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Response of *Zea Mays* L to Tillage and Urea Fertilizer

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ABSTRACT: The purpose of cultivation intensity and using kind Urea mature as an activity in corn culture creates the best environmental to plant growth and yield. The experiment was conducted in Sempaja village-Samarinda district. Randomized Split-Plot Design analysis in Randomized Block Design was used with 2 treatments and 3 replications. The treatments consist of two method of tillage (no tillage and conventional tillage) and two kind of urea mature (without Urea, Prill Urea and Briket Urea). The result showed that combination with conventional tillage method and briket urea give significantly effect on plant growth, yield components, and yield of corn.

KEY WORDS: Corn, Tillage, urea, yield

INTRODUCTION

Corn is a food crop commodity that has a strategic value second only to rice for the Indonesian economy, being a vital part of the program to create resilient agricultural development balanced with improved farmer welfare. It is expected to support the growth and development of the industrial sector.

Corn production in East Kalimantan Province averages 2.1 tons per hectare which is much lower than the national production of 3.2 tons per hectare (Anonymous, 2003). This is due to the fact that agricultural soils in East Kalimantan province generally have unfavorable physical and chemical properties. There are various constraints on the chemical and physical properties of the soil, especially soil fertility and tillage properties. Most agricultural land in East Kalimantan has a shallow solum, with a very thin top soil layer. This condition makes it very easy for these lands to degrade and decline in fertility.

Tillage treatments have an important effect on soil microstructure characteristics, water thermal properties and nutrients, but little is known in the newly reclaimed cultivated land. For the reason, a long-term field study was to evaluate the tillage effects on soil physicochemical properties and crop yield in newly reclaimed cultivated land via the macroscopic and microscopic analysis. Tillage treatment is a traditional soil improvement method, which can significantly regulate the dynamic balance of water, fertilizer, gas and heat in the soil.

Nitrogen (N) is a major nutrient for corn (*Zea mays* L.) production and the suitable time of N applied could increase corn yield, but the variation of the yield is tightly associated with the N rate and external environment (Chen et al., 2015; Banger et al., 2018). The continuous cultivation of crops and the adverse environmental factors make the arable soil deficient in nitrogen (N) along with other plant nutrients. For this reason, various efforts have been made to increase corn production, including through the use of fertilizers and tillage.

This study aims to determine the effect of different tillage intensities and the use of 2 types of urea fertilizer on the growth and production of Corn (Zea mays L) Hybrid C-1.

MATERIALS AND METHODS

The research used a Randomized Group Design in the form of a Separate Plots Design with 3 (three) replications. The treatment consisted of 2 factors, namely:

1. Tillage Factor (P) as the main plot was given in 2 forms, namely
   a. No Tillage (p1)
   b. Conventional tillage (p2)
2. Urea Fertilizer Type Factor (N) as a subplot is given in 5 levels, namely:
   a. Without Urea Fertilizer (u0)

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b. Urea prill fertilizer at a dose of 100 kg/hectare
c. Urea prill fertilizer at a dose of 200 kg/hectare
d. Urea briquette fertilizer at a dose of 100 kg/hectare
e. Urea briquette fertilizer at a dose of 200 kg/hectare

Treatment of tillage was carried out using simple equipment, no tillage (P1) and conventional tillage (P2) 1 week apart. TSP and KCI fertilizers as base fertilizers at the recommended dose. Urea Prill fertilizer was applied twice (⅓ part at the age of 1 mst and ⅔ part at the age of 6 wap), while Urea Briquette fertilizer was applied at the same time when corn had grown (1mst). Planting was done using tugal, 3 seeds per hole with a spacing of 70 cm x 30 cm. Pest management was carried out with Furadan 3G (at planting), Thiodan and Dithane M45 at the recommended dose and time of application.

Data observed consisted of plant height, cob length, number of seed rows/cob, weight of 100 dry kernels and dry kernel production.

RESULT AND DISCUSSION

Corn has high productivity, but it is very sensitive to the agroecological and agrotechnical conditions. Good tillage ensures the creation of an optimal soil structure, as well as to obtain a balance between water, aeration and soil moisture in the soil. Because the main purpose of tillage is to form and maintain stable soil aggregates while improving soil physical properties. This condition allows the circulation and utilization of nutrients in the soil. (Blanco & Ruis, 2018: Bottinelli, N. *et al* 2017).

However, intensive tillage and high chemical input have been widely used in rotation systems, for high production. Frequent conventional tillage disturbs soil aggregate stability, thereby increasing soil organic matter degradation (Rong et al., 2017). Moreover, crop straw burning or removal, reduces the amount of organic substances in the soil, decreases soil fertility and productivity. It also affects the structural stability of the soil and the absorption of nutrients by crops, and finally affects crop yield (Kristo *et al*, 2013). Deep tillage resulted in taller plants, which may be attributed to improved root growth, better aeration, and more water content, as well as the exploration of a larger volume of soil for nutrients. These findings corroborate those of Shahzad et al., (2015), who found that deep tillage resulted in the highest plant height, stem diameter, cob diameter, cob length, and number of grain rows per cob

Many different fertilization measures had been used to improve soil quality of newly reclaimed cultivated land, and research results showed that organic fertilizer application with chemical fertilizer was the best choice for soil improvement. Fertilizer have been adopted to restore the soil nutrient status of newly reclaimed cultivated land, which concluded that mineral addition had a positive impact on soil water thermal properties, soil nutrients and crop yield. All these factors will affect the ability of the plants to establish good vigor and at the same time ensure high crop production.

