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Land Productivity Improvement through Giving Fertilizer N, P, K and Planting Time of Peanut (*Arachis hypogaea* L.) in the Intercropping System with Maize (*Zea mays* L.)

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Abstract

The purpose of this research is to investigate the productivity of land by N,P,K fertilizer and time of planting peanuts in intercropping systems with maize. This research was conducted applying experimental garden at Agriculture Faculty of Halu Oleo University, Kendari. The research was conducted in the dry season, from August to November 2015. The research was arranged meant by split plot design with two replications. The main plot is NPK fertilizer dose (S) consisted of three levels namely 56-36-25 kg ha^{-1} (S1), 90-54-25 kg ha^{-1} (S2) , 124-72-50 kg ha^{-1} (S3). The subplots was planting time of peanuts with maize intercropping (W) consisted of three levels, namely planting time of peanuts 10 days before planting (DBP) maize (W1), planting peanuts with maize simultaneously (W0), and planting peanuts 10 days after planting (DAP) maize (W2). There are nine treatment combinations of two factors mentioned. Each combination treatment was repeated three times, coupled with each of the three experimental plots for monoculture cropping systems of peanuts and maize. The total number of units was 45 units experimental. Data experiments were analyzed by using analysis of variance followed by Duncan's Multiple Range Test. The results showed that the treatment time 10 DBP planting peanuts with maize to increase productivity, reduce competition index and efficient of the use fertilizer. Provision of fertilizer NPK 124-72-50 kg ha^{-1} dose can increase growth and yield of maize and peanuts.

Keywords: NPK, planting time, peanuts, maize, intercropping

A. Introduction

Southeast Sulawesi (SULTRA) is one of the areas that have the potential of dryland quite extensive which has been used for the development of food crops, especially maize and peanuts. Dry land is defined as land in a natural state, the upper and lower body ground throughout the year did not experience water saturated or not flooded most of the year were below field capacity (Satari *et al*., 1991 cited by Sabaruddin, 2003). The physical condition of dry land are generally in the form of rain fed land Agro-ecology distinctively highly heterogeneous due to the availability of water and fertility, the level of technology adoption is still low and the availability of capital is very limited and susceptible to erosion.

Maize production in Southeast Sulawesi province in 2013 amounted to 67,578 tons of dry seed which had decreased by 10,869 tons (13.86%) compared with production in 2012. The decline in maize production due to reduced harvested area of approximately 3,751 hectares (12.15%), and productivity decreased by 0.49 quintal / hectare (1.95%) (BPS, 2014). While the production of peanut Southeast Sulawesi province in 2013 amounted to 4,941 tons of dry seeds which had decreased by 258 tons 4,96%) compared with 2012. The decline in the production of peanut production in 2013 due to reduced harvested area of 949 hectares (12,66%), while productivity increased by around 0,61 quintal / hectare (8,81%) (BPS, 2014).

The decline in maize production in Southeast Sulawesi caused by the conversion of agricultural land into non-agricultural proposition and soil fertility problems (Subandi, 2007). The type of soil in Southeast Sulawesi is dominated by land ultisol. The limiting factor is the ultisol soil acidity and low soil fertility (Karimuna, 2000), so that the organic fertilizers and inorganic fertilizers as an effort to improve the content of organic matter to improve soil structure. The addition of fertilizer N, P and K are very important on the ground ultisol, because of fertilizer N, P, and K is very beneficial to the growth and crop production. One attempt to do so while ensuring production of corn is by using a pattern of intercropping corn and peanuts. Intercropping is an attempt to plant several kinds of plants on land and the same time or almost simultaneously, which is arranged so that the rows of plants. Intercropping can also increase the productivity of land (Warsana, 2009). Land productivity is the ability of the land to produce crops production in the unit area and can be planted with various species of plants with maximal production.

Intercropping system has inherent limitations of competition between plants in decision nutrients in the soil that would be mutually inhibit plant growth (Sabaruddin *et al.,* 2003). The negative impact from the effect of competition can be reduced by providing nutrients needed by plants and crops main stream (Balitkabi, 2009). Provision of these nutrients can be done with the application of fertilizer N, P, K so that the nutrients can be met and absorbed by plants well.

