The effect of season on farmer’s purchasing of liquid leaf fertilizers

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Abstract. This aim of this research is to analyse the effect of planting season factor on the purchasing intensity of liquid leaf fertilizer products by onion farmers in Brebes, Central Java Indonesia. This research was conducted by using a survey approach through interviews of 100 respondents of onion farmers on April until May 2017. The effect of planting season factor on the purchasing of liquid leaf fertilizer on the purchasing intensity were analysed by using t-independent sample test and dummy regression analysis. The result shows that intensity of the use of liquid fertilizer was affected by the planting season. The purchasing intensity of liquid fertilizer products by the farmers in wet season (10.26 litter ha⁻¹) was higher than the dry season (4.81 litter ha⁻¹)

1. Introduction
Fertilizer takes the important role in agriculture since the pre-industry began to the revolution of industry in 20 century. The using of fertilizer significantly can also help the global population. The fulfillment of food supply to half-most population in the world is fulfilled by the using of synthetic nitrogen fertilizer [1]. Commercial fertilizer, organic or inorganic, takes an important role to increase the productivity from 30% to 50% [2]. The inorganic fertilizer has been used in many centuries before while the synthetic fertilizer, which consists of eight inorganic fertilizers, has been used since the revolution of industry began [1].

According Department of fertilizer and pesticide(2004), fertilizing is one of the management to increase the fertility of land without adding the nutrition elements but it tends to rely on the original nutrition elements from the land. As a matter of consideration, it can decrease the farmers’ productivity and leads the unbalance capacity of nutrition from the plant. It decreases slowly during the harvest moon, in residual water, the erosion or distillation process. The integrated management by giving fertilizer increases the nutrition capacity and keeps the quality of land. Fertilizer is the most essential element in agricultural process whether it is based on the quality or quantity factor. It takes the important role in increasing the production in agricultural process [3].

Before the 1950s, only solid fertilizer was produced and available in the agricultural input market. Furthermore, liquid fertilizer is also produced to support agriculture. Advantage of liquid fertilizer include heavy use, quick plant response, lowered application cost, homogeneity, ability to combine with other agrochemicals in a single application, higher nutrient concentrations, and the ease of making
compound fertilizers [4,5]. Liquid fertilizer re less expensive than solid only if materials are purchased as concentrated liquids [5]. Liquid fertilizers are popular because of the ease of handling and application. Homogeneous liquid fertilizers, in contrast to solid fertilizers, present no special problems during application by the farmer. Furthermore the storage of liquid fertilizers is less difficult than that of solid ones. Small amounts of herbicides and insecticides can be mixed with liquid fertilizers far more easily [4]. Whereas the disadvantages of liquid fertilizer include the drawbacks that they usually have lower nutrient content and are sensitive to impurities, as well as to precipitation and crystallization, especially caused by magnesium and fluorine [4]. The liquid fertilizer system is that it requires special storage and application tanks and pumps, which greatly increase costs [6].

Fertilization is an activity to support the business activities of the red onion farmers in Brebes Regency, Central Java, Indonesia. Brebes regency is the main production areas of red onion in Indonesia. The agricultural sector accounts for 53 % of Gross Domestic Product (GDP) Brebes district, which is 50 % of the red onion farming [7]. An intensive use of fertilizers to keep the crop yields onion farmers. One type of liquid fertilizer available on the market is a liquid leaf (foliar) fertilizer. Liquid foliar fertilizers are substances that contain primary nutrients and/or micronutrients, are applied to the leaves, and are absorbed into the leaves. Liquid form is designed to be sprayed directly to the leaves of plants providing nutrition to the foliar will cause nutrients to be absorbed directly through the leaves of the plant, stimulating activity in the leaves, which in turn stimulates the development of roots, because the plants start to need more water. Stomata of the leaves have the ability to absorb nutrients very quickly. Although not as much and ’quickly as’ fertilizer roots, leaves or foliar fertilizer use by farmers onion is now very common. Moreover, to meet the nutritional needs of micro plant complements fertilizer provided through the roots [8]. The most important liquid foliar fertilizer is urea (46% N) which is highly soluble in water and rapidly absorbed by plants via the leaves. Therefore, urea is frequently used as a component of fertilizer suspensions and solutions. In addition to nitrogen, other macro- and micronutrients can be added, frequently in a nutrient ratio tailored to the demand of specific target crops.

