MAPPING OF NPK IN SOIL FOR PRECISION AGRICULTURE APPLICATION ON RICE PLANT

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ABSTRACT

Nutrients available in the soil of rice fields are not always uniform. The study aims to determine the variability of Nitrogen, Phosphorus and Potassium (NPK) contain in the soil. Research was conducted in Wotan, Bener, Sragen regency. Determination of NPK was done using a modified device of soil test. A paddy field was set up into 50 plots measuring 10 x 6 m2, and soil samples were taken from each plot. The NPK test results were mapped. Map of NPK distribution status of rice field show that the availability of NPK in the soil were uniform. N level was low, P and K levels were high in the soil. Urea fertilizer recommendations were required at low N plot was 300 kg N / ha. SP-36 fertilizer recommendation for high P plot was 75 kg / ha. Plant height, number of leaves, number of tillers per hill, dry weight of plant per hill in applying NPK compound fertilizer in farmer dose with VRA was significantly higher than application of URA. Recommendations of KCl for high K plot was 75 kg / ha.

KEYWORDS: Mapping, Soil Nutrient, Nitrogen, Phosporus, Potasium

INTRODUCTION

The productivity levelling off as well as the more expensive of fertilizer price are an encouragement to further increase of farming systems efficiency mainly fertilizer efficiency in paddy rice as the largest fertilizer consumers. Therefore, the determination of the appropriate dose of fertilizer is very important. Efficient use of fertilizers will be a significant role in increasing farmers' income, sustainability of production systems, saving energy resources and sustainability of environment. Productivity can be sustained by using organic fertilizer. Soil environment will be improved by adding organic fertilizer more than inorganic ones.

On conventional agriculture, all part of land get uniform fertilization treatment. The constant rate of application is often based on measurements of properties of composite soil samples were collected to represent the average characteristics of the whole land. With such treatment, the possibility that could happen is the excessive application or an application is lacking. The application of precision agriculture technology, agricultural input arrangement can be made for specific needs at each point in the field (Virgawati, 2010).

The provision of a uniform dose of fertilizer in rice is still practiced until now in the village of Wotan, Bener, Sragen regency. Head of Agriculture Station of Sragen informs that in the average farmer uses 600 kg of urea, 300 kg SP-36 and 150 kg of KCl per hectare (Padmini, 2010). The use of chemical fertilizer is given three times and lasted when the plant was three weeks after transplanting. Rice is in the early tillering stage. This method is considered less efficient, because basically the nutrients available in the rice fields are not always uniform. So that fertilizer demand will also vary, according to dose, time or place.

More detailed information about the paddy soil nutrient status is needed by mapping the nutrient content of the soil prior to planting. This mapping was a preliminary study with the aims to determine the variability of Nitrogen, Phosphorus and Potassium (NPK) contain in the soil of rice field. The information can be used to estimate the more accurate dose of fertilizer that will be provided in the specific growing season. Further research is expected to prove that the doses of fertilizer which are applied according to the recommendations of the mapping in the growing season are more efficient.

"Gledur" is a tool for inorganic fertilizers application, and unable for organic fertilizer application. By using "Gledur", fertilizer can be put near the roots of rice with a certain dose efficiently so as to stimulate the growth of paddy. In other words plants grow optimally and having a high resistance to pests and diseases, reducing the consumption of pesticides and their dangerous residues. "Gledur" also designed for weeding, so weeding activity can be done simultaneously with fertilizer application. It can reduce the cost for weeding and herbicides.

RESEARCH METHODS

Research was conducted in split plot randomized completely block design with three replicates. Main plot was fertilizer application: 1) Uniform Rate Application; 2) Variable Rate Application. Sub plot was fertilizers dose: 1) NPK compound fertilizer as farmers dose; 2) two tons of organic manure + NPK 50% of farmers dose; 3) two tons of organic manure + 200 kg/ha Urea; 4) two tons of organic manure + 200 kg/ha Urea.

Determination of NPK nutrients available in the soil was conducted by using a paddy soil test device (PUTS) developed by the Soil Research Institute (2005). PUTS extracted soil nutrients (N, P, K) which were in the soil solution. Measurements were made with a staining method (colorimetric) and the measurement results were qualitative, classified into class Low, Medium, and High (Soil Research Institute, 2005).

