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# Impacts of various fertilizer combinations onto some agronomical traits of rice (*Oryza sativa* L.) grown employing hazton methods

Hanida Robbani<sup>1</sup>, Widyatmani Sih Dewi<sup>2</sup>, Haryuni Prasojo<sup>3</sup> and Supriyadi Darsowiyono<sup>2\*</sup>

<sup>1</sup>Department of Agrotechnology, Faculty of Agriculture, University of Sebelas Maret, Surakarta, Indonesia.

<sup>2</sup>Department of Soil Science, Faculty of Agriculture, University of Sebelas Maret, Surakarta, Indonesia.

<sup>3</sup>Department of Agrotechnology, Faculty of Agriculture, University of Tunas Pembangunan, Surakarta, Indonesia.

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Hazton cultivating methods is an engineered rice cultivation method using old seeds aged 25-30 days after seedling with 20-30 stems per planting hole. The old seeds have several advantages: their harvest period is faster, and their plant adapts easily and minimize the embroidery. The objective of this study was to determine the effect of various fertilizer combinations and *Jajar legowo* planting system on the growth and yields of rice on cultivating Hazton methods. This research was carried out on July-October 2017 located in rice field of Tunjung Semi Village, Sambungmacan Sub-district, Sragen Regency, Central Java, Indonesia. Randomized Complete Block Design (RCBD) was used for this research with two treatment factors namely Fertilization (P) which consists of P1 (N 179,34 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 149,94 kg.ha<sup>-1</sup>, K<sub>2</sub>O 132,3 kg.ha<sup>-1</sup>, S 29,4 kg.ha<sup>-1</sup>), P2 (N 115 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 27 kg.ha<sup>-1</sup>, K<sub>2</sub>O 30 kg.ha<sup>-1</sup>), P3 (N 103,5 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 9 kg.ha<sup>-1</sup>, K<sub>2</sub>O 18 kg.ha<sup>-1</sup>, Manure 2 ton.ha<sup>-1</sup>) and the Planting Method (H) consists of H1 (Hazton *Jajar legowo* 6:1) and H2 (Hazton Conventional). The inspected characteristics are plant height, number of tillers, content and uptake of N, P, K, spikelet fertility, grains moisture, weight of 1000 grains and rice production. The treatment P3 resulted the highest weight of 1000 grains. The treatment H1 resulted in higher rice production than the treatment H2.

**Key words:** Cultivation method, planting system, inorganic fertilizer, manure.

## INTRODUCTION

Rice (*Oryza sativa* L.) is an important crop in Indonesia because rice is the main staple food in the country (Widyastuti et al., 2015). Moreover, rice also has been the staple food of more than half of the world's population. Indonesian people consumes rice at

approximately 85,045 kg per capita per year in 2015 (CBS, 2017c). Indonesian's population density in 2015 was 134 people per km<sup>2</sup>. The number has increased from the previous year with 132 people per km<sup>2</sup> (CBS, 2017b). The increasing number of people causes the

\*Corresponding author. E-mail: [supriyadi\\_uns@yahoo.com](mailto:supriyadi_uns@yahoo.com). Tel: 08179488860.

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need for more production of rice. The conversion of industries in Indonesia reaches more than 110.000 ha per year. The less agricultural land area, the most realistic effort to increase rice production is by increasing the productivity of agricultural land.

Hazton cultivating technology is an engineered rice cultivation introduced in 2012 in West Kalimantan by Ir. Hazairin, M.S. Head of Department of Food Crops and Horticulture of West Kalimantan Province and Anton Komaruddin SP, M.Si. staff at the Office of Food Crops and Horticulture West Kalimantan Province. Hazton Technology is a planting technique which relies on using old seeds aged 25 to 30 days after seedling (DAS) with 20 to 30 stems per planting hole. Hazton Cultivating Methods can increase the production of Cibogo and Inpari rice variety in West Kalimantan Province (Wibowo et al., 2015).

Java province is the most crowded province in Indonesia. The conversion of agricultural land is increased every year. Hazton technology is expected to increasing the productivity of rice in Java, despite the agricultural land decreased. The test results of Hazton technology delivering diverse productivity ranged from 4 to 9 ton.ha<sup>-1</sup> in several regions (Wibowo et al., 2015). Hazton Cultivation Technology has several advantages namely the harvest period is faster, the plant is easy to adapt and not easy to stress, minimize the embroidery and high grain quality. However, Hazton Cultivation Technology also has some disadvantages that requires additional fertilization and being susceptible to disease disorders.

