



Effectiveness of herbicide mixture IPA glyphosate 300 g/l and 2, 4-d dimethyl amine 100 g/l against weeds in land preparation of no-tillage soybean cultivation

Dedi Widayat, Yayan Sumekar*, Uum Umiyati, Tsamara Thahira

Faculty of Agriculture, Universitas Padjadjan, Jatinangor, Indonesia

Abstract

Tillage with a no-tillage system can save time and costs on soybean cultivation. The no-tillage system is carried out by applying herbicides to control weeds in the field. The herbicides used are mixed herbicides to broaden the spectrum of weed control. This study aimed to determine the effectiveness of the herbicide mixture of IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l in suppressing weed growth in no-tillage soybean cultivation. The research was conducted in January-April 2023 at the Agrowisata Sawah Menak land, Sumedang. The trial used a randomized group design with six treatments and four replications with herbicide doses of 1,50 l/ha; 2,00 l/ha; 2,50 l/ha; 3,00 l/ha; 3,50 l/ha; and Control with perfect-tillage treatment. The experimental results showed that the herbicide mixture IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l effectively controlled total weeds at a dose of 3,00 l / ha and can be used as an alternative tillage in no-tillage soybean cultivation.

Keywords: Effective, no-tillage, soybean, weed control

Introduction

Soybean (*Glycine max* L.) is one of the food crops sources of protein and vegetable oil widely used as food raw material in Indonesia. National soybean productivity increased by 6,44% from 2020 to 2021, according to the Central Statistics Agency (BPS, 2021, 2022). Despite the increase nationally, not a few provinces have experienced a decrease in soybean production due to the declining land area in recent years and other factors such as pests and diseases, weeds, and inappropriate tillage (Wedastra *et al.*, 2022)^[11].

Tillage is crucial in soybean cultivation to prepare the land and create a good root area for plant growth (Raintung, 2010)^[5]. One of the tillage systems widely applied to soybean cultivation is the zero-tillage system. No-tillage systems are alternative tillage that can save time, labor, and costs on tillage by applying herbicides for weed control. Herbicide application effectively and efficiently prepares land in the no-tillage system (Umiyati & Kurniadie, 2016)^[9].

Tillage with the no-tillage system is identical to the condition of land covered with weeds. This can cause competition for water, nutrients, sunlight, and growing space that can interfere with the growth and development of soybean plants as said by Harliani & Eko (2017) that the level of nutrient absorption is one of the factors that can affect plant growth. Losses caused by weeds in soybean crops can reduce yields by 20% to 80% (Hendriwal *et al.*, 2014).

Weed control can be done by several methods, including chemically using herbicides. Farmers with sizeable agricultural land often carry this Control because it can save time, cost, and labor (Umiyati, 2016)^[10]. Continuous use of herbicides can cause resistance to weeds in the long run. One effort to reduce these negative impacts is to use mixed herbicides such as IPA Glyphosate and 2,4-D Dimethyl Amine.

Herbicide made from IPA Glyphosate is a non-selective systemic herbicide that works by inhibiting the work of the EPSP synthetase enzyme so that it interferes with the activity of reduction, photorespiration, and amino acid metabolism bound to the enzyme. The herbicide 2,4-D Dimethyl Amine is a systemic herbicide that disrupts the meristem cell division process to stop the cell elongation process (Tobing *et al.*, 2019; Widayat *et al.*, 2021)^[8, 12]. This study aims to determine the effectiveness of the herbicide mixture of IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l against weeds also the growth and yield of no-tillage soybean cultivations.

Materials and Methods

This research was conducted in Agrowisata Sawah Menak land, Sumedang Regency, and the Weed Laboratory of Padjadjaran University from January to April 2023. The tools used in this study are rulers or meters, notebooks, plastic buckets, paper, envelopes, plastic, cameras, semi-automatic knapsack sprayer and T-jet nozzles, measuring cups, ovens, and analytical scales. The materials used in this study were Anjasmoro cultivar soybean plants, urea fertilizer, TSP, and KCl, and the IPA herbicide Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l.

The experimental design used a randomized group design (RAK) consisting of six treatments and four repeats so that 24 experimental units were obtained, namely: A. IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l dose 1,50 l/ha; B. IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l dose 2,00 l/ha; C. IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l dose 2,50 l/ha; D. IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l dose 3,00 l/ha; E. IPA Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l dose 3,50 l/ha; and Control with perfect tillage. Herbicide application is carried out two weeks before planting. The observation parameters consisted of total weed dry weight, phytotoxicity, plant height, number

of trifoliate leaves, number of pods, number of seeds per pod, and weight of 100 grains. Data processing uses various analysis methods through SASM-Agri software and Duncan's Multiple Range Test at the 5% level.

Result and Discussion

Weed Components

The weed components observed were the total dry weight of weeds found in the experimental plot, including *Setaria palmifolia*, *Fimbristylis miliacea*, *Ludwigia octovalvis*, *Cyperus rotundus*, *Axonopus compressus*, *Monochoria*

vaginalis, *Gratiola officinalis*, *Oldenlandia corymbosa*, *Erigeron sumatrensis*, *Eclipta prostrata*, *Cleome ruidosperma*, and *Alternanthera sessilis*. The observed data in Table 1 showed that herbicide treatment of IPA mixture of glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l was effective in controlling total weeds starting at a dose of 1,50 l/ha at 5 and 8 WAA compared to controls. Total weed growth is inhibited, ranging from 5 WAA to 8 WAA as said by Singh *et al.* (2020) [7] that herbicides have active persistence properties in the soil to control weeds for a long time.

