

## **Benefits from Organic Fertilizer by Wheat (*Triticum aestivum*) and Faba Bean (*Vicia faba*) Under Intercropping System in Western Shoa, Ethiopia**

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**Abstract:** Manure is a best many nutrients supply for crop production. It also considered as valuable sources for increasing soil organic matter content and improving soil structure. The cropping systems were composed of sole wheat, sole faba bean, and alternate at two locations. The treatments were formed from different concentrations (control, 1t ha<sup>-1</sup> and 5t ha<sup>-1</sup>) of organic fertilizer (made up of cow dung). An arrangement of cropping systems with different concentrations of organic fertilizers has been proved to have an effect on yield and growth parameters of both wheat and faba bean. The maximum yield of wheat were recorded when 5t ha<sup>-1</sup> organic fertilizer was applied to alternate cropped system. While, maximum yield of faba bean (2000Kg ha<sup>-1</sup>) were obtained when it were sown alone at 5t ha<sup>-1</sup> organic fertilizer. Even though all cropped system has been shown a better yield at high concentrations of organic fertilizer, intercropped systems did contributing in the production of the highest yield of wheat at both sites. From the obtained result, it can be concluded that, as concentration of organic fertilizer increased, there is an increment of yields among both cultivars at both Guder and Ginchi sites. But, the best yields of wheat were obtained from alternative intercropping at highest tested organic fertilizer at both sites. The tested level of organic fertilizer and cropping systems approach has very much useful as it increase the yield.

**Keywords:** Organic fertilizer, Biomass, Cropping System, Faba bean, Tiller, Yield.

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### **1. INTRODUCTION**

Manure is a best many nutrients supply for crop production. It also considered as valuable sources for increasing soil organic matter content and improving soil structure. Moreover, compost has a high nutritional value, with high concentrations of especially nitrogen, phosphorus and potassium (Tayebeh Abedi *et al*, 2010). The wise use of this integrated nutrient can contribute for sustainable agricultural productivity through enhancing plant growth, water, and soil and land management. Thus, integrated soil nutrient management was increased the crop yield. According to Zahoor (2014), farmyard manures have a high potential to boost up crop productivity in terms of yield and yield components when combined with chemical fertilizer. Study done on effect of bio-fertilizer when supplied to wheat along with recommended dose of N-P-K fertilizers showed that, a significant influence on plant height, number of tillers plant, spike length, and grain yield.

There is a need to increase the yield of cereal crops to achieve an integrated farming to fulfill its demands resulted from the world population. This, yield increment can be obtained from using organic fertilizers or developing a cropping systems such as intercropping. Previous report had shown that the sheep manure, cow manure and poultry manure were contributed for better yield production of wheat (Ahmed Mam Rasul *et al*, 2015). Wheat is one of the most important crops which play a major role to solve food insufficient problem (Muhammed *et al.*, 2013).

Faba bean is grown world-wide as protein source for food and feed, but at the same time faba bean offers ecosystem services such as renewable inputs of nitrogen (N) into crops and soil via biological N<sub>2</sub> fixation, and a diversification of cropping systems (Jensen *et al* 2010). According to Eskandari and Ghanbari (2010), intercropping is important practice for the development of sustainable food as it has a potential benefits for high productivity and profitability, improvement of soil fertility through the addition of nitrogen and efficient use of environmental resources through the complementary effects of two or more crops. The aim of this study was to evaluate the effect of organic fertilizer on yield and yield components of inter-cropped wheat and faba bean.

## 2. MATERIALS AND METHODS

### 2.1. Description of the Study Area

The field experiments were carried out in western Shoa at Ginchi and Guder during main cropping season of 2012-2013. The study sites were located in West Shoa zone of Oromia National Regional State, central Ethiopia. Ginchi research site is located at 85 km West of Addis Ababa while, Guder Production Farm is located at 124 km, West of Addis Ababa at an altitude of 2200 and 1800 above mean sea level, respectively. The soil type of Ginchi research site is Vertisols with pH of 6.5 at soil depth of 0 to 30 cm. Slope of the study site is ranges from 2 to 5%. On the other hand, the soil type of Guder Production Farm is Nitosol with soil pH of 5.5 to 6.0 at similar soil depth. Both study areas have a unimodal rainfall pattern and average annual total rainfall ranging between 800-1260 mm. The annual (2012-2013) mean minimum, maximum and average air temperatures are 8.91, 25.0 and 18.37 °C, respectively.

### 2.2. Experimental Design and Treatments

The experiments were laid out in a randomized complete block designs (RCBD) with three replications. The cropping systems were composed of sole wheat, sole faba bean, and alternate at two locations. The treatments were formed from different concentrations (control, 1t ha<sup>-1</sup> and 5t ha<sup>-1</sup>) of organic fertilizer (made up of cow dung). All agronomic practices were undertaken. The improved wheat variety and Faba bean were sown in drill at a seed rate of 175 kg ha<sup>-1</sup> and 200 kg ha<sup>-1</sup>, respectively (Getachewet *al.*, 2008). Detailed information of yield-crop spatial arrangements relationship during intercropping were investigated and recorded.

