Combination urea and compost fertilizer with different defoliation affected corn and peanut production based on integrated farming system

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Abstract. This research was aimed to study the effect of combination of compost and urea fertilizer, leaf defoliation intercropping system of corn and peanut crop. This study was conducted for 4 months and designed by Separate Plot Design. Defoliation of leaves under cob is main plot and combination of urea and compost doses is subplot. The treatments are as follows; main plot d0 = Without defoliation (control); d1 = 50% Defoliation; d2 = 100% Defoliation and combination of Urea and Compost doses ; Subplot: p0 = 250 kg Urea/ha + 3 tons of compost/ha; p1 = 230 kg Urea/ha + 6 tons of compost/ha; p2 = 210 kg Urea/ha + 9 tons of compost/ha; p3 = 190 kg Urea/ha + 12 tons of compost/ha. Each combination is repeated three times so that the total number is 36 plot experiments. Data were analyzed by using variance analysis and analysis of continuation test of least significance different (LSD). The results showed that the combination of fertilization is the same dry shelled corn production and dry peanut. d1 treatment and its interaction could increase dry production of shelled corn and peanut. Intercropping of corn and peanut is feasible to be cultivated in an integrated farming system.

1. Introduction

The deterioration in land carrying capacity due to artificial chemical inputs directly impacts the offending or declining effects of feed and food supply capacity [1]. Soil barrier factors are low acidity and soil fertility, especially P and other macronutrients [2]. Land increasingly decline with the use of chemicals content further exacerbated by inability of land management. Actually, it can be minimized by using organic fertilizer originating from feces and urine. The potential of livestock as a provider of organic fertilizer is maximized through the processing of feces and urine as compost. Provision of compost fertilizer by reducing the use of artificial fertilizers to measure the effectiveness of its use to increase soil nutrients and increase crop production [3]. Fertilizer from livestock manure, in an integrated manner, provides a better effect on soil on aspects of conservation and plant growth [4,5]. Manure and artificial fertilizers both have advantages and disadvantages. It can be given by fertilizer
**Defoliation** is the removal of above-ground plant material [7]. The principle of such treatment is to regulate the balance of plant hormones.

Various efforts increase corn productivity has been done such as superior varieties, fertilization and plant spacing. Setting spacing on an area of agricultural land is one way that affects the results to be achieved [8]. In addition to the above-mentioned ways, to increase the productivity of the land, especially on dry land can be done through intercropping. Intercropping on dry land can maintain moisture and soil moisture content and reduce erosion and increase soil fertility [9]. Efforts through the application of innovation and technology can be finished to maximize the improvement of feed quality so that imported meat will reach 70% [10] can be derived.

This research was conducted to assess the effectiveness of compost in corn and peanut crops and production of corn and peanut waste by intercropping pattern along with defoliation. It was an effort to minimize the use of shades causing reduction of etiolating, dry matter of corn and peanut varieties [11].

### 2. Research methodology

This research was conducted for 4 months starting from February to June 2015 at Animal Center Complex Faculty of Animal science Hasanuddin University Makassar for composting, Experimental Farm Faculty of Agriculture Hasanuddin University Makassar for planting of peanut and corn intercropping.

This study, using Separate Plot Design. Defoliation of leaves under cob is main plot and the combination of urea and compost fertilizer dosis sub plot. The treatments of main plots where: d0 = Without defoliation (control) d1 = 50% Defoliation d2 = 100% Defoliation The treatments of subplot were: p0 = 250 kg Urea/ha + 3 tons of compost/ha; p1 = 230 kg Urea/ha + 6 tons of compost/ha; p2 = 210 kg Urea/ha + 9 tons of compost/ha; p3 = 190 kg Urea/ha + 12 tons of compost/ha.

Each combination is repeated three times so that the total number is 36 plot experiments. Data were analyzed by using variance analysis and analysis of continuation test of least significance different (LSD).

#### Table 1. Soil Analysis

| Treatment | Parameter    | Unit | Value | Criteria |
|-----------|--------------|------|-------|----------|
| P1        | C-Organik    | (%)  | 1.45  | Lower    |
|           | N-Total      | (%)  | 0.11  | Lower    |
|           | P2O5         | (ppm)| 11.38 | Upper higher |
|           | K            | (cmol/kg)| 0.21 | Lower    |
| P2        | C-Organik    | (%)  | 1.49  | Lower    |
|           | N-Total      | (%)  | 0.07  | Lower    |
|           | P2O5         | (ppm)| 12.56 | Upper higher |
|           | K            | (cmol/kg)| 0.19 | Lower    |
| P3        | C-Organik    | (%)  | 1.62  | Lower    |
|           | N-Total      | (%)  | 0.12  | Lower    |
|           | P2O5         | (ppm)| 12.42 | Upper higher |
|           | K            | (cmol/kg)| 0.16 | Lower    |
| P4        | C-Organik    | (%)  | 1.71  | Lower    |
|           | N-Total      | (%)  | 0.14  | Lower    |
|           | P2O5         | (ppm)| 11.59 | Upper higher |
|           | K            | (cmol/kg)| 0.2  | Lower    |