The use of liquid foliar fertilizers by red onions farmers can be influenced by the planting season. In fertilizing shallots in planting wet and dry seasons there is a difference, namely the problem of the need (N) of Nitrogen, during the wet season the nitrogen needs of plants are aided by rainwater containing high nitrogen, while for dry season planting is only obtained from the soil only If the plant has excess nitrogen, during the wet season it will cause the plants to be too fertile and susceptible to diseases such as late blight, powdery mildew, bacteria etc. And vice versa if the lack of nitrogen substances plant growth will be slow and stunted. Fertilization and selection of the right fertilizer are needed. The fertilizer demand tends to increase in wet season because the use of the fertilizer will decrease in the dry season [9]. But it is different from the irrigated-agricultural areas which do not depend on the season [10,11]. Climate change has a significant impact on agricultural sector and become a challenge to farmers in adaptation toward the land use and production changes [12]. The wider the area, the greater the need of fertilizer in production activities [13,14];

The agricultural area nowadays can be characterized only from limited land area, the fertility decrease in agricultural land. The unpredicted weather and climate can affect farmers’ behavior to use fertilizers. Behavior of farmers in the intensive use of fertilizers is not only influenced by agriculture environmental factors, but also psycho-social-economic factors [15]. The factors in soil fertility determine the fertilizer amount needed by farmers [16]. Farmers who have a good experience in deciding the types of fertilizer tend to use the same fertilizer which the farmers bought before production activities begin in the next period [17,18]. Formal information sources are from worker extension [15]. Non-formal information sources are from community [15]. Farmers can easily be influenced by the neighbors who successfully manage their agricultural production by using certain types of fertilizer [19]. Community farmers generally are difficult to use certain types of fertilizer in the long term and it is believed that it can increase the agricultural production [20]. A farmer occupation is generally based on tradition, what they are used to do, and hereditary. It is difficult to face the changes for old farmers in community because they (especially the older generation) are still follow the tradition.
The aims of this research are to analyze the influences of the planting season on the purchasing intensity of liquid foliar fertilizer products by onion farmers in Brebes, Central Java Indonesia. This paper is organized into five sections. The next section research method, including the sampling, data collection techniques, and measurement methods. Research findings are then presented in the results section, which is followed by conclusion, implications, and recommendations.

2. Research method
This research was conducted in Brebes Central Java in April to May 2017. This research used survey approach through interviews with 100 onion farmer respondents. The variables in this research consist of exogenous variable, endogenous variable and control variables. Endogenous variable is Purchasing Intensity of Liquid Foliar Fertilizer. Exogenous variables is Planting Season. Control variables consist of: Non Liquid Foliar Fertilizer, Organic fertilizer usage, Access to Irrigation, Income, Experience, Farmer Group, Worker Extension, and Sales Recommendation. The variable and operational definition was show in Table 1.

### Table 1. Variabel and operational definition.

| Variable                                      | Code | Indicator                                                                 |
|-----------------------------------------------|------|---------------------------------------------------------------------------|
| Purchasing Intensity of Liquid Foliar Fertilizer | Y    | Total purchasing of liquid foliar anorganic fertilizer (litter)             |
| Planting Season                               | D    | Dummy of Planting Season (0= Wet Season, 1= Dry Season)                   |
| Land                                          | A    | total area (Hectare, Ha)                                                  |
| Access to Irrigation                          | IRIG | access to irrigation Infrastructure(1= technical/semi-technical, 0 = rain fed) |
| Income                                        | INC  | income from on farm and off farm(Rp)                                      |
| Experience                                    | EXP  | Experience of farmers (year)                                              |
| Farmer Group                                  | GROUP| Involvement level (1= Yes, 0= No)                                        |
| Worker Extention                              | WE   | recommendation from agricultural worker extention (1 = often, 0 = rarely / never) |
| Sales Recommendation                          | PROM | recommendation from sales(1 = often, 0 = rarely / never)                   |

By using the analysis of multiple linier regression, the model is demonstrated as follows:

\[
Y = \beta_0 + \beta_1A + \beta_2D + \beta_3IRIG + \epsilon_1
\]

\[
Y = \gamma_0 + \gamma_1A + \gamma_2D + \gamma_3IRIG + \gamma_4INC + \gamma_5EXP + \gamma_6GROUP + \gamma_7WE + \gamma_8PROM + \epsilon_2
\]

In which: \(\alpha\) = intercept and slope. To assess the accuracy of the sample regression function in assessing the actual value can be measured from its goodness of fit. Statistically the goodness of fit can be measured from the statistical value of F and coefficient termination. The coefficient of determination (R²) is used to determine the percentage of dependent variable change caused by the independent variable. F test is the significance testing of the equations used to determine how influence the independent variables on dependent variable (Y). T test is testing the hypothesis whether the independent variables (Xi) individually affect the dependent variable (Y). The level of significant use (D ≤ 0.05).

