JOURNAL OF DEGRADED AND MINING LANDS MANAGEMENT
ISSN: 2339-076X (p); 2502-2458 (e), Volume 6, Number 4 (July 2019):1857-1860
DOI:10.15243/jdmlm.2019.064.1857

Research Article

Pyraclostrobin effect for nitrogen fertilizer efficiency on maize

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Received 14 April 2019, Accepted 15 June 2019

Abstract: Maize is one of the food crop commodities that can take a role in the development of the agricultural sector. The purpose of this research was to know the effect of pyraclostrobin and nitrogen on the maize plant. The experimental design used in this study was a factorial completely randomized block design with three replications. The first factor was pyraclostrobin (P) that consisted of P0 = no pyraclostrobin application, and P1 = foliar spray of pryraclostrobin 400 mL/ha. The second factor was nitrogen application (N) that consisted of N0 = without N fertilizer, N30 = 30 kg N/ha, N60 = 60 kg N/ha, N90 = 90 kg N/ha, and N120 = 120 kg N/ha. The data was focused on the plant height, flowering and earing age, protein and amylose content of the seed, respectively. Data were analyzed by variance analysis followed by. analysis of the least significant difference (LSD) at the level of 5%. Nitrogen application increased protein content but reduced amylose content. Pyraclostrobin application that significantly increased the amylose content even in the high nitrogen application dosage.

Keywords*: fertilizer efficiency, pyraclostrobin, maize, nitrogen*

To cite this article: Tyasmoro, S.Y., Wicaksono, K.P., Permanasari, P.N., Saitama, A. and Zaini, A.H. 2019. Pyraclostrobin effect for nitrogen fertilizer efficiency on maize J. Degrade. Min. Land Manage. 6(4): 1857-1860, DOI:10.15243/jdmlm.2019.064.1857.

Introduction

Maize is one of the commodities of food crops that can take a role in the development of the agricultural sector. In Indonesia, maize is the second food commodity after rice. Maize demand continues to increase from year to year in line with improving the living standards of people's economy and the advancement of the animal feed industry so that efforts need to increase production. The rate of increase in maize production in Indonesia is relatively slow, on the other hand, the need for maize as raw material for feed industry and food industry has increased faster. Some attempts to increase maize production are by balanced fertilization, disease control, and the use of growth regulators (Kaido et al., 2013). The constraints faced in maize production are the availability and regularity of production and supply stocks. Several ways are being done to improve the quality and yield with the expansion of plant area and the use of the superior seed, maintenance, pest and disease control and fertilization. The application of cultivation technology classified as new is the use of plant growth regulator (PGR). PGR is a compound that functions to influence physiological processes in plants. Giving PGR pyraclostrobin timely and optimal fertilization is expected to improve the quality and yield of maize. According to Efendi et al. (2011), Pyraclostrobin application with concentration 1-1.5 mL/L of water is only effective when accompanied by urea fertilizer with an optimum dosage of 300 kg/ha but not effective on urea with a dose of 100, 200 and 400 kg/ha. The use of pyraclostrobin in the growing phase of cultivated plants can trigger plant growth and yield (Krieger et al., 2001). Pyraclostrobin application on maize can increase chlorophyll of leaves and stem diameter (Asputri et al., 2013). Pyraclostrobin can retain leaf chlorophyll when flowering and the number of leaves in maize plants. Pyraclostrobin

is a fungicide that also serves as a trigger for plant growth and yield. The use of pyraclostrobin is expected to increase plant height, leaf number, length of the cob, maize cob without husk, shelled grain weight/cob and weight of 100 grains (Jabs et al., 2002). The purpose of this experiment was to elucidate the effectiveness of pyraclostrobin use at the level of nitrogen fertilization to maize production.