B. Methodology

This research was conducted at the Experimental Farm, Unit of Dryland Agriculture Faculty Haluoleo University Kendari. The research location is at an altitude of 25 meters above sea level and the position 04000'46 "LS and 122031'06" BT. Research planned to run for four months in the dry season, which was from August to November 2015.

Field trial organized by randomized block design (RAK) with two factors. Both these factors are designed in a split plot design (Split Plot Design). The first factor is the inorganic fertilizer (S) is placed as the main plot (main plot) which consists of three levels, namely NPK dose combination (a) a dose of NPK 56:36:25 kg ha^{-1} (equivalent Urea: SP-36: KCl 125-100-50 kg ha^{-1}) (S1), (b) a dose of NPK 90:54:25 kg ha^{-1} (equivalent Urea: SP-36: KCl 200-150-50 kg ha^{-1} (S2), (b) a dose of NPK 124: 72: 50 kg ha^{-1} (equivalent Urea: SP-36: KCl 275-200-100 kg ha^{-1} (S3). the second factor is the time of planting peanuts in crops such as corn (W) as subplots (sub plot), consists of three levels of planting time namely (a) planting peanuts 10 days before planting (HSB) corn (W1), (b) simultaneously planting corn planting peanuts (W0), and (c) the planting of peanuts 10 days after planting (DAP), corn (W2). There are nine treatment combinations of the two factors mentioned above. Each combination treatment was repeated three times, coupled with each of the three experimental plots for the system monoculture corn and peanuts. The total number of experimental units was 45 units of trial

C. Result and Discussion

1. Leaf Size Index

ILD at the age of 56 HST obtained at the highest dose treatment of NPK 90-54-25 kg ha-1 and the treatment time of planting peanuts 10 days prior to planting corn namely 0.20, a high leaf area index usually increases photosynthesis and the absorption of nutrients and the results of

plant dry matter. The greater the P element available to plants, the greater the P element that can be absorbed by plants, the photosynthesis will increase and the rate of plant growth also increases and promotes the growth of roots and systems rooting good, spurring the formation of flowers and ripening fruit / seeds, the harvesting, increase the percentage of the formation of flowers into fruits / seeds (Karama, Subandi, and Makarim, 1991; Salisbury & Ross, 1995).

Table 1. Effect of dosage of NPK fertilizer and planting peanuts in crops such as corn on the leaf size index of corn plants aged 56 HST

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.04^{b}_{q}	$1.42^{b}_{p\,q}$	$1.81^{a\,b}_{p}$	2 = 0.51
90: 54: 25	1.71^{a}_{q}	2.35^{a}_{p}	1.36^{b}_{q}	3 = 0.53
124: 72: 50	$1.64^{a\,b}_{q}$	$2.13^{a}_{p\,q}$	2.26^{a}_{p}	
DMRT 0.05	2 = 0.506	3 = 0.531		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

2. The product of Plants

Table 2. Effect of NPK fertilizer dose and timing of planting peanuts in intercropping with maize against corn crop yield (ton ha-1)

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	3.90^{b}_{q}	4.64^{b}_{p}	5.24^{a}_{p}	2 = 0.60
90: 54: 25	3.98^{b}_{q}	5.00^{b}_{p}	3.24^{b}_{r}	3 = 0.63
124: 72: 50	4.65^{a}_{q}	6.43^{a}_{p}	5.24^{a}_{q}	
DMRT 0.05	2 = 0.62	3 = 0.65		

Description: The numbers followed by letters are not the same in the same row (p, q, r) and column (a,b) significantly different at DMRT 0.05

Table 3. Effect of NPK fertilizer dose and timing of planting peanuts in crops such as corn to peanut crop yield (ton ha-1)

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.52^{a}_{q}	1.43^{b}_{q}	1.55^{a}_{p}	2 = 0.25
90: 54: 25	1.38^{a}_{q}	1.73^{a}_{p}	1.31^{a}_{q}	3 = 0.27
124: 72: 50	1.53^{a}_{q}	1.86^{a}_{p}	1.48^{a}_{q}	
DMRT 0.05	2 = 0.285	3 = 0.299		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

