesis (Turner, 2018) [14]. This study aims to determine the effectiveness of a mixture of herbicides of atrazin and topramezone against weeds in corn cultivation.

Materials and Methods

This research will be carried out from September 2025 to December 2025 at the Greenhouse of the Faculty of Agriculture, Padjajaran University, Jatinangor District,

Sumedang Regency, West Java Province. The materials used in this experiment are corn seedling plants, atrazine herbicide 300 g/l + topramezone 10 g/l, Urea, TSP and KCl fertilizers. The tools used in this experiment are semi-automatic knapsack sprayer and T-jet nozzles, measuring cups, digital scales, ovens, scissors, hoe, plastic, labels, quadrants size 0.5 m x 0.5 m, envelopes, stationery, as well as cameras as a documentation tool. This experiment used the Group Random Design (RAK) method which consisted of 7 treatments and each treatment was repeated 4 times, making a total of 28 experimental tiles. The experimental plot unit consists of plots measuring 4 x 7 m and planting distance of 40 cm x 70 cm. The treatment observed was the administration of a mixed herbicide dose of atrazine 300 g/l + topramezone 10 g/l, while the treatment tested consisted of:

Table 1: Herbicide Mixture Treatment

Treatment	Dose (l/ha)
A. Atrazine 300 g/l + Topramezone 10 g/l	1,5
B. Atrazine 300 g/l + Topramezone 10 g/l	2,0
C. Atrazine 300 g/l + Topramezone 10 g/l	2,5
D. Atrazine 300 g/l + Topramezone 10 g/l	3,0
E. Atrazine 300 g/l + Topramezone 10 g/l	3,5
F. Manual weeding	-
G. Control	-

Results and Discussion

Total Weed Dry Weight

Based on the analysis of the dry weight of weeds, it was shown that there was an interaction between the increase in the dose of herbicides and the total dry weight of the weeds produced. The higher the dose of herbicide given, the lower the dry weight of the weeds produced. This is because the higher the dose, the greater the active ingredient given. This is in accordance with the opinion of Zhang (2013) [16] who said that the size of the herbicide dose determines the amount of active ingredients used in weed control. The higher the dose of herbicide used, the greater the effect and can reduce selectivity (Nurjanah, 2002) [10]. The magnitude of herbicide suppression is determined by the level of translocation (Ngawit, 2011).

Table 2: Total Weed Dry Weight

Treatment	Dose (l/ha)	Total Weed Dry Weight	
		3 MSA	6 MSA
A. At 300 g/l + Top 10 g/l	1,5	20.47c	55.95b
B. At 300 g/l + Top 10 g/l	2,0	19.22bc	54.40b
C. At 300 g/l + Top 10 g/l	2,5	18,21ab	51.34ab
D. At 300 g/l + Top 10 g/l	3,0	17.37a	50,20ab
E. At 300 g/l + Top 10 g/l	3,5	16.74a	46.83a
F. Manual weeding	-	26.73d	78.50c
G. Control	-	37.30th	114.50d

Remarks: The average score followed by different letters in the same column shows a marked difference at the 5% level in the Duncan Test. MSA = Week after application.

The effectiveness of weed control can be seen from the total dry weight of weeds. Weed control is said to be effective when the total dry weight of the weed is low. The dose of the herbicide Atrazin + Topramezone had an effect on the dry weight of the weeds. The greater the symptoms of damage caused to weeds, the lower the dry weight produced by the weed. The lower the dry weight of the weed indicates the higher the herbicide efficacy.

Herbicide treatment Atrazin + Topramezon is also able to cause the highest efficacy in weeds of the grass group. The higher the herbicide dose level, the higher the efficacy rate of the herbicide. These results are in accordance with the study conducted by Chipomho *et al*. (2019) [3] which shows that herbicide mixing can increase the spectrum of weed control and can increase weed mortality levels (when mixing is synergistic) when compared to using a single herbicide.