According to the guide book of PUTS, soil sampling conducted in a single composite of 5-8 samples represented to 3-5 ha of paddy fields that were more or less uniform. In this study soil samples were taken and tested singly represent a narrow unit area by dividing the area of 3000 m2 paddy field into 50 plots. Each plot was 10 x 6 m. Soil samples were taken from each plot prior rice planting. Plots locations were depicted on a map of the scale 1: 500. NPK soil test results in each plot were included in the map so the nutrient status will be displayed. This map is then used as a reference in estimating the needs of NPK fertilizer on any plots as recommended by Soil Research Institute.

The data was subjected to an analysis of variance and Duncan's Multiple Range Test (α:5%)

RESULTS AND DISCUSSION

NPK soil mapping results are presented in Figures 1, 2 and 3. It shows that in a paddy field, NPK content in the soil is uniform. By using NPK distribution maps, it can be determined that NPK availability status in the soil is uniform. N level was low, P and K levels were high in the soil. Rice fields with high N, P and K content were expressed as fertile rice fields so that the effort to preserve the productivity of the land are easier than paddy fields with low nutrients status. Specifically benefit is the provision of fertilizer

recommendation of N, P, and K for paddy can be more precise and efficient in order to obtain fertilizer savings (Subiakta, 2005).

Recommendations given by Plant Research Institution are for rice equivalent to IR-64 varieties or have the potential outcome of 5-7 t grain/ ha for clay or sandy soil (The Soil Research Institute, 2005). Rice in the area of research using Mekongga varieties have the potential outcome of 6 t grain / ha in clay soil, so according to Plant Research Institution fertilizer recommendations given for each plot in the area of research are as presented in Table 1. The manner and time of fertilization is shown in Table 2.

Nitrogen (N) in the soil has a dynamic nature and easily lost, washed by the water. To improve the efficiency of its use, N fertilizer in the form of urea or ZA should be given 2-3 times for one growing season, as well as the adequacy level is monitored by the Leaf Color Chart (LCC) (The Soil Research Institute, 2005).

Further research will be done in rice cultivation with a method and dose of appropriate recommended fertilization on each plot experiments to determine the level of efficiency of fertilization.