The results also show that the effect of the interaction between the dose of NPK fertilizer and planting tangible and very real effect on plant height peanuts at age 42 HST and 56 HST highest dosage of NPK fertilizer 124-72-50 kg ha-1 and the treatment time peanut planting 10 days after planting corn but not significantly different from the dosage of NPK fertilizer 56-36-25 kg ha-1 and the treatment time of planting peanuts 10 days prior to planting corn. One of the plants intercropped first planted the plants are able to take advantage of growth factors in advance without any competition. Treatment of peanut planting maize 10 days before the peanuts are first exploit growth factor peanut plants first master of space to grow before corn become a competitor in the fulfillment of nutrient needs. Bean plant roots have grown and able to absorb most of the nutrients from the soil and peanut leaf canopy has developed to adsorb sunlight without competing with corn plants that grow later and discount posture higher than peanut.

Table 4. Effect of NPK fertilizer dose and timing of planting peanuts in crops such as corn on the values of equality land

NPK dose	Peanut Planting time			DMRT 0.05
	coincide	10 HSB	10 HST	
56: 36: 25	1.73^{a}_{p}	1.70^{b}_{p}	1.80^{a}_{p}	2 = 0.16
90: 54: 25	1.38^{b}_{q}	1.84^{b}_{p}	1.31^{c}_{q}	3 = 0.17
124: 72: 50	1.59^{a}_{q}	2.18^{a}_{p}	1.58^{b}_{q}	
DMRT 0.05	2 = 0.20	3 = 0.21		

Description: The numbers followed by letters are not the same in the same row (p, q) and column (a,b) significantly different at DMRT 0.05

Increasing doses of NPK fertilizer 124-72-50 kg ha-1 at the time of planting peanuts 10 days before planting maize is to increase crop production to the value of the land equal 2.18. This value represents the efficiency of the land, that is, if the value> 1 means profitable. Intercropping systems can increase the productivity of agricultural land if the type of plant species are combined in these systems form a mutually beneficial interaction.

Selection of corn and peanuts as the main component in the system of intercropping have a significant role, as well as corn and peanuts is a plant that is widely known and widely used as a necessity that needs to be developed and improved production. Intercropping systems can increase the productivity of agricultural land if the types of plants are combined in these systems form a mutually beneficial interaction.

Another thing to note in the pattern of intercropping is planting time, because the time of planting associated with vegetative growth, vegetative growth that is faster and dominate the space it will be better able to compete in the fight over water, nutrients and light compared with growth of vegetative slow, finally will affect production. Willey *et al*. (1982) stated that in preparing the cropping system needs to pay attention to the sensitivity of plants to competition during the life cycle. In the period of plant growth are certain periods that are very sensitive to the environment and the stress in the period, influence growth and yield. In order that competition between plant species as small as possible; it should be regulated so demand the highest growth resources for each type of plant does not occur at the same time.

Competition index is an indicator of competition among plants in the cropping system. Competition index can occur intra-specific and inter-specific. Intra-specific competition is usually greater than the inter user specific same plant growth due to compete for nutrients, water and light in the same needs. Variance showed that the interaction between NPK fertilizer and planting very significant effect on the index of competition. The highest competition index obtained in the commission of a dose of NPK 90-54-25 kg ha-1 and the treatment time of planting peanuts 10 days after planting the corn that is the index value and the carrying out of competitions 0.927 dosage of NPK 90-54-25 kg Judge 1 and treatment at the same time of planting peanuts corn is 0.924, while the lowest index gained competition is 0.876 in treatment which is a combination dosage of NPK fertilizer 124-72-50 kg ha-1 and the planting of peanuts 10 days prior to planting corn.

D. Conclusion

1. NPK fertilizer combination treatment and the treatment time of planting peanuts 10 days prior to planting corn, can promote the growth and yield of corn and peanut crops, increase productivity and reduce the index of competition and make efficient use of fertilizers.
2. The interaction between the dose of NPK 124-72-50 kg ha^{-1} and the time of planting peanuts 10 days prior to planting corn can increase crop yields of corn (6.43 t ha^{-1}) and groundnut (1.86 t ha^{-1}), resulting in land equity value is 2.18.

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