3. Result and discussion
The results of this research show that 100 respondents using both liquid foliar, non-liquid and organic fertilizers. The average purchase of liquid foliar fertilizer products is presented in table 2. Based on table 2 the farmers used the liquid foliar both wet and dry season and the average purchase of liquid foliar...
fertilizer is 7.06 liters/yr in an average land area of 0.47 Ha. For each area (Hectare) the average of liquid foliar was 15.40 liters/hectare which is consists of 4.81 liters/hectare in the wet season and 10.26 liters/hectare in the dry season. Purchases in dry season greater that wet season because the farmers need the benefit of liquid foliar fertilizer to increasing greenery of plants.

Table 2. Average total purchasing of liquid foliar fertilizer.

| District   | Land Ownership (Hectare) | Total Purchasing of Liquid Foliar Fertilizer (litter) Planting Season | Total/Ha |
|------------|-------------------------|---------------------------------------------------------------------|---------|
|            |                         | Wet | Dry | Total |                       |
| 1. Bulakamba | 0.26                    | 1.62 | 3.00 | 4.62 | 17.75                 |
| 2. Larangan  | 0.33                    | 1.81 | 3.53 | 5.34 | 16.19                 |
| 3. Kersana   | 0.59                    | 3.00 | 6.33 | 9.33 | 15.82                 |
| 4. Ketanggungan | 0.45                | 2.21 | 4.68 | 6.89 | 15.32                 |
| 5. Wanasari  | 0.37                    | 1.70 | 3.70 | 55.40| 14.59                 |
| 6. Tanjung   | 0.55                    | 2.29 | 5.57 | 7.86 | 14.29                 |
| 7. Losari    | 0.78                    | 3.40 | 7.85 | 11.25| 14.42                 |
| 8. Brebes    | 0.49                    | 2.00 | 4.00 | 6.00 | 12.24                 |
| 9. Banjarharjo | 0.38             | 2.10 | 4.25 | 6.35 | 16.71                 |
| 10. Jabtibarang | 0.72       | 3.33 | 7.25 | 10.58| 14.70                 |
| 11. Songom   | 0.23                    | 1.33 | 2.67 | 4.00 | 17.39                 |
| Mean (litter) | 0.47                | 2.25 | 4.80 | 7.06 | 15.40                 |
| Mean (litter/Ha) | 1                  | 4.81 | 10.26| 15.40|                     |

Source: Field survey in 2017.

The regression testing factors influencing the purchase Liquid Foliar Fertilizer presented in Table 3. The first model illustrates the influence of the planting season factor on the purchase of Liquid Foliar Fertilizer with variable control of land area. The 2nd model illustrates the influence of the planting season factor on the purchase of Liquid Foliar Fertilizer, with variable control of land area, psycho-social-economic environmental factors of farmers.

Table 3. The result of the regression test influencing the fertilizer purchasing factors.

|                | 1st Model |          | 2nd Model |          |
|----------------|-----------|----------|-----------|----------|
|                | β         | ρ        | β         | ρ        |
| (Constant)     | 1.633     | 0.427    | 1.700     | 0.427    |
| Exogenous Variable |          |          |           |          |
| Dummy Planting Season | 1.423 | ***0.000 | 1.678 | ***0.009 |
| Control Variables |          |          |           |          |
| Land area      | 14.144    | ***0.000 | 14.725    | ***0.000 |
| Irrigation     | -0.065    | 0.677    | -0.066    | 0.722    |
| Income         | 0.063     |          | 0.063     | ***0.001 |
| Experience     | 0.431     |          | 0.336     | 0.387    |
| The farmers group | 1.465 |          | 1.077     | 0.107    |
| The sales recommendation | 0.799 |          | 0.799 | ***0.003 |
| R Square       | 0.433     |          | 0.589     |          |
| F-test         | 14.274    |          | 19.645    |          |
| Sig. F-test (p)| 0.000     |          | 0.000     |          |