The number of seeds 20-30 stems per planting hole makes the plants to be more dense and lush. Lush plant conditions pave way for diseases. Higher plant density leads to competition for sunlight, nutrients, oxygen and water (Bozorgi et al., 2011). The lack of sunlight, nutrients, oxygen and water will be an obstacle in increasing rice yields. This can be overcome by changes in the management of affected resources such as nutrition, air, water, soil microorganism and solar energy (Ceasay et al., 2006). Balanced fertilization and *Jajar legowo* planting system in this study is expected to overcome the weaknesses of Hazton cultivation method.

*Jajar legowo* planting system is a planting system that uses one blank row between two rows of rice plant. The blank row given after two or more rows of rice plants. The blank row is a blank space without a plantation. The width of blank row is two times plant spacing. The aims of *Jajar legowo* planting pattern is to maximize the absorption of sunlight by plants. Easier absorption of sunlight and diffusion of CO<sub>2</sub> causes the process of photosynthesis to be more optimal (Lin et al., 2009). Moreover, the plants grown in optimum distances will grow better because there is less competition for nutrients and water (Sohel et al., 2009).

*Jajar legowo* system also play role in reducing pests and diseases because the land is relatively open. Relatively open land decreases humidity and resulted in

lack of diseases, and blank row in *Jajar legowo* facilitates the process of plant maintenance (Qibtiyah and Amiroh, 2015). Another advantage of *Jajar legowo* is that the blank row does not reduce the plant population and does not decrease the production. *Jajar legowo* planting system actually increases the plant population by 15 to 25% more than tile system population, as in *Jajar legowo* 2:1 dan 4:1 (Darmawan, 2016).

Balanced fertilization is a mixed fertilization of organic and inorganic fertilizers. The merger of organic and inorganic fertilizers aims to meet the nutritional needs of the plant (Ashur and Purwaningrum, 2015). Organic matter affects the physical, chemical and biological properties of the soil. Organic matter serves as a source of plant nutrients, providing food and energy for beneficial organism, improves soil structure, water holding capacity and prevents erosion (Sultana et al., 2015). In addition, the advantage of organic waste applications in agriculture is that organic waste can provide some nutrients for plants with little additional cost (Myint et al., 2010). Manure is kind of organic material that affects soil productivity. The paddy fields with manure added as crop nutrient source beside inorganic fertilizer had higher soil quality index (Supriyadi et al., 2017).

## MATERIALS AND METHODS

### Experimental Design

The experiment used Randomized Complete Block Design (RCBD) with two factors, that is Fertilization (P) and Planting Method (H). The fertilization treatment (P) consisting of:

P1: N 179,34 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 149,94 kg.ha<sup>-1</sup>, K<sub>2</sub>O 132,3 kg.ha<sup>-1</sup>, S 29,4 kg.ha<sup>-1</sup> (according to local farmer's habits)

P2: N 115 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 27 kg.ha<sup>-1</sup>, K<sub>2</sub>O 30 kg.ha<sup>-1</sup> (Indonesian Agricultural Ministry, 2007)

P3: N 103,5 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 9 kg.ha<sup>-1</sup>, K<sub>2</sub>O 18 kg.ha<sup>-1</sup>, Manure 2 ton.ha<sup>-1</sup> (balanced fertilization) (Indonesian Agricultural Ministry, 2007)

The planting method treatment (H) consisting of:

H1: Hazton *Jajar legowo* 6:1

H2: Hazton Conventional

From these two factors, 6 treatments combinations were collected, namely H1P1, H1P2, H1P3, H2P1, H2P2, H2P3. The treatments combinations replicated 4 times.

