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Evaluation Effect of Different Organic Fertilizers and NP Rate on Bread Wheat (*Triticum aestivum* L.) Yield and Yield Components in Lume District

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Abstract: Low oil fertility was one of the major limiting factors for wheat yield reduction. As a result, inorganic fertilizers are commonly supplied to the crop. However, continuous and sole use of inorganic fertilizers may lead to; deterioration in soil chemical, physical and biological properties. Therefore, the study aimed at investigation of integrated use of organic and inorganic fertilizers on crop yield and yield components, which was conducted in a field experiment in Lume district, East Shoa Zone Ethiopia during 2018 cropping season. The organic sources used were compost and vermincompost and urea and NPS were used as an inorganic source of fertilizers. These treatments consist of: T1= 5.64t/ha compost, T2= 5.68t/haVC, T3=100% recommended NP inorganic fertilizers, T4=50% recommended NP inorganic fertilizers + 2.82t/ha compost, T5=50% recommended inorganic fertilizers + 2.84t/havermincompost, T6=No fertilizers application (control). The experiment was laid out as a randomized complete block design replicated three