Materials and Methods

The research was conducted from May to September 2017 at Jatikerto Village, Kromengan District, Malang Regency, East Java. The experimental design used in this study was a factorial completely randomized block design with three replications. The first factor was pyraclostrobin (P) that consisted of P0 = no pyraclostrobin application, and P1 = foliar spray of pryraclostrobin 400 mL/ha. The second factor was nitrogen application (N) that consisted of N0 = without N fertilizer, N30 = 30 kg N/ha, N60 = 60 kg N/ha, N90 = 90 kg N/ha, and N120 = 120 kg N/ha. Maize cultivation used the standard manual of maize cultivation started with soil tillage, seedling cultivation, fertilization, pest and weed control. Pyraclostrobin application by foliar spray was conducted once at 30 days after planting, with 400 mL/ha concentration. Nitrogen fertilizer was given at 30 days and 40 days after planting each with half of the treatment's dosage. The data of observations in the study were analyzed by variance analysis (F test) at the level of 5%. If there were significantly different results, it would be continued with the LSD (least significant difference) test at the level of 5% (Gomez and Gomez, 1995).

Results

Based on the data listed in Table 1 to Table 4, there were different responses of maize plants to the application of pyraclostrobin and the dosage of nitrogen fertilizer. One of the parameters measured in this study was plant height. There was an independent effect between pyraclostrobin and nitrogen fertilizer application. On several variables, the efficiency of nitrogen fertilizer to plant height did not depend on pyraclostrobin application (Table 1). The first generative growth parameter observed was flowering time. This is important to observe because the generative phase of a plant is observed with the appearance of flower buds on the plant. There was no significant earlier or delayed flowering as a response of treatments (Table 2). The application of nitrogen fertilizers and pyraclostrobin did not affect the time of flowering on maize. Both flowering and earing age showed the same response with all the treatments. Pyraclostrobin did not delay flowering.

Table 1. Effect of pyraclostrobin and nitrogen fertilizer on maize plant height.

Treatment	Plant Age (weeks)		
	4	5	6
Pyraclostrobin (mL/ha)			
0	75.77	99.87	119.10
400	78.69	100.63	118.33
LSD (5%)	ns	ns	ns
Nitrogen (N/ha)			
0	77.39	98.89	117.08
30	76.52	101.5	122.13
60	77.19	97.25	117.75
90	77.54	101.63	120.04
120	77.49	102	116.58
LSD (5%)	ns	ns	ns

Descriptions: LSD = Least Significant Difference; ns = not significant.

Table 2. Effect of pyraclostrobin and nitrogen fertilizer on flowering and earing age.

Treatment	Plant Age (weeks)		
	Female	Male	Ear
Pyraclostrobin (mL/ha)			
0	63.49	59.31	62.56
400	62.48	59.10	61.78
LSD (5%)	ns	ns	ns
Nitrogen (N/ha)			
0	63.85	59.07	62.94
30	63.71	59.00	62.92
60	63.08	59.58	62.29
90	62.83	59.17	62.04
120	61.46	59.21	60.67
LSD (5%)	ns	ns	ns

Descriptions: LSD = Least Significant Difference; ns = not significant.

Pyraclostrobin had the important role in increasing the efficiency of nitrogen application. There was new information about effect pyraclostrobin on amylose content of maize (Table 3), pyraclostrobin application of 400 mL/ha increased grain amylose content from 17.33% to 20.53% or increased to 18.5% higher. The content of maize protein was strongly influenced by nitrogen, whereas the use of pyraclostrobin did not show any effect on the seed protein of maize kernels (Table 4). The weight of

the ear and the weight of the seed plant contains nitrogen (Figure 1).

Table 3. Effect of pyraclostrobin and nitrogen fertilizer on amylose content of maize.

Treatment	Amylose (%)	
P0N0	18.97	b
P0N30	20.65	cd
P0N60	15.20	a
P0N90	15.99	a
P0N120	15.88	a
P1N0	20.32	c
P1N30	20.81	cd
P1N60	20.71	cd
P1N90	19.43	b
P1N120	21.40	d
LSD (5%)	0.88	

Description: Numbers followed by the same letters in the same column showed no significant difference based on LSD 5%; LSD = Least Significant Difference; ns = not significant.

Table 4. Effect of pyraclostrobin and nitrogen fertilizer on protein content of maize.