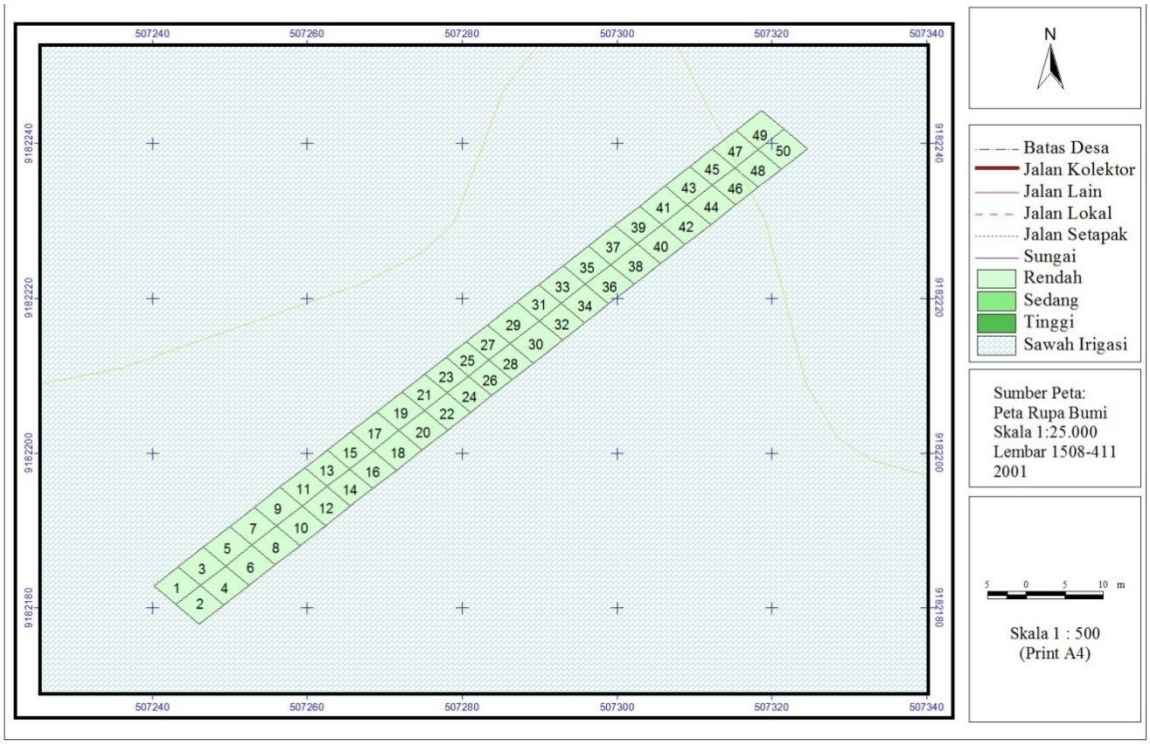

Figure 1. Map of low N status prior rice planting

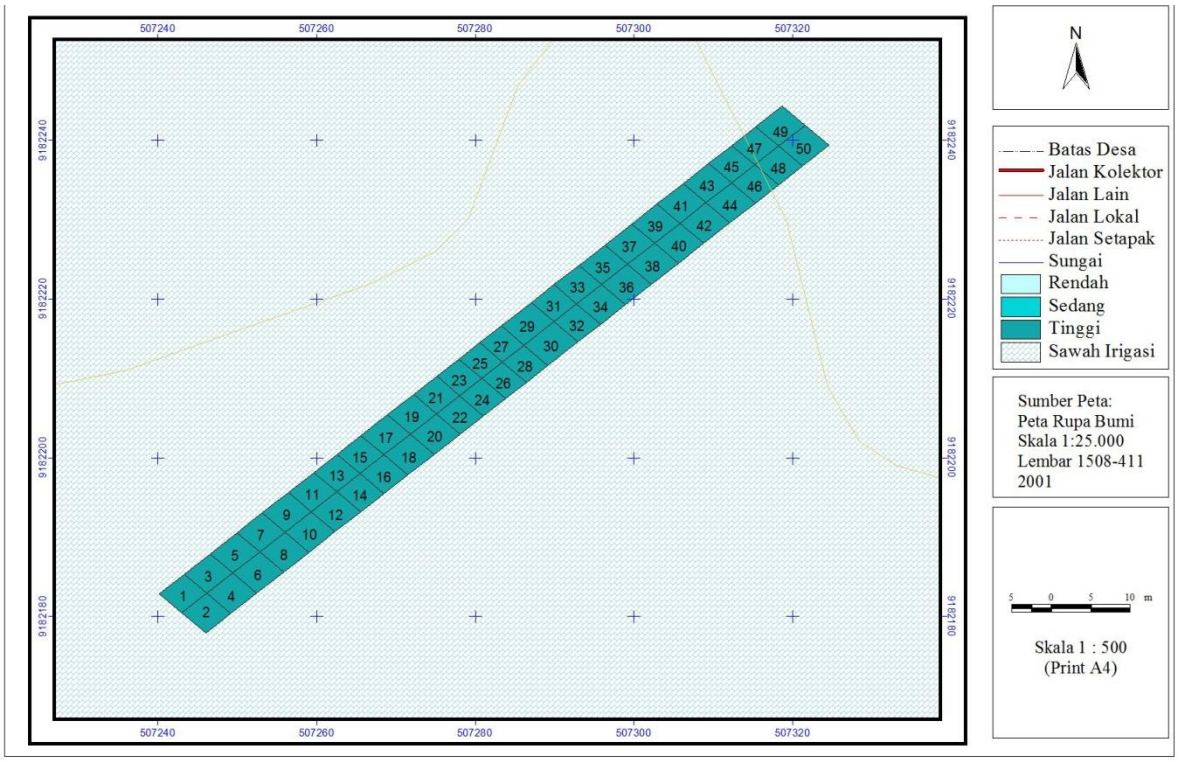

Figure 2. Map of high P status prior rice planting

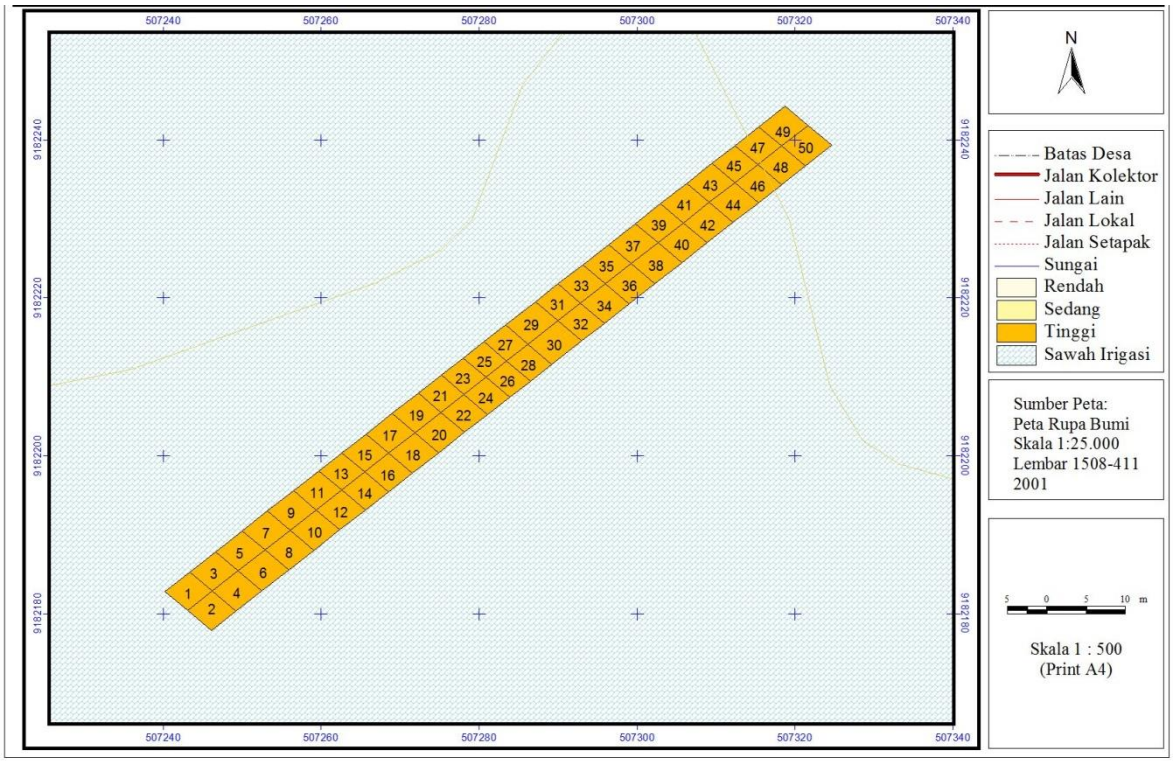

Figure 3. Map of high K status prior rice planting

Tabel 1. Nutrientns availability in soil and fertilization recommendation

Nutrients	Nutrients availability	Fertilization recommendation
N	Low	Urea 300 kg/ha
P	High	SP36 70 kg/ha
K	High	KCl 75 kg/ha

Tabel 2. Method and time of fertilization

Fertilizer	Basal fertilizer (1-2 wat)	2nd additional fertilizer (3-5 wat)	3rd additional fertilizer (6-7 wat)
Urea	1/3 Dose	1/3 Dose	1/3 Dose
SP36	Full dose	-	-
KCl	1/2 dose	1/2 dose	-

Soil research institute, 2005; wat: week after transplanting

Plant height and the number of leaves in applying NPK compound fertilizer in farmer dose with VRA was significantly higher than application VRA and URA by using 2 tons of organic manure + 200 kg/ha Urea and 2 tons of organic manure + 100 kg/ha Urea respectively, but not significantly different with URA by using NPK compound fertilizer of farmers dose, 2 tons of organic manure + NPK 50% of farmers dose and VRA by using 2 tons of organic manure + NPK 50% of farmers dose and 2 tons of organic manure +200 kg/ha Urea (Table 3).