Source: Soil Laboratory, Faculty of Agriculture Hasanuddin University, 2016

#### 2.1. Soil analysis

Soil analysis in this experiment was aimed to find out soil pH and total nitrogen content of soil, phosphorus and potassium before and after experiments. The soil samples to be analyzed were layers ie 0 - 30 cm depth in the experimental plot that had been made. This analysis became the basis for
determining the dose and discussion of fertilizer treatment. The soil analysis after the experiment is presented in table 1;

2.2. Natural fertilizer
A feces produced by cattle is used as basic fertilizer for corn and peanut plant. Fermenting using EM4 for at least 3 weeks so that compost is produced. The ingredients needed in composting are: 1,000 kg cow manure, 2.5 kg EM4, 100 kg husk ash, 20 kg calcite/dolomite, by mixing livestock manure with EM4, stirring evenly and then putting it in the first tub and then leaving it for 1 week and then reversed while mixing organic ashes and calcite. It was rested every week until matured which is marked by physic. the mark such as black soil, crumb structure, good odour, undissolved into water. This mature compost is then analyzed for its ingredients. The parameters are presented in table 2.

| Parameter | Unit | Value |
|-----------|------|-------|
| pH        |      | 6.8   |
| C-Organik | %    | 3.9   |
| N-Total   | %    | 0.19  |
| P2O5      | %    | 1.38  |
| K2O       | %    | 0.51  |
| Ca        | %    | 1.37  |
| Mg        | %    | 0.11  |
| S         | %    | 0.081 |

Source: Soil Laboratory, Faculty of Agriculture Hasanuddin University, 2016

2.3. Land preparation
Processing of the soil is done one week before planting. 36 beds with size of 3 m x 2 m per plot with the distance between beds 0.5 m while between groups 1 m. The field is surrounded by a moat with a width and a depth of 0.5 m. Along with the soil processing; the soil is given for compost fertilizer with an appropriate dose of treatment.

2.4. Planting
Planting is done as deep as ± 5 cm with plant spacing of 140 cm x 40 cm for corn plant and 40 cm x 20 cm for peanut plant planted among rows of corn plants, peanut planting time 10 days earlier from corn plant, each hole planted 2 seeds for corn and 3 seeds for peanut plants. Peanut planting should be done earlier than the corn in the intercropping system because in terms of peanut morphology is shorter than corn. In addition, it is also seen that corn crops grow faster than in peanut crops. Therefore, the planting of corn after planting peanut will give maximum results [12,13]. In terms of nutrient and water absorption, corn crops have obstacles because the length and number of roots of peanut crop are greater than that of corn plant roots. With organic nutrients and planting time can increase the high growth of corn crops [14].

2.5. Plant maintenance
Maintenance includes watering every morning and evening depending on soil moisture. Weeding and developing are conducted simultaneously twice at the age of 10 and 30 days, depending on local environmental conditions and is done when the pest plants begin to grow and compete to get food or nutrients. Fertilization is done twice, the first fertilization with half the dose of N and all P and K are given when the plant is 7 days after planting and half the remaining urea dose is given at the age of 30 days with the appropriate dose of treatment. Control of plant pests and diseases with regard to planting conditions.
2.6. Harvest
Corn can be harvested after the age of ± 90-100 days. The characteristics of corn plants that are ready to be harvested are during cooking (mature) where the dry weight of the corn grains has reached the optimum water content. Harvesting is done by taking all parts of the plant and cutting limits 5 cm from rooting.

Peanut plants can be harvested when visually the peanut entered the physiological phase is characterized by the number of leaves that have changed color from green to yellow. When the plants are removed, will look pods with a clear texture and darker color. Superior varieties and local varieties of Spanish type have a cooking age between 85 - 90 days while the type of Valencia between 100 - 110 days [15]

3. Result and discussion
Based on the result of analysis of variance indicate that leaf defoliation percentage under cob very influential real, combination of fertilizer and interaction of both had not significantly affected on the production of dry corn per hectare corn.