### Field work

The research was carried out from July to October 2017 located in rice field of Tunjung Semi Village, Sambungmacan Sub-district, Sragen Regency, Central Java, Indonesia. The geographical location of the research is 7°22'49.7" LS and 111°5'37.3" BT. The treatment plots size was 5 m × 3 m, and the number of plots is 24. The rice planted was IR64 variety with the plant spacing is 25 cm × 25 cm. The planting method treatment divided into two, H1 (Hazton *Jajar legowo* 6:1) and H2 (Hazton Conventional). The treatment H1 (Hazton *Jajar legowo* 6:1) is combination between Hazton method (old seeds aged 30 DAS with the number of seeds is 15 per planting hole) and *Jajar legowo* 6:1 (blank space given every after 6 rows of rice plant). The treatment H2 (Hazton Conventional) is only using Hazton method (old seeds aged 30 DAS with the number of

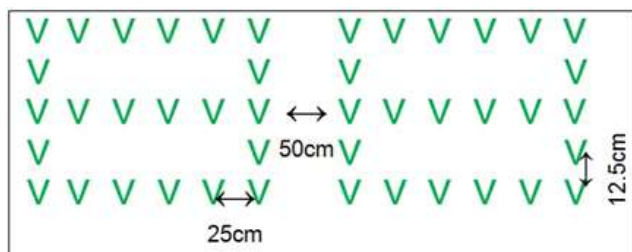


Figure 1. H1 (Hazton Jajar Legowo 6:1) plot's design.

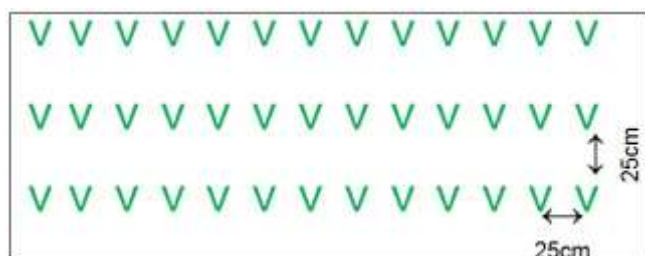


Figure 2. H2 (Hazton conventional) plot's design.

seeds is 15 per planting hole) without combination. Afterwards, the fertilization treatment (P) given in the two stages. The first fertilization was done 7 DAP and the second fertilization was done after 30 DAP. Manure is given at 2 weeks before planting (Figures 1 and 2).

### Soil and plant tissue analysis

The analysis of the soil and plant tissue was carried out in Chemistry and Soil Fertility Laboratory and Ecology Management and Plant Production Laboratory of Agriculture Faculty of Sebelas Maret University Surakarta, Indonesia. The soil analysis of the location of the research contains actual pH analysis ( $H_2O$ ), Cation Exchange Capacity (CEC), N-total, P-available, K-exchange, organic material and soil texture. The soil N-total was analyzed by *Kjeldahl* method, P-available by Olsen method, CEC and K-exchange using  $NH_4Oac$  1 M, pH 7.0 extract, C-organic by Walkey and Black method, and soil texture was analyzed using Hydrometer method. The scoring for each characteristics according to Eviati and Sulaeman (2009). Observation of plant tissue variables consisted of N, P, K content on crop tissue and N, P, K uptake. This analysis was performed when the plant was in the maximum vegetative phase. Content of N on crop tissue was analyzed by *Kjeldahl* method, content of P and content of K were analyzed using  $HNO_3$  and  $HClO_4$  extract (Eviati and Sulaeman, 2009).

### The observation of plant growth and yields

The observation of plant vegetative growth variables consisted of plant height, number of tillers, and number of productive tillers was measured at 15, 30, 45 and 85 DAP. The observation of rice yield variables consisted of the spikelet fertility % ( $SF = \frac{\sum \text{filled grains}}{\sum \text{grains per plot}} \times 100\%$ ), the weight of 1000 grains, the moisture % of grain ( $MG = \frac{\text{the weight of (wet grains-dry grains)}}{\text{the weight of wet grains}} \times 100\%$ ), the grains production per plot and the grains production per

hectare was measured after harvest.

### Statistical analysis

SPSS 22.0 statistical package was used to analyzed the data. Data were analyzed by variance analysis using F-test at 5% level. If there is a significant effect then continued comparison analysis using *Duncan Multiple Range Test* (DMRT) at 5% level. The relationship between observed variables was analyzed by *Pearson's* correlation test.