The mixing of the herbicides Atrazin + Topramezone is able to increase the working effectiveness of each single herbicide. This is evidenced by a co-toxicity value of 1.7 which means that the mixing is synergistic. Sembodo and Wati (2021). The symptoms of poisoning caused by mixed herbicides are greater than the symptoms of poisoning in weeds applied by a single herbicide. The application of the herbicide Atrazin + Topramezon resulted in the death of the entire weed body. In 3 and 6 MSAs, the application of mixed herbicides Atrazin + Topramezon at a dose of 1.5 l/ha was able to cause weed poisoning compared to no treatment or control. In 3 and 6 MSAs, herbicide treatment of Atrazin + Topramezon at a dose of 1.5 l/ha was able to suppress growth in weeds *Alternanthera ficoides, Cynodon dactilon, Ipomoea obscura, Setaria plicata, Bidens alba, Panicum repens, Digitaria sanguinalis, Euphorbia hirta, Mimosa pudica, Oxalis borreilea and Philanthus niruri*. The highest level of weed poisoning was found in the herbicide treatment Atrazin + Topramezon at a dose of 3.5 l/ha. Herbicide treatment of Atrazin + Topramezone with a lower dose of 1.5 l/ha was also able to cause weed poisoning at 3 and 6 MSA when compared to controls.

The application of the mixed herbicide Atrazin + Topramezon has not been able to cause poisoning *of Cyperus rotundus* weeds at 3 and 6 MSA, which is indicated by a level of toxicity equivalent to control. The herbicide mixture Atrazin + Topramezon is less able to cause poisoning of weeds than in broadleaf weeds and grasses. In their experiment, Alfulaila *et al*. (2017) [1] stated that the use of mixed herbicides Atrazin + Topramezon was not effective in controlling *Cyperus rotundus* weeds. This is because the herbicide Atrazin + Topramezon is only able to systemically poison the young shoots *of Cyperus rotundus* without being able to poison the root system and its tubers because there is thick periderm tissue.

The results of the analysis showed that the use of a mixed herbicide of Atrazin + Topramezon and manual weeding was not effective in controlling *Cyperus rotundus weeds.* These weeds have the ability to regenerate or multiply with seeds or stolons or rhizomes, so that they can excel in competition or compete with corn crops. Mixed treatment of Atrazin + Topramezon herbicides and weed weeding had a noticeable effect on the total dry weight of weeds at 3 and 6 MSA. This is because weeding treatment of 3 and 6 MSA can suppress weed growth and reduce weed competition with corn plants, especially in the critical period of corn plants, which is between the ages of 20 and 45 hst. In addition, at the age of 28 to 56 hst, corn plants are in an exponential phase, where corn plants experience rapid growth and plant organs have functioned perfectly, so that plants are able to compete for water, light and nutrients in large quantities (Duncar, 2002).

The application of herbicides carried out at the age of 15 hst is an effort to control weeds early, herbicides suppress the early growth of weeds by damaging the chloroplast system and disrupting the photosystem II which causes the bleaching process and in the end the dead weeds also try to suppress the weed population as early as possible, especially weeds that are difficult to control with herbicides, namely *Cyperus rontundus* weeds. Furthermore, the treatment of a mixture of herbicides Atrazin + Topramezon aged 15 hst, can suppress some weed populations, and can reduce weed competition with cultivated plants. So as to reduce the level of nutrient competition between weed plants and corn plants.

Plant Height

The growth and development process of plants is influenced by the state of the growing environment. Environmental factors that are important for plant growth are the availability of nutrients and the control of plant pest organisms. The growth of corn plants is directly related to the presence of weeds around the plants that have been treated. Weeds in treatment without weed control are more, so corn growth in this treatment is lower than with herbicide treatment.

Table 3: Plant Height

Treatment	Dose (l/ha)	Plant Height		
		1 MSA	3 MSA	5 MSA
A. At 300 g/l + Top 10 g/l	1,5	6.60ab	43.33c	69.03bc
B. At 300 g/l + Top 10 g/l	2,0	7.60b	44.25c	70.35c
C. At 300 g/l + Top 10 g/l	2,5	8.75bc	44.15c	73.00c
D. At 300 g/l + Top 10 g/l	3,0	8.78bc	43.90c	78.38c
E. At 300 g/l + Top 10 g/l	3,5	9.43c	44.45c	81.33c
F. Manual weeding	-	5.23a	37.28b	56.58ab
G. Control	-	4.68a	34.63a	51.03a

Remarks: The average score followed by different letters in the same column shows a marked difference at the 5% level in the Duncan Test. MSA = Week after application.