Table 3. Average production of dry shelled corn and peanut (ton/ha)

| Defoliation | Level of fertilization | Average |
|-------------|------------------------|---------|
|             | p1   | p2   | p3   | p4   |         |
| d0          | 2.50c | 3.06c | 2.71ab | 2.36c | 2.66   |
| d1          | 3.59c | 3.47cd | 3.55e  | 3.55de | 3.54   |
| d2          | 3.08c | 2.89b  | 2.92bc | 2.88b  | 2.94   |

Description: The numbers followed by the same letter mean not significantly different (P>0.05)

Based on the result of the analysis of variance indicate that the percentage of leaf defoliation under the cob has no significant effect on the combination of fertilizers and their interaction on the production of dry shelled corn waste per hectare.

Table 4. Average production of dry shelled corn waste (ton/ha)

| Defoliation | Level of fertilization | Average |
|-------------|------------------------|---------|
|             | p1    | p2    | p3    | p4    |         |
| d0          | 8.96  | 9.49  | 8.47  | 9.32  | 9.06   |
| d1          | 7.37  | 7.67  | 9.48  | 7.26  | 7.94   |
| d2          | 8.96  | 7.83  | 8.51  | 8.27  | 8.39   |

Description: The numbers followed by the same letter mean not significantly different at the test level BNTα=0.05

Based on the result of the analysis of variance indicate that leaf defoliation percentage below cob has no significant effect on the combination of fertilizers and their interaction on the production of dry corn per hectare.

Table 5. Average fresh production of shelled corn waste (ton/ha)

| Defoliation | Level of fertilization | Average |
|-------------|------------------------|---------|
|             | p1    | p2    | p3    | p4    |         |
| d0          | 20.90 | 19.73 | 19.61 | 22.51 | 20.69  |
| d1          | 24.08 | 21.91 | 20.25 | 19.74 | 21.49  |
| d2          | 17.77 | 18.72 | 21.68 | 21.56 | 19.90  |

Description: The numbers followed by the same letter mean not significantly different (P>0.05)

Dry peanut production and its variation showed that the percentage of leaf defoliation below the ear, fertilizer combination and interaction both had significant effect on dry peanut production.
The use of inorganic fertilizer combination with organic as plot factor in this research showed that it has affected to dry shelled corn production, corn waste production and peanut waste production but give a real influence on peanut peanut production These results indicate that the combination treatment of fertilizers gives relatively equal production of corn due to the inorganic fertilizer doses administered although different but also followed by different doses of organic fertilizers in which each addition of organic fertilizer dosage will be followed by a reduction in the dose of an inorganic fertilizer with the urea doses. However, the aim that all treatments have the same amount of N according to the needs of the n of corn originating from the soil, urea or from the fixation of N in the air through the rhizobium bacteria present in the peanut root nodules. The same N element derived from the fertilizer provided is useful in the cleavage and enlargement of cells occurring in the apical meristem, allowing for the high growth of plants in the corn, followed by rapid leaf growth.

Nitrogen nutrient is a very important macro element for growth and crop production, but its availability in soil is always low so it needs effort to add to the plant can grow and produce satisfactorily. The ability of corn plants to absorb nitrogen to produce seeds and stems varies according to stage when N is absorbed[16], so dosage will determine the optimal nutrient supply to the plant tissue. There is a real influence on dry peanut production due to the combined treatment of urea and compost fertilizers because of the ability of peanut plants to utilize nutrients received with the assumption of using the right dosage of fertilizer. The crop response to fertilizer application will increase when using the right dose of fertilizer. Each plant needs to obtain fertilization with the appropriate dosage to occur balance of nutrients in the soil that can cause plants to grow and develop well and produce optimal production. Optimal fertilization efficiency can be achieved if fertilizer is given in an amount that suits the needs of the plant, not too much and not too little [17].

In addition, the combined urea and compost doses are in accordance with recommended doses that are generally able to produce higher yields of the plant. This is thought to be due to the given doses that are well absorbed by plant roots so that these factors will support the ongoing photosynthesis for the formation of food reserves for growth and development of plants, including in supporting the growth potential of both generative and vegetative (some role of N elements in the body plants such as protein and protoplasmic substances, in which proteins are essential for the formation of enzymes which are the catalyst for many reactions in photosynthesis.

The ability of plants to grow properly is influenced by the availability of nutrients in sufficient quantities. Urea is needed in large quantities to spur vegetative development [18]. Furthermore, phosphorus is needed to stimulate root growth, accelerate flowering, and ripening of fruits and some of the compilers of fat and protein while potassium plays an important role in the metabolism process [19], helps the formation of proteins and carbohydrates, strengthens the stems and improves the quality of the fruit.