## RESULTS AND DISCUSSION

### Sites characteristic

The soil texture at the research location was clay with composition of sand 3.46%, dust 10.38% and clay 86.15%. The value of Cation Exchange Capacity (CEC) of soil is  $37.50 \text{ cmol}(+)\cdot\text{kg}^{-1}$  classified as high. The value of soil pH is 6,27 classified as a bit acid. Organic material in the research location is 1.35% classified as low. Content of soil N-total (0.42%) is medium. Content of soil P-available (6,84 ppm) is low and content of soil K-exchange which was  $0.25 \text{ cmol}(+)\cdot\text{kg}^{-1}$  is also classified as low (Table 1). The relatively low nutrient condition at the research location requires fertilizer to support the growth and development of rice crops. Plants require  $5 \text{ kg}\cdot\text{ha}^{-1}$  N,  $19 \text{ kg}\cdot\text{ha}^{-1}$  P and  $112 \text{ kg}\cdot\text{ha}^{-1}$  K to produce an average of 6 tons $\cdot\text{ha}^{-1}$  rice (Dobermann and Fairhurst, 2000). Organic material in the research location is low, it also requires organic substance to support the soil. C-organic has influences to the soil quality because C-organic showed a significant correlation to all of physical soil properties (Supriyadi et al., 2014).

### The vegetative growth

The result of variance analysis using F-test level 5% showed that the fertilization treatment had a very significant effect on the plant height and the number of tillers. The planting method treatment had a very significant effect on the plant height, but had no significant effect on the number of tillers. The interaction between fertilization treatment and planting method had no significant effect on the plant height and the number of tillers.

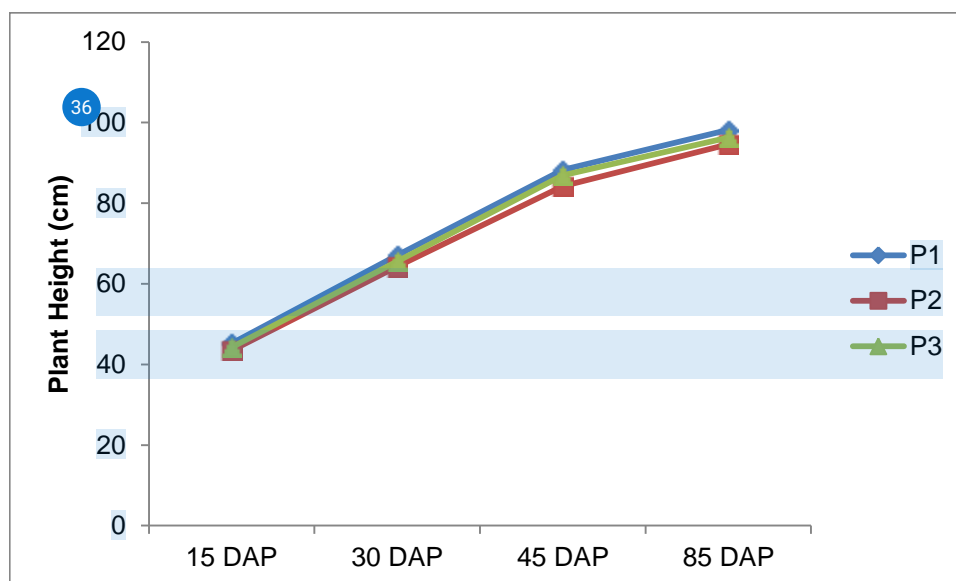
In general, the best plant growth was recorded in the treatment P1 ( $N 179.34 \text{ kg}\cdot\text{ha}^{-1}$ ,  $P_2O_5 149.94 \text{ kg}\cdot\text{ha}^{-1}$ ,  $K_2O 132.3 \text{ kg}\cdot\text{ha}^{-1}$ ,  $S 29.4 \text{ kg}\cdot\text{ha}^{-1}$ ). The second best plant growth was recorded in the treatment P3 ( $N 107.5 \text{ kg}\cdot\text{ha}^{-1}$ ,  $P_2O_5 9 \text{ kg}\cdot\text{ha}^{-1}$ ,  $K_2O 18 \text{ kg}\cdot\text{ha}^{-1}$ , Manure 2 ton $\cdot\text{ha}^{-1}$ ) (Figure 3). The result of the plant height in the treatment P1 is 98.18 cm, but the number of tillers on the treatment P1 shows no significant different with the treatment P3. The number of tillers on the treatment P1 is 20.27 while the treatment P3 is 20.91 (Table 2).

**Table 1.** Results of soil analysis of the research location.

S/N	Soil Characteristics	Results	Unit	Level
1.	pH H <sub>2</sub> O	6.27	-	A bit acid*
2.	CEC	37.50	cmol(+).kg <sup>-1</sup>	High*
3.	N-Total	0.42	%	Medium*
4.	P-Available	6.84	ppm	Low*
5.	K-Exchange	0.25	cmol(+).kg <sup>-1</sup>	Low*
6.	Organic Material	1.35	%	Low*
7.	Soil Texture			Clay*
	Sand	3.46	%	
	Dust	10.38	%	
	Clay	86.15	%	

Source: Analysis results of Soil Chemistry and Fertility Laboratory of Agriculture Faculty, Sebelas Maret University, Surakarta, 2017.

Note: \*Level according to (Eviati and Sulaeman, 2009).

**Figure 3.** The effect of fertilizer treatment to the plant height.**Table 2.** The effect of fertilization treatment and planting method to the plant height and the number of tillers.

Treatment	Plant height (cm)	Number of tillers at 45 DAP	Number of productive tillers
<b>Fertilization</b>			
P1	98.18 <sup>a</sup>	20.27 <sup>a</sup>	19.64 <sup>a</sup>
P2	94.60 <sup>c</sup>	17.91 <sup>b</sup>	17.53 <sup>b</sup>
P3	96.30 <sup>b</sup>	20.91 <sup>a</sup>	20.61 <sup>a</sup>
<b>Planting method</b>			
H1	95.20 <sup>b</sup>	19.50	19.14
H2	97.52 <sup>a</sup>	19.89	19.39

Note: The numbers followed by the same letters show difference no significant in the Duncan test level 5%.



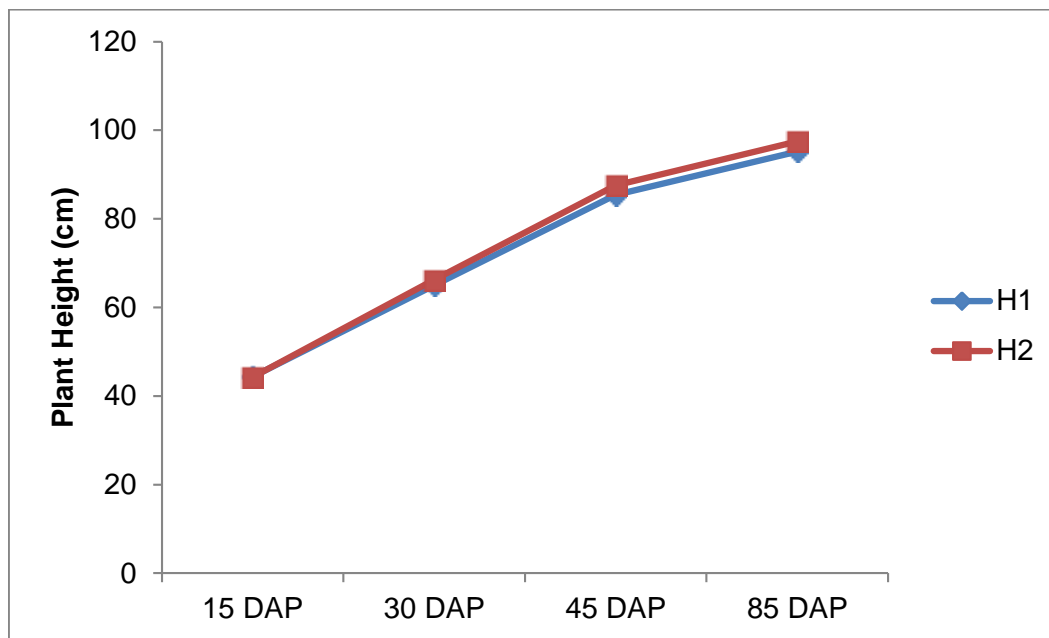


Figure 4. The effect of planting method treatment to the plant height.

The treatment P1 had highest dose of inorganic fertilizer, it affected the plant height. The treatment P3 still had lower plant height than the treatment P1. Nevertheless, the treatment P3 can increase the number of tillers comparable to the treatment P1. According to the previous study by Santosa and Suryanto (2015) about rice growth using inorganic and manure fertilizer resulted that the application of inorganic fertilizer ( $100 \text{ kg} \cdot \text{ha}^{-1} \text{ N}$ ,  $50 \text{ kg} \cdot \text{ha}^{-1} \text{ P}_2\text{O}_5$ ,  $70 \text{ kg} \cdot \text{ha}^{-1} \text{ K}_2\text{O}$ ) is increasing the growth of the plant more than by using  $10 \text{ ton} \cdot \text{ha}^{-1}$  manure. The other study by Sudarsono et al. (2014) resulted that the application of  $10 \text{ ton} \cdot \text{ha}^{-1}$  cow manure increased number of tillers, compared with no manure. The combination of manure and inorganic fertilizer can provide complete macro nutrients (N, P, K, Ca, Mg, S) and micro nutrients in equal quantities for the growth and development of plant.

The plant growth on the treatment H2 (Hazton Conventional) shows better result than the treatment H1 (Hazton *Jajar legowo* 6:1) (Figure 4). The plant height on the treatment H2 is 97.52 cm while the plant height on the treatment H1 is 95.20 cm (Table 2). The planting method on treatment H1 (Hazton *Jajar legowo* 6:1) give blank space between plant rows, but the plant population inside the rows will increase. The increased population in *Jajar legowo* 6:1 is 14.29% from the conventional system. Increasing plant density had an effect on the plant growth. The rate of photosynthesis is strongly influenced by the spread of sunlight in the plant canopy, and the presence of shade leaves will reduce the rate of photosynthesis. The lower plant density resulted the better plant growth (Asmamaw, 2017).

#### The content of N, P, K on crop tissue and N, P, K uptake

The result of variance analysis using F-test level 5% showed that the fertilization treatment had a significant effect on the content of P on crop tissue and had a very significant effect on the content of N and the content of K. The fertilization treatment also had a very significant effect on the uptake of N, P and K per plant. The planting method treatment had no significant effect on the content of N, P, K on crop tissue and the uptake of N, P, K. The interaction between fertilization and planting method treatment also had no significant effect on content of N, P, K on crop tissue and N, P, K uptake.

The highest content of N and K on crop tissue was recorded in the treatment P1 ( $\text{N } 179.34 \text{ kg} \cdot \text{ha}^{-1}$ ,  $\text{P}_2\text{O}_5$   $149.94 \text{ kg} \cdot \text{ha}^{-1}$ ,  $\text{K}_2\text{O}$   $132.3 \text{ kg} \cdot \text{ha}^{-1}$ ,  $\text{S } 29.4 \text{ kg} \cdot \text{ha}^{-1}$ ). The highest N and K uptake also recorded in the treatment P1. However, the content of P on crop tissue in the treatment P1 had no significant difference to the treatment P3 ( $\text{N } 103.5 \text{ kg} \cdot \text{ha}^{-1}$ ,  $\text{P}_2\text{O}_5$   $9 \text{ kg} \cdot \text{ha}^{-1}$ ,  $\text{K}_2\text{O}$   $18 \text{ kg} \cdot \text{ha}^{-1}$ , Manure  $2 \text{ ton} \cdot \text{ha}^{-1}$ ), and so is the uptake of P (Table 3). The single inorganic fertilizer had highest single primary nutrient, above all the treatment P1 had highest dosage of N,  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$ . The dosage of inorganic fertilizer affected the nutrient uptake. The inorganic fertilization itself caused the highest nutrient uptake by rice plant on the maximum vegetative phase, compared to the organic fertilization (Azizah et al., 2013). The opposite result showed in the research by Jeon (2012), increasing level of N application had no effect on the N uptake of plant. Despite of that, the treatment P3

**Table 3.** The effect of fertilization treatment to the content of N, P, K on crop tissue and the uptake of N, P, K.

Fertilization Treatment	Content			Nutrient uptake (g per plant)		
	N (%)	P (%)	K (%)	N	P	K
P1	3.01 <sup>a</sup>	0.43 <sup>a</sup>	1.83 <sup>a</sup>	1.09 <sup>a</sup>	0.16 <sup>a</sup>	0.67 <sup>a</sup>
P2	2.25 <sup>b</sup>	0.39 <sup>b</sup>	1.47 <sup>b</sup>	0.80 <sup>c</sup>	0.14 <sup>b</sup>	0.52 <sup>b</sup>
P3	2.41 <sup>b</sup>	0.42 <sup>ab</sup>	1.48 <sup>b</sup>	0.91 <sup>b</sup>	0.16 <sup>a</sup>	0.56 <sup>b</sup>

Note: The numbers followed by the same letters show difference no significant in the Duncan test level 5%.

**Table 4.** The effect of fertilization treatment to the rice yields component.

Fertilization treatment	Spikelet fertility (%)	Moisture of grain (%)	Weight of 1000 grains (g)
P1	85.62 <sup>b</sup>	24.37 <sup>a</sup>	35.53 <sup>b</sup>
P2	87.01 <sup>a</sup>	25.08 <sup>b</sup>	35.47 <sup>b</sup>
P3	88.95 <sup>a</sup>	25.06 <sup>a</sup>	35.67 <sup>a</sup>

Note: The numbers followed by the same letters show difference no significant in the Duncan test level 5%.

can increase the uptake of P. The treatment P3 contains manure that affects soil productivity. Kasim et al. (2011) stated that the organic substances could enhance the nutrient uptake of plant. Organic material can increase the availability of P from mineral. The phosphorus elements in the soil can also be found in the form of Al-P, Fe-P and Ca-P. The decomposition products from manure such as humic acids is able to suppress the fixation of P so as to decrease the Al-P and Fe-P form, and increase the available-P levels (Zhang et al., 2009).

### The rice yields component

The result of variance analysis using F-test level 5% showed that the fertilization treatment had a very significant effect on the spikelet fertility (%), the moisture of grain (%) and the weight of 1000 grains. The planting method treatment had no significant effect on the spikelet fertility (%), the moisture of grain (%) and the weight of 1000 grains. The interaction between fertilization and planting method treatment also had no significant effect on the spikelet fertility (%), the moisture of grain (%) and the weight of 1000 grains.

The treatment P3 (N 103.5 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 9 kg.ha<sup>-1</sup>, K<sub>2</sub>O 18 kg.ha<sup>-1</sup>, Manure 2 ton.ha<sup>-1</sup>) showed the highest result in the weight of 1000 grains. The spikelet fertility (%) in the treatment P3 had no significant different to the treatment P2 and the moisture of grain (%) in the treatment P3 had no significant different to treatment P1 (Table 4). The weight of grain depends on the dry matter accumulation in grains. Dry matter accumulation depends on the processes of carbon and nitrogen assimilation pre-anthesis and translocation post-anthesis (Tang et al., 2009). If the process goes well then the filled grains will take the maximum place. The carbon and nitrogen assimilation affected by the availability of nutrients during

reproductive phase. Pan et al. (2009) stated that the mix of inorganic and organic can increase the efficiency of fertilization. Manure can increase the cations holding capacity which is affected the nutrient availability. The higher the cations holding capacity the lower nutrient leaching occurred. There is a positive connection between organic material given with the availability of plant nutrients (Ming et al., 2011).

The result of variance analysis using F-test level 5% showed that the treatment fertilization had a very significant effect on the production of grains per plot and the production of grains per hectare. The planting method treatment also had a very significant effect on the production of grains per plot and the production of grains per hectare. While, the interaction between fertilization and planting method treatment had no significant effect on the production of grains per plot and the production of grains per hectare.

The production of grains per plot on treatment P1 (N 179.7 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 149.94 kg.ha<sup>-1</sup>, K<sub>2</sub>O 132.3 kg.ha<sup>-1</sup>, S 29.4 kg.ha<sup>-1</sup>) was not significantly different with the treatment P3 (N 103.5 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 9 kg.ha<sup>-1</sup>, K<sub>2</sub>O 18 kg.ha<sup>-1</sup>, Manure 2 ton.ha<sup>-1</sup>). The production on the treatment plot P1 was 16.16 kg while treatment plot P3 was 16.63 kg. The treatment P1 and P3 also had no significant difference to the production of grains per hectare, the treatment P1 produce 9.79 ton.ha<sup>-1</sup> while treatment P3 produce 10.08 ton.ha<sup>-1</sup>. The lower grains production was the treatment plot P2 (N 115 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 27 kg.ha<sup>-1</sup>, K<sub>2</sub>O 30 kg.ha<sup>-1</sup>). The production of grains on treatment plot P2 was 14.95 kg, while the production per hectare was 9.06 ton.ha<sup>-1</sup> (Table 5).