Source: Field Survey in 2017

The of the regression equation demonstrate by the F-test of 14.274 (1st model) and 19.945 (2nd model). Therefore the value ρ both 1st and 2nd model = 0.000. It means that the model is good and acceptable, also no different between the observed data and the model. In the 1rd Model, results of regression equation reaches $R^2$ values of 0.433 or 43.3% reflecting that all the independent variables are able to explain the variation changes which increase or decrease in dependent variable (Total Purchase of Liquid.
Foliar Fertilizer) to 43.3%, while the other is, 56.7% influenced by other variables that are not involved in this research model. In the 2nd Model, results of regression equation reaches $R^2$ values of 0.589 or 58.9% reflecting that all the independent variables are able to explain the variation changes which increase or decrease in dependent variable to 58.9%, while the other is, 41.1% influenced by other variables that are not involved in this research model.

The factor of planting season both in first and second models have a positive effect on purchase of liquid foliar fertilizer ($p = 0.000 < 5\%$). The regression coefficient in 1st model ($\beta$) = 1.423 and 2nd model ($\beta$) = 1.678. Those value means that in 1st and 2nd model each the purchase of Liquid Foliar Fertilizer in dry season is higher than 1.423 liters and 1.678 liters compared to wet season (in the case other variables was constant). In the 2nd model the purchase of liquid foliar fertilizer not only influenced by planting season, but also depend on irrigation access, land area, experience, income, sales recommendations, and worker extension.

The land factor has a positive effect on the total purchase of foliar fertilizer ($p = 0.000$) both 1st and 2nd model. The land factors positively affects the amount of purchase liquid fertilizer ($p = 0.000<1\%$). It's means that the increasing of land area will be followed by an increasing of the amount of liquid fertilizer. The extent of land area will be increasing the scale of farming. The large of land area requires more input from suppliers, including the use of fertilizers to increasing agricultural production [11,13,14,18].

Based on Table 3 the irrigation access doesn’t significantly influence the purchase amount of liquid fertilizer ($p = 0.677$ and 0.722 > 0.05). The demand of liquid fertilizer in the semi-technical irrigation system is higher than technical irrigation systems. In technical irrigation, waters flow naturally from reservoir to irrigation channel, but in semi technical irrigations the supply of water come from pumping of groundwater. The sources of water irrigations effected the content of nutrient both in semi technical and technical irrigation, while the nutrient content in water of technical irrigation system higher than semi technical irrigation. Semi technical irrigation also need liquid foliar fertilizer higher than rainfed farming. Land with irrigation networks are usually flat, accessible and have lower risk in various conditions of rainfall, so farmer have low risk when applying intensive fertilizing. The results greatly safer in various conditions of rainfall so that farmers face a lower risk in applying more intensive fertilizing [9-11].

The incomes and experience factor have positively affects to liquid fertilizer purchasing ($p= 10\%$). It means that the increasing of income and farmer experiences will be increasing of liquid fertilizer purchase. The raising of farmers income on one million rupiah will increasing number of purchase liquid foliar to 0.063 liters. Farmers with higher incomes have an ability to purchase liquid fertilizer, while farmers with low financial will reduce the liquid fertilizer and change it with anorganic fertilizer using other organic fertilizers [19-22]. Farmer experiences also affected to liquid fertilizer purchase. Farmers who have successful using certain type of fertilizer in onion cultivations, tend to use those fertilizer in the next period cultivations [17,18].

Farmer’s group and worker extension does not significantly influence the amount of liquid fertilizer purchases ($p = 0.613 > 5\%$). the Agriculture extensions worker give an advice to the farmer how to use liquid fertilizer. The agricultural extension also influence knowledge, perceptions and attitudes of farmers [15]. However, the results of this research found that the factor of agricultural extension agents had no significant effect to the amount of purchases of liquid supplementary fertilizer. The results of this research are different from the previous research [15]. The insignificant influence caused by frequent meetings of agricultural extension agents without being accompanied by advice from agricultural extension workers. Same with two factor above, sales recommendations also not significantly to the purchase amount of liquid fertilizer ($p = 0.613 > 5\%$). This sales recommendation doesn’t effective to increasing the amount of purchase liquid fertilizers

4. Conclusion
The results of this research show that the amount of purchase of liquid foliar fertilizer of onion farmers in the wet season was higher than the dry season. Other factors that affected significantly to liquid
fertilizer purchase by farmer’s including land area, farmer experiences, irrigation and farmer’s income. On the other hand, farmer groups, worker extension and sales recommendations doesn’t significantly influence to liquid fertilizer purchase.

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