Low growth is caused by corn plants growing with weeds and experiencing competition for nutrients, light, water, growing space and gas (CO2, O2) for their growth. The limited elements needed by plants results in inhibition of plant growth. This is in accordance with the opinion of Moenandir (2010) that the presence of weeds around plants has a quantitative and qualitative effect, namely plant growth becomes depressed and small and the shape of the plant changes.

The results of the variety analysis on plant height showed noticeably different results. Weeds that grow or germinate before or at the same time as managed crops have a major impact on plant growth and yield. This is in accordance with the opinion of Puspitasari (2013) [11] who shows that the effect of Topramezon herbicide dosage on the growth of corn plants begins to be evident at the age of 28 days after planting for plant height variables.

Weight of Corn Yield

Based on the results of the analysis (Table 4) showing a real influence on the production of corn plants, the high dry weight of total weeds in the control treatment is suspected to have resulted in the growth and development of corn plants being disrupted, so that production in the control decreases due to competition between corn plants and weeds. The level of competition between plants and weeds is difficult to interpret carefully because it depends on four factors, namely the stadia of plant growth, weed density, water and nutrient stress levels, and weed species. If left unchecked, broadleaf weeds and grasses can significantly suppress the growth and development of corn.

Table 4: Corn yield

Treatment	Dose (l/ha)	Corn Yield
A. At 300 g/l + Top 10 g/l	1,5	3438.75b
B. At 300 g/l + Top 10 g/l	2,0	3425.00b
C. At 300 g/l + Top 10 g/l	2,5	3567.50b
D. At 300 g/l + Top 10 g/l	3,0	3507.50b
E. At 300 g/l + Top 10 g/l	3,5	3605.00b
F. Manual weeding	-	2575.50a
G. Control	-	2477.50a

Remarks: The average score followed by different letters in the same column shows a marked difference at the 5% level in the Duncan Test. MSA = Week after application.

The results of the analysis of the Duncan Test at the level of 5% of the average yield of sweet corn crops are seen in Table 4, it can be seen that the average treatment of a mixture of herbicides Atrazin + Topramezon of all doses gives a significantly different yield of corn with manual weeding and control. The application of Atrazin + Topramezon herbicide mixture treatment is able to provide a higher yield of sweet corn than the yield of sweet corn with manual weeding treatment and control.

The yield of sweet corn is influenced by management, genotype and environment. Affects the ability of the plant to express its genetic potential. The management factor is the ability to provide an environment that supports plant growth, so that the nutrients needed by plants can be available and support growth to achieve the desired crop yield. The yield of corn plants is affected by the presence of weeds. The presence of weeds in corn plantations allows competition between the two, resulting in stunted plant growth and reduced crop yield. Corn plants that grow in weed-overgrown land conditions cannot accumulate more photosyntheses. This is in accordance with the opinion of Sebayang (2010) [12] and Widaryanto (2010) [15] that if a plant is stressed with water, temperature, light or nutrients results in the disruption of the photosynthesis process. Therefore, the large dose of herbicides greatly affects the level of weed suppression which ultimately affects the yield of corn crops.

Conclusion

From the results of the research that has been carried out, it is known that the treatment of the herbicide campran Atrazin + Topramezon is able to control and suppress weed growth in sweet corn plantations with tolerant phytotoxicity and is not harmful to the growth and yield of sweet corn plants. It is known that the treatment of a mixture of herbicides Atrazin + Topramezon with a dose of 2 l/ha is the best dose in suppressing weed growth.

Weed control on sweet corn cultivation land can use a mixture of herbicides Atrazin + Topramezon with a dose of 2 l/ha and further testing needs to be carried out by observing weed intake 3 weeks after planting, 6 weeks after planting, and 8 weeks after planting to calculate dry weight and analyze statistics.

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