Compost as organic fertilizer included in the category of complex fertilizers that contain macro and micronutrients, so that nutrients needed by plants more complete and sufficiently available. Availability of the necessary elements of the plant will further support the growth and production of plants. Availability of nutrients that can be absorbed by plants is a factor that can affect the level of crop productivity [16].

Compost provided can be a good source of nutrients, to support the production of crops due to a balance between the needs and the level of nutrient availability in soil that allows plants to grow vegetative and the development of parts of reproduction well. The Relation between organic matter

### Table 6. Average production of dry peanut (ton/ha)

| Defoliation Level | p1   | p2   | p3   | p4   | Average |
|-------------------|------|------|------|------|---------|
| d0                | 3.89e| 4.29d| 4.27cd| 3.55e| 4.00    |
| d1                | 5.15a| 4.07cde| 4.28cd| 4.06cde| 4.39    |
| d2                | 4.91ab| 4.48bc| 4.62abc| 4.87ab| 4.71    |

Description: The numbers followed by the same letter mean not significantly different (P>0.05)
can have an effect directly or indirectly. Directly organic matter is a natural substrate for saprophytic microorganisms and indirectly provides nutrients for plants through the decomposition of soil microorganisms [19]. Long-term composting is also able to increase the activity of nitrogen-fixing microbes by increasing the content decomposed soil organic matter to promote stable aggregate formation and cation exchange capacity [20].

The percentage of main factor treatments had significantly affected on the observed components of dry corn production and dry peanut production but did not exert any influence on observation components of corn waste production and peanut waste production. The result of the variance analysis showed that the percentage of defoliation has a significant effect on the production of dry shelled corn and dry peanut production and has no effect on corn waste production and peanut waste production.

Analysis of variance indicated that that 50% defoliation of leaves under the cob produces the best average in dry corn peanut per hectare production. This is thought to be due to 50% defoliation is the exact percentage in which the assimilate distribution can be more concentrated to the plant generative parts (cobs) that are no longer divided into other organs because the leaves under the cob are generally old and more sheltered so the ability of photosynthesis is also lower and the resulting photosynthetic is also lower.

Some research results as reported, [21] defoliation of corn leaves above 50% tends to decrease the yield of corn. The upper leaves contribute substantially to the development of the user portion of assimilating products since they are the most absorbing organs of solar radiation to be used in photosynthesis. Young leaves at the top of the tree absorb the most radiation and distribute large amounts of assimilating to other parts of the plant. On the contrary, older leaves at the bottom of the sheltered canopy have a low assimilation rate and provide only a small amount of assimilating yields to the other plants. Therefore, more advantageous when the lower leaves are removed [22].

Defoliation has been shown to induce changes in plant quality [23, 24]. Defoliation is an act of m defoliation is pruning the tip of the stem [7]. The principle of such treatment is to regulate the balance of plant hormones. among other cytokines with auxin in the axillary leaf below the tip of the stem [7, 25]. 50% defoliation under cob is more optimal than 100% defoliation caused by 50% defoliation still separates some leaves under the cob that leaves are still considered optimal in supplying assimilate and discard the leaves especially shaded and considered no longer effective as a source of assimilating. Defoliation of leaves that are not effective in photosynthesis is intended to reduce internal competitors between the parts of the plants that become the users of assimilates, in addition to other purposes such as leaves can be used for ruminants feed or prevent the accumulation of plants so easy occupied nesting various pests and diseases [26].

Implementation of defoliation is determined by three factors namely defoliation time, defoliation position and percentage rate of defoliation. Corn leaf defoliation is an attempt to increase the productivity of corn because defoliation can increase the rate of clean assimilation, which is the average measure of leaf efficiency to produce dry matter. The distribution of dry matter is mostly found in cobs, which is 60% of the total production of dry matter [21] Treatment without defoliation means allowing the leaves of the plants to compete with other plant organs in the use of assimilates while their activity in photosynthesis is not optimal anymore so that such leaves tend to be parasitic (harmful), while the 100% defoliation that removes all the leaves under the cob tends to decrease production of defoliated plants.