Treatment	Protein (%)
Pyraclostrobin (mL/ha)	
0	4.38
400	4.25
LSD (5%)	ns
Nitrogen (N/ha)	
0	3.91 a
30	3.85 a
60	4.54 b
90	4.61 b
120	4.69 b
LSD (5%)	0,57

Description: Numbers followed by the same letters in the same column showed no significant difference based on LSD 5%; LSD = Least Significant Difference; ns = not significant.

Discussion

One way to increase maize productivity is to prevent diseases. In the cultivation of maize, many diseases that attack maize crops are caused by fungi. Prevention of fungi can be done by using systemic fungicides. One type of fungicide is pyraclostrobin. Pyraclostrobin is a water-soluble, water-soluble emulsion fungicide, which acts as a trigger for growth and yield of plants (Efendi et al., 2014). Aside from being a fungicide, pyraclostrobin can be used as an additional nutrient for plants because pyraclostrobin also contains nitrogen (N) and chlorine (Cl) elements needed by plants. The nitrogen element in pyraclostrobin is thought to increase the availability of nitrogen in the soil (Xiang et al., 2005).

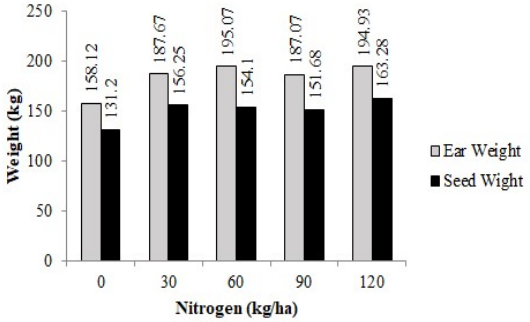

Figure 1. Effect nitrogen on ear weight and seed weight.

Pyraclostrobin is one type of fungicide that can provide tolerant effects on stress in the growth phase of plants such as hot or cold temperature, water and drought. According to Nason et al. (2007), One effect of pyraclostrobin for plants is to increase the tolerance of stress and increase the yield of crop production. Responses occurred in each treatment nitrogen and pyraclostrobin application showed that each treatment had a different response to input from the environment and plant nutrition. Nasir (2002) stated that maximum yields can be achieved if the superior cultivars receive a response to the optimum combination of water, fertilizer and other aquaculture practices. All these input combinations are important in achieving high productivity.

The application of pyraclostrobin 400 mL/ha did not affect the growth and yield of maize crops. These results are consistent with a study of Sanjaya et al. (2014) which showed that the different pyraclostrobin treatment did not significantly affect parameters of observation. Growth and yield of maize crops with pyraclostrobin application increase compared with no pyraclostrobin treatment. Restiana (2012) showed that the application of pyraclostrobin of 400 mL/ha had not markedly improved growth and yield of maize crop. Amin et al. (2013) stated that at the time of the use of pyraclostrobin is highly dependent on the addition of nitrogen fertilizer. This was confirmed by Khan et al. (2011) that the addition of the appropriate nitrogen on maize, mainly hybrid varieties could improve crop growth and yield parameters. Nitrogen application increased protein content yet reduced amylose content. Pyraclostrobin

application significantly increased the amylose content even in the high nitrogen application dosage. The amylose content at the treatments without giving pyraclostrobin (0 ml ha^{-1}) at various level of fertilizer nitrogen content was lower than that of pyraclostrobin of 400 mL/ha. This was in accordance with the research results of Restiana (2012), where application pyraclostrobin of 400 mL/ha tended to increase the amylose content. According to Salisbury and Ross (1995), starch is formed as a result of photosynthesis. The process of photosynthesis requires sunlight and chlorophyll if no sunlight is absorbed then photosynthesis will not occur and no starch will be formed. Amylum is present in many parts of the plant tissue, but the most is in food storage places such as in seeds in maize plants (Sing et al., 2005). The amylose content of maize is still relatively low; maize containing 50-70% amylose is included in the criteria of high ammonia maize or amylomize (Suarni et al., 2007).

Conclusion

The application of pyraclostrobin on maize, significantly increased the efficiency of nitrogen fertilization. The application of pyraclostrobin of 400 mL/ha increased grain amylose to 18.5%. Nitrogen fertilizer increased amylose and protein contents.

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