### 2.3. Data Collection and Analysis

The collected data includes plant height, dry biomass, number of tillers and grain yield. Collected data were subjected to analysis of variance (ANOVA). Treatments and mean differences were separated by the least significant difference (LSD) test at 0.05 probability level. All statistical analyses were performed using the SPSS version 16.0 statistical software.

## 3. RESULTS AND DISCUSSIONS

### 3.1. Effect of Organic Fertilizer on Cropping Systems, Yield and Other Growth Parameters at Guder Site

Different concentrations of organic fertilizers (0, 1, and 5t ha<sup>-1</sup>) were used to determine the yield and other growth parameters among cropping systems. Accordingly, the maximum yield of wheat were recorded when 5t ha<sup>-1</sup> organic fertilizer was applied to alternate cropped system. While, maximum yield of faba bean (2000Kg ha<sup>-1</sup>) were obtained when it were sown alone at 5t ha<sup>-1</sup> organic fertilizer. From the different intercropped systems tested at Guder site, the maximum wheat dry biomass (3858Kg ha<sup>-1</sup>), tiller number (6.3) and spike length (8cm) were obtained during alternatively intercropped. But the capacity of wheat to induce yield was reduced when sown alone (800Kg ha<sup>-1</sup>) at absence of organic fertilizer. An increment of yield was also recorded when 1tha<sup>-1</sup> organic fertilizer were applied to alone cropped system for both cultivars. The minimum faba bean yield was obtained from alternate intercropped (1075 Kg ha<sup>-1</sup>) at absence of organic fertilizer. Wheat plants were shortest in the sole plot (103 cm). But the height of wheat increased in faba bean population in alternate (109 cm) intercropped. This result revealed that, application of organic fertilizer to alternate intercropped wheat with faba bean was effective in yield at Guder site (LER>2) (table 1).

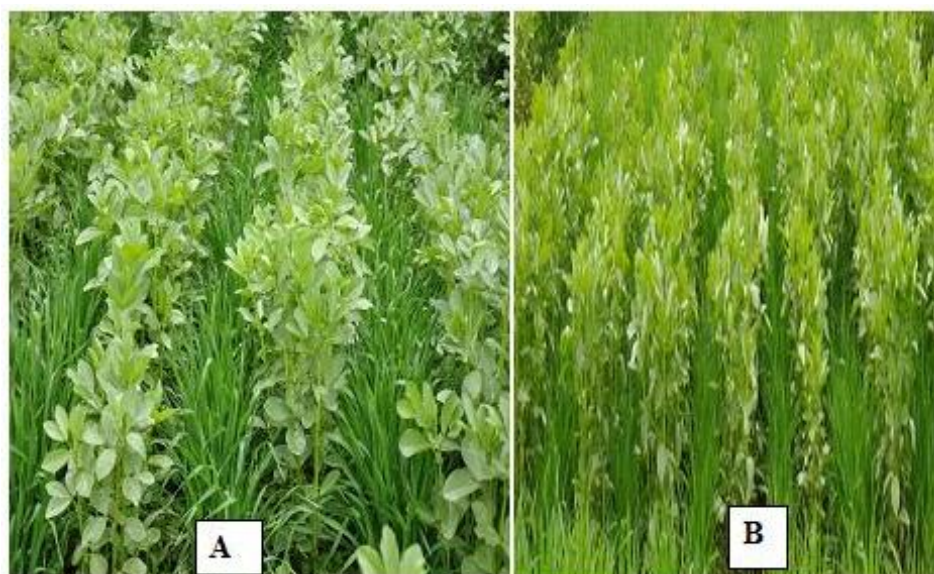
**Table 1.** Organic fertilizers on cropped systems, yield and other growth parameters at Guder site

Cropping systems	Organic fertilizer (t ha <sup>-1</sup> )	Yield (Kg ha <sup>-1</sup> )	Dry Biomass (Kg ha <sup>-1</sup> )	Height (cm)	Tiller No	Spike length (cm)	LER
1. Sole Wheat	0	800.6d	1697.5d	103c	3.7b	6.4bc	
	1	1350c	2515c	105c	3.8b	6.5b	
	5	1700ab	3200a	107b	3.8b	6.0c	
2. Sole Faba Bean	0	1000c	1930.8d	134a	4.8 a	—	
	1	1500b	2955b	135a	4.9a		
	5	1820a	3490a	135a	5.0a		
3. Alternate intercropped							
	0	1520.8b	2968.3b	109b	6.1a	7.4b	2.22
	Wheat	1	1700ab	3350a	108b	6.3a	7.6a
	5	2000a	3858a	109b	6.3a	8.0a	
Faba Bean	0	1075c	1866.6d	130a	2.8d	—	
	1	1501b	2980b	132a	2.7d		
	5	1200c	2300c	134a	2.9d		

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The data present the mean number of yield and other growth parameters of the experiments. Means having the same letters in a column were not significantly different at 5% probability level.