Lower leaf removal is effective in reducing competition for photosynthesis accumulation, allowing the photosynthesis to be centred on the upper leaves that receive more sunlight energy and can easily channel to the lower user areas, mainly cobs. The best peanut production obtained from the influence of 50% defoliation can be explained that higher plant defoliation (corn crops) in the intercropping system is one of the alternatives to increase the radiation received by lower plants (peanut). Through defoliation, the negative effects of shading effects can be reduced, as the index of leaf area (ILD) decreases as a result of the radiation passed on and received by the lower plants is increasing. Increased radiation acceptance by peanut plants causes the photosynthesis process to run perfectly so that dry peanut production increases. If defoliation is done at the bottom of the plant, in addition to
increasing the radiation received by the lower plants, it can also cause air circulation (CO₂ and O₂) and other microclimates (temperature and humidity) to be better so as to provide environmental conditions which is conducive to the plant for its growth and development. Deflection factors can be managed by adjusting the inventory levels of the above-ground biomass produced each year [27, 28].

The interaction of combination of fertilizer with defoliation percentage gives effect to the production of dry pod and peanut waste. The results of the variance analysis showed that the combination of fertilizer and the percentage of defoliation had significantly affected on the components mentioned above.

Analysis of Variance indicated that interaction between 50% defoliation in corn leaves under cob with 3 tons of compost ha⁻¹ (d₁p₁) yields the highest average peanut production per hectare (24.08 ton/ha) and the interaction between 50% defoliation in corn leaves under cob with 3 tons of compost ha⁻¹ (d₁p₁) yielded the highest dry peanut production (5.15 ton/ha), respectively. Peanut is planted on rained lowland and dry land with an average production of 1.0 - 2.0 tons/ha in rainfed lowland and 0.5 to 1.5 ton/ha on dry land [29] whereas the average production at the farm level below 1.0 ton/ha [30].

Defoliation of 50% and 3 tons of compost ha⁻¹ allows the growth of vegetative soil cultivated plants so that the habitus of the plant becomes thick, finally, vegetative organs such as stems and leaves produced more which causes the average production of plant waste generated also more. This is assumed by the combination of fertilizer and 50% defoliation is able to spur the rapid growth of vegetative plants peanut, especially leaf and its completeness for photosynthesis. Nitrogen plays an important role in terms of leaf green formation which is very useful in the process of photosynthesis. Another function is to form proteins, fats and various organic compounds [18].

Furthermore, 50% deficiency and 3 tons of ha⁻¹ compost also allow the growth of generative soil-bean plants so that generative organs such as pods and seeds are produced. This is assumed by the combination of fertilizer and 50% defoliation is able to spur the growth of generative peanut crops rapidly, especially pods and seeds and the activity of photosynthesis. The higher the result of photosynthesis, the greater the accumulation of food reserves are transrated into pods/seeds with the assumption that other factors such as light, water temperature and nutrients in optimal conditions [22]. So that, the number of pods/seeds formed more perfect, furthermore, the amount of nitrogen that is given to plants can usually increase the weight of pods/seeds of plant [31].

The intercropping effort is a planting system whereby two or more different plant species are planted simultaneously in relatively equal or different time with intermittent planting and regular plant spacing on the same plot of land and which aims to improve soil quality and improve yield crop productivity harvest, plant product diversity and plant yield stability [32]. The advantages gained by intercropping among others are facilitating maintenance, minimizing the risk of crop failure, saving in the use of production facilities and increasing the efficiency of land use [33, 34] Another advantage is the formation of soil microbial diversity. Intercropping plants are plants from other families and that meet the requirements of nutrients, pests and diseases sensitizing to toxins such as plants between corn and peanut [35, 36]. In the intercropping system of planting time also has an important role especially in shade-sensitive plants. Intercropping between corn and peanut often results in a shade of peanut by corn crops. To mitigate this effect, the timing of corn and peanut planting should be arranged so that at a critical period of growth the competition can be suppressed [37].

Based on research that has been done, intercropping between corn and peanut with 50% defoliation can increase the production of corn and peanut. According to previous research, intercropping of corn and peanut can increase yield [38]. However, the resulting biomass does not show significant value. This is in accordance with the opinion [39,40,41] found that peanut biomass does not show growth effects in intercrops. However, Peanut is legume plants that can be symbiotic with rhizobium capable of binding Nitrogen free in the air and can fertilize the soil. Organic nutrients given directly through the leaves of corn plants can reduce competition in nutrient removal between corn and peanut crops, especially from the soil.

Leaf giving can accelerate nutrient absorption in plants and effectively cope with the lack of Microelements [42]. The important thing in the intercropping pattern is to avoid the competition of
plants in utilizing nutrients, light and growing space because if there is competition will affect the growth and production of plants[43,44,45].

4. Conclusion
The combination of urea and compost produced relatively the same corn production and different peanut production. However, 50% defoliation increased production of both corn and peanut. There is an interaction between the combination of fertilization and the level of leaf defoliation under the cob on production of corn and peanut.

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