Table 1: Average Total Weed Dry Weight

Code	Treatment	Dosage	Dry Weight (g)		
			1 DBP	5 WAA	8 WAA
A	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	1,50 l/ha	7,21 a	17,52 b	27,13 b
B	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,00 l/ha	3,26 b	11,88 c	15,90 c
C	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,50 l/ha	1,61 bc	8,19 cd	13,13 c
D	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,00 l/ha	1,02 bc	6,76 d	15,69 c
E	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,50 l/ha	0,25 c	4,13 d	9,40 c
F	Control (perfect tillage)	-	9,18 a	31,10 a	64,12 a

Note: The average number marked with the same letter in the same column is not significantly different based on Duncan's Multiple Range Test at the 5% level. DBP = day before planting. WAA = week after application.

Growth Components of Soybean

Table 2: Average Plant Height

Code	Treatment	Dosage	Plant Height (cm)		
			2 WAP	4 WAP	6 WAP
A	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	1,50 l/ha	13,53 bc	58,10 bc	73,75 bc
B	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,00 l/ha	15,10 ab	63,10 ab	75,38 b
C	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,50 l/ha	16,15 a	64,03 a	74,60 b
D	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,00 l/ha	15,50 a	66,73 a	75,60 b
E	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,50 l/ha	15,68 a	68,20 a	83,63 a
F	Control (perfect tillage)	-	12,15 c	55,75 c	72,08 c

Note: The average number marked with the same letter in the same column is not significantly different based on Duncan's Multiple Range Test at the 5% level. WAP = week after planting. Number of samples = 10 plants.

1. Plant Height

The observational data in Table 2 showed that herbicide treatment of IPA mixture of glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l resulted in a higher average plant height and significantly different doses starting at 2,00 l/ha at 2, 4, and 6 WAP. This is because a higher dose of herbicide can inhibit weed growth better due to the large number of active ingredients absorbed by weeds (Tobing *et al.*, 2019) [8].

2. Number of Trifoliate Leaves

The observational data in Table 3 showed that the herbicide treatment of IPA mixture of Glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l resulted in a higher number of trifoliate leaves starting at a dose of 1,50 l/ha at 4 and 6 WAP compared to the control treatment. This is because weed growth has been controlled for two weeks before planting in the no-tillage system, so competition between weeds and soybean plants is not too high (Muyassar *et al.*, 2020) [3].

Table 3: Average Number of Trifoliate Leaves

Code	Treatment	Dosage	Number of Trifoliate Leaves	
			2 WAP	4 WAP
A	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	1,50 l/ha	6,45 d	15,00 d
B	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,00 l/ha	6,73 d	15,08 d
C	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,50 l/ha	7,55 c	15,63 c
D	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,00 l/ha	8,30 b	21,40 b
E	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,50 l/ha	11,70 a	22,00 a
F	Control (perfect tillage)	-	5,30 e	13,15 e

Note: The average number marked with the same letter in the same column is not significantly different based on Duncan's Multiple Range Test at the 5% level. WAP = week after planting. Number of samples = 10 plants.

Number of Pods

The observational data in Table 4 showed that herbicide treatment of IPA mixture of Glyphosate 300 g/l + 2,4-D

Dimethyl Amine 100 g/l resulted in a more significant number of total pods and filled pods and fewer hollow pods starting at a dose of 3,00 l/ha compared to controls. This

shows that giving high doses can suppress weed growth better in the no-tillage system so that it can increase the growth of soybean plants in the vegetative phase and produce more pods in the generative phase (Saputri *et al.*, 2020)^[6].

Yield Components of Soybean

The yield component is observed based on the weight of 100 grains of soybean plants. The observational data in Table 5 showed that the herbicide treatment of the IPA

mixture of glyphosate 300 g/l + 2,4-D Dimethyl Amine 100 g/l produced an average weight of 100 grains which was not significantly different from the Control but resulted in a weight of 100 grains greater than the Control starting dose of 3,00 l / ha. This shows that the application of the IPA mixture herbicide Glyphosate 300 g / l + 2,4-D Dimethyl Amine 100 g / l does not affect the weight of 100 soybeans because the weight of 100 grains is more influenced by internal factors (genetic) than external factors (environment) (Saputri *et al.*, 2020)^[6].

Table 4: Average Number of Pods

Code	Treatment	Dosage	Total Pods	Full Pods	Empty Pods
A	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	1,50 l/ha	42,35 c	36,08 c	6,28 a
B	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,00 l/ha	41,20 c	35,85 c	5,98 a
C	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,50 l/ha	42,28 c	36,30 c	5,35 b
D	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,00 l/ha	54,58 b	52,05 b	2,28 c
E	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,50 l/ha	60,15 a	57,88 a	2,35 c
F	Control (perfect tillage)	-	39,95 c	37,60 c	2,53 c

Note: The average number marked with the same letter in the same column is not significantly different based on Duncan's Multiple Range Test at the 5% level. Number of samples = 10 plants.

Table 5: Average Weight of 100 Grains

Code	Treatment	Dosage	Weight (g)
A	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	1,50 l/ha	15,66 b
B	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,00 l/ha	17,05 ab
C	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	2,50 l/ha	17,14 ab
D	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,00 l/ha	17,95 a
E	IPA Glyphosate 300 g/l +2,4-D Dimethyl Amine 100 g/l	3,50 l/ha	18,60 a
F	Control (perfect tillage)	-	17,53 a

Note: The average number marked with the same letter in the same column is not significantly different based on Duncan's Multiple Range Test at the 5% level. Number of samples = 10 plants.

Conclusion

Herbicide mixture IPA Glyphosate 300 g / l + 2,4-D Dimethyl Amine 100 g / l starting dose 3.00 l / ha effectively control total weeds, has a good effect on plant height, number of trifoliolate leaves, number of pods, and weight of 100 grains and can be used as an alternative tillage in no-tillage soybean cultivation.

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