During the first 45 days, well defined growth parameters were observed at all cropping systems except for a slight difference (Figure 1).



**Figure 1.** Application of organic fertilizers to alternate inter-cropped system of wheat with Faba bean at Guder site (A=Alternate intercropped treated at 5t ha<sup>-1</sup> organic fertilizer, B=Alternate intercropped treated as control) from 12 July to 27 August 2012).

### 3.2. Effect of organic fertilizer on cropping systems, yield and other growth parameters at Ginchi site

Like Guder, Ginchi site also produced the best yield of wheat (1600Kg ha<sup>-1</sup>) once 5t ha<sup>-1</sup> organic fertilizer was applied to alternate intercropped system. Likewise, significant yield was obtained from sole cropped (1500Kg ha<sup>-1</sup>) system of faba bean. The maximum biomasses (3100 Kg ha<sup>-1</sup>) and (3000 Kg ha<sup>-1</sup>) were also obtained on alternate for wheat and sole cropped for faba bean treated at 5t ha<sup>-1</sup>, respectively. Even though significant yield of faba bean was obtained from sole intercropped system at 5t ha<sup>-1</sup> organic fertilizer, non-significant yields were obtained at alternate intercropped systems. A significantly different tiller number and spike length were also proved on alternate and sole cropped systems (Table 2). Even though, length of wheat cultivar in all cropping system was nearly the same at different treatments of organic fertilizers, sole faba bean has shown a significant length (90cm) over sole) and alternate (89cm) intercropped systems treated at 5t ha<sup>-1</sup> organic fertilizer (table 2).

**Table 2.** Organic fertilizers on cropped systems, yield and other growth parameters at Ginchi site

Cropping systems	Organic fertilizer (t ha <sup>-1</sup> )	Yield (Kg ha <sup>-1</sup> )	Dry Biomass (Kg ha <sup>-1</sup> )	Height (cm)	Tiller No	Spike length (cm)	LER
1. Sole Wheat	0	790d	1478.3c	83d	1.7d	5.2c	
	1	900d	1715bc	87c	2.5c	5.6b	
	5	1250c	2310b	88b	3.0b	6.5a	
2. Sole Faba Bean	0	892.5d	1694.2bc	88b	2.4	—	
	1	945d	1790bc	87c	3.0b		
	5	1500b	3000a	90a	5.0a		
3. Alternate intercropped							
Wheat	0	1013c	1900.8bc	85d	2.2c	5.6b	2.3
	1	1255c	2300b	88b	3.0b	6.5a	
	5	1600b	3100a	90a	4.0a	6.8a	
Faba Bean	0	608.3d	1105.2d	86c	1.9d	—	
	1	720d	1340c	89a	2.0c		
	5	1120c	2100b	89a	3.0b		

The data present the mean number of yield and growth parameters of the experiments. Means having the same letters in a column were not significantly different at 5% probability level.

Results of the investigation showed that the highest wheat yield at Guder and Ginchi was obtained when wheat was intercropped alternatively with faba bean at 5t ha<sup>-1</sup> fertilizer. Thus, the yield of sole wheat at control was lower compared with the yield obtained from wheat-legume intercropped systems at 5t ha<sup>-1</sup> organic fertilizer. This fact is supported by the research of Zahoor (2014), which indicated that organic fertilizer has the ability of increased yield production. Similarly, sole cropped possesses significant wheat yield at Guder and Ginchi sites, at highest organic fertilizer. But the lowest yield was obtained from sole wheat at both sites at the lower concentrations of organic fertilizer and control. This in accordance with the report of Ahmed Mam Rasul *et al*, 2015, shown that the sheep manure, cow manure and poultry manure were contributed for better yield production of wheat.

Even though all cropped system has been shown a better yield at high concentrations of organic fertilizer, intercropped systems did contributing in the production of the highest yield of wheat at both sites. This significant yield differences among both cultivars could be the result of arranges the organic treatments as sole and alternate cropping system. Similar report has been made by (Ahmed Mam Rasul *et al*, 2015).

#### **4. CONCLUSION**

From the obtained result, it can be concluded that, as concentration of organic fertilizer increased, there is an increment of yields among both cultivars at both Guder and Ginchi sites. But, the best yields of wheat were obtained from alternative intercropping at highest tested organic fertilizer at both sites. An arrangement of cropping systems with different concentrations of organic fertilizers has been proved to have an effect on yield and growth parameters of both wheat and faba bean. The tested level of organic fertilizer and cropping systems approach has very much useful as it increase the yield.

#### **ACKNOWLEDGEMENT**

The authors would like to acknowledge Ambo University for financial and technical supports for the study.

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