Table 3. The effect of VRA by using gledur to the plant height and number of leaves at 45 days after transplanting

FERTILIZER TREATMENT		Plant height	Number of leaves
Uniform Rate Application (URA)	NPK compound fertilizer. Farmers dose	106,78 ab	130,17 ab
	2 tons of organic manure + NPK 50% of farmers dose	105,25abc	127,61abc
	2 tons of organic manure + 200 kg/ha Urea	103,25 c	124,83bc
	2 tons of organic manure + 200 kg/ha Urea	101,58d	125,62 bc
Variable Rate Application(VRA)	NPK compound fertilizer. Farmers dose	107,82 a	130,79 a
	2 tons of organic manure + NPK 50% of farmers dose	106,66ab	129,57ab
	2 tons of organic manure + 200 kg/ha Urea	106,32 abc	126,58abc
	2 tons of organic manure + 200 kg/ha Urea	104,11b	122,31 c
Interaction		+	+

Notes: Means followed by the same letter in a column are not significantly different ($P \leq 0.05$)

The number of tillers per hill by applying VRA with NPK compound fertilizer of farmers dose, 2 tons of organic manure + NPK 50% of farmers dose and 2 tons of organic manure + 200 kg/ha Urea was significantly higher than URA, but not significantly different to 2 tons of organic manure + 100 kg/ha Urea. Dry weight of plant per hill by applying VRA with NPK compound fertilizer of farmers dose was significantly higher than URA, but not significantly different to 2 tons of organic manure + NPK 50% of farmers dose and 2 tons of organic manure + 200 kg/ha and 2 tons of organic manure + 100 kg/ha Urea (Table 4).

Table 4. The effect of VRA by using gledur to the tiller and plant dry weight at 45 days after transplanting

FERTILIZER TREATMENT		Number of tillers per hill	Dry weight of plant per hill
Uniform Rate Application (URA)	NPK compound fertilizer. Farmers dose	26,43 abc	54,83 abc
	2 tons of organic manure + NPK 50% of farmers dose	25,50 bc	51,61 c
	2 tons of organic manure + 200 kg/ha Urea	25,00 c	55,01 abc
	2 tons of organic manure + 200 kg/ha Urea	25,33 bc	53,62 bc
Variable Rate Application(VRA)	NPK compound fertilizer. Farmers dose	27,44 a	62,69 a
	2 tons of organic manure + NPK 50% of farmers dose	27,24 a	58,87 ab
	2 tons of organic manure + 200 kg/ha Urea	27,22 a	60, 14 abc
	2 tons of organic manure + 200 kg/ha Urea	26,58 ab	58,31 abc
Interaction		+	+

Notes: Means followed by the same letter in a column are not significantly different ($P \leq 0.05$)

Excessive use of inorganic fertilizers has a bad influence on the environment such as on soil, water, water wildlife, etc. Plants need 10 kinds of elements including micro elements. Inorganic fertilizers for rice contain only limited elements: N, P, K and S. The micro elements found abundantly in organic fertilizer, therefore rice that are fertilized with inorganic fertilizer + organic fertilizer will give a perfect nutrient for production. The conventional fertilizer application (URA) only got 30-50% efficiency. So the 300 kg of urea was only 90 -150 kg effectively fertilize for 6 tons of dry grain rice production. “Gledur” technology in application of 200 kg of urea into the soil had produced more than 6 tons of dry grain. Fertilization experiments by applying 187.50 kg urea directly into the soil were able to produce 9 tons of dry grain. It can be expected that “Gledur” is able to reduce fertilizer and increase production (Amir, 2010)

CONCLUSIONS AND SUGGESTIONS

NPK nutrient status of the soil in the village of Wotan, Bener, Sragen regency showed the uniform availability of NPK. N level was low, P and K levels were high in the soil. Urea fertilizer recommendations were required at low N plot was 300 kg N / ha. SP-36 fertilizer recommendation for high P plot was 75 kg / ha. Plant height, number of leaves,

number of tillers per hill, dry weight of plant per hill in applying NPK compound fertilizer in farmer dose with VRA was significantly higher than application of URA. Recommendations of KCl for high K plot was 75 kg / ha. Suggestion to the agricultural field officers is to provide guidance to farmers in the provision of appropriate fertilizer recommendations, as appropriate dosage, time and location.

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