The production of grains on the treatment plot H1 (Hazton Method *Jajar legowo* 6:1) is higher than the treatment plot H2 (Hazton Conventional). The treatment H1 produced grains 16.48 kg per plot, while per hectare produce 9.99 ton.ha<sup>-1</sup> (Table 5). Plant population on the

**Table 5.** The effect of fertilization treatment dan planting method to the production of grains.

Treatment	Grains production	
	kg per plot	ton.ha <sup>-1</sup>
<b>Fertilization</b>		
P1	16.16 <sup>a</sup>	9.79 <sup>a</sup>
P2	14.95 <sup>b</sup>	9.06 <sup>b</sup>
P3	16.63 <sup>a</sup>	10.08 <sup>a</sup>
<b>Planting method</b>		
H1	16.48 <sup>a</sup>	9.99 <sup>a</sup>
H2	15.34 <sup>b</sup>	9.30 <sup>b</sup>

Note: The numbers followed by the same letters show difference no significant in the Duncan test level 5%.

**Table 6.** The correlation of N,P,K content and N,P,K uptake to vegetative growth and rice yields component.

	PH	NT	NPT	N	P	K	NU	PU	KU	SF	MG	1000G
PH	1	0.53**	0.30	0.45*	0.21	0.46*	0.48*	0.23	0.53**	-0.03	0.40	0.31
NT		1	0.96**	0.37	0.44*	0.18	0.46*	0.51*	0.31	0.04	0.63**	0.46*
NPT			1	0.28	0.42*	0.08	0.37	0.49*	0.20	0.18	0.54**	0.47*
N				1	0.46*	0.72**	0.98**	0.44*	0.73**	-0.40	0.21	0.02
P					1	0.256	0.53**	0.94**	0.35	-0.15	0.10	0.09
K						1	0.67**	0.20	0.98**	-0.35	0.24	0.01
NU							1	0.55**	0.72**	-0.29	0.29	0.15
PU								1	0.34	-0.04	0.17	0.27
KU									1	-0.25	0.32	0.15
SF										1	0.19	0.22
MG											1	0.52**
1000G												1

Note: \*\*= correlated very real, \*= correlated real. N = Content of N, P = Content of P, K = Content of K, NU= N Uptake, PU = P Uptake, KU = K Uptake, PH = Plant Height, NT = Number of Tillers, NPT = Number of Productive Tillers, N = Content of N, P = Content of P, K = Content of K, NU= N Uptake, PU = P Uptake, KU = K Uptake, SF= Spikelet Fertility (%), MG= Moisture of Grain (%), 1000G= Weight of 1000 Grains

treatment H1 is heigher than the treatment H2, this cause the grains production per plot higher than the treatment H1, and the production per hectare will also be higher. Increasing plant density significantly decreased the number of panicles per hill but significantly increased the number of panicles per m<sup>2</sup> (Matsumoto et al., 2017).

The plant height positively correlated with the content and the uptake of N and K. The number of productive tillers positively correlated with the content and the uptake of P (Table 6). Positive correlations indicate that as the size or height of a trait increases, it will always be followed by an increase in the magnitude or height of the other. The higher the contents of N and K on crop tissue, the higher the plant height. The higher the contents of P on crop tissue, the higher the number of productive tillers. The nutrient content and uptake by plant determines the vegetative growth. N, P and K nutrient elements are the primary nutrients needed by plants in relatively large quantities compared to other elements (Marlina et al.,

2014). Similiary with the study by Hwang et al. (2012), at the moment that content of P on stem increased significantly under high N-P fertilization treatment, the number of tillers also increased. Futhermore, plant's vegetative growth determines the component of yields of rice. Maximum growth will produce maximum plant products as well. The number of tillers positively correlated with the moisture of grain and the weight of 1000 grains (Table 6).

## Conclusions

High dosage of inorganic fertilizer (N 179.34 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 149.94 kg.ha<sup>-1</sup>, K<sub>2</sub>O 132.3 kg.ha<sup>-1</sup>, S 29.4 kg.ha<sup>-1</sup>) resulted in best plant height and content of N and K on crop tissue. Balanced fertilization (N 103.5 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 9 kg.ha<sup>-1</sup>, K<sub>2</sub>O 18 kg.ha<sup>-1</sup>, Manure 2 ton.ha<sup>-1</sup>) resulted in highest weight of 1000 grains and can replace the use of



high dosage inorganic fertilizer (N 179.34 kg.ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> 149.94 kg.ha<sup>-1</sup>, K<sub>2</sub>O 132.3 kg.ha<sup>-1</sup>, S 29.4 kg.ha<sup>-1</sup>) on the number of tillers and the grains production. Hazton Jajar Hazton Conventional.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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