At the 45th day of age, differences in plant height were strongly influenced by the intensity of tillage and the application of urea briquette fertilizer (see Table 1). Dryland tillage only once (p1) provides land conditions that are large chunks, hard and dry quickly because of the dominant clay fraction. This condition initially inhibits growth, while intensive tillage provides less dense soil conditions that benefit the absorption of various nutrients needed by plants.

Table 1. Recapitulation of Corn *(Zea Mays L.)* Response to Tillage Intensity and Urea Fertilizer Type

Treatment	Crop height (45 days)	Length of cob (cm)	Lines/cob	Weight of 100 seed (gram)	Production (tons/Ha)
p1n0	195.9 e	16.9 f	17.9 f	21.8 I	2.8 f
p1n1	198.9 d	18.5 e	19.0 f	22.8 h	3.5 e
p1n2	203.7 b	19.8 b	20.0 e	24.9 f	3.7 e
p1n3	199.0 d	19.8 b	22.8 d	24.5 e	4.2 d
p1n4	203.9 b	20.1 ab	25.2 b	25.6 c	4.9 b
p2n0	200.2 c	19.0 d	18.3 g	22.2 I	2.9 f
p2n1	206.2 a	19.3 c	19.2 f	23.5 g	3.6 e
p2n2	206.5 a	20.3 ab	20.3 e	25.0 d	4.3 d
p2n3	206.6 a	20.7 a	23.0 c	26.0 b	4.6 c
p2n4	206.9 a	20.7 a	27.1 a	27.4 a	5.1 a

Description: Significant T-test 5%

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The application of prill urea was beneficial at the beginning of growth, although overall the corn plants that received urea briquettes showed better plant height. This is largely due to the fact that urea briquettes are able to provide nutrients continuously. It is in accordance with the results of research by Kristo et al (2013) and Nagy *et al* (2000) that the amount of photosynthate that will be used by plants for growth and the formation of generative components will be determined by the availability of nutrients. Sufficient and continuous availability of nitrogen nutrients, as a characteristic of urea briquettes, will increase the quality of plant vigor and at the same time plant production.

Yield Component's

The differences in tillage intensity and the application of urea fertilizer types and doses gave significantly different effects on the dimensions of length and cob diameter as well as the number of rows of seeds/cob. Table 1 shows that on dry land, perfect tillage is required, and although there is no significant effect, the application of prill urea fertilizer has actually increased the number of rows of seeds/cob. In contrast, the application of urea briquettes with perfect tillage (p2n4) showed the best results and significantly different.

Tillage intensity significantly affects the weight of 100 dry kernels (gram) and dry kernel production (gram). This is in accordance with Sutoro (1988) and Shahid et al (2016) that on heavy textured soils intensive tillage will have a beneficial impact on increasing the growth and yield of corn. This condition will be evident during periods of reduced rainfall.

Under dry conditions the final yield of corn was significantly affected by the soil tillage system (Kristo et al., 2013; Memon et al., 2012). Soil tillage systems had different effects on the preservation of the soil moisture contents, which significantly affected corn yield (Simic et al. 2009) Under extremely dry conditions the final yield of corn was significantly affected by the soil tillage system (Kristo et al., 2013; Memon et al., 2012). Soil tillage systems had different effects on the preservation of the soil moisture contents, which significantly affected corn yield (Simic et al. 2009)

The application of a combination of tillage intensity with briquetted urea fertilizer at the p2n4 level overall showed the best results.. A positive interaction between tillage and fertilisation was observed, with higher yield variation (CV=40.07) in the non-fertilised (N0) tillage plots, compared to those which received the Urea 100 and 160 kg ha-^{1} treatments (CV=22.42). Similar observations were made by Iqbal, et al., (2013) who postulated that effects of tillage depth as well as the number of interventions are reduced or compensated for by fertilization.

Intensive tillage on heavy textured soils will accelerate the loss of excess water, and at the same time will improve soil aeration. Overall, these conditions will have a favorable impact on the development of the plant root system. Generally, P1 and straw returning can increase soil macro-aggregation, improve soil structural status, promote soil C storage, and enhance soil microbial abundance and diversity (Wang et al., 2017). While most previous studies have shown that P1 and straw returning practice result in changes in the physical, chemical and biological properties of soil.

An addition, it has been reported that P1 practice and straw returning are key factors that control the processes of soil aggregation (Kumari et al., 2011; Kristo et al 2013), and the degree of soil aggregation generally affects the turnover rates and stability of soil organic (Yu *et al*., 2012). The different soil aggregate fractions provide spatially heterogeneous conditions for microbes, including differences in soil organic composition, oxygen concentration and water potential, and these conditions can change the soil microbial community compositions (Garcia-Franco *et al*., 2015). Our findings contradict those of Wasaya *et al*., (2017) and Shahid *et al*., (2015), who claimed that deep tillage and fertilizer application had an effect on grain yield. In terms of fertilizer, it resulted in a large rise in the 1000-grain weight of corn.

Tillage is central to the agrotechnical factors which modifies soil structure by changing its physical properties, such as soil moisture content, bulk density and penetration resistance. These changes in soil physical properties, as a result of different tillage practices, influenced seedling emergence, plant population density, root distribution and crop yield (Iqbal, et al., 2013; Rashidi and Keshavarzpour, 2007).

According to Nagy (1996) & Fenyves (1997) the depth and method of tillage do not significantly influence the yield of corn on well structured soil. It can be inferred based on the results of our tillage treatments, that soil at the experimental site possess good attributes and may not be the ideal location to evaluate the effectiveness of various tillage treatments.

CONCLUSION

Perfect tillage and application of urea briquette fertilizer 4 grains per plant showed a significant effect on corn plant growth and gave the highest dry shelled yield (5.8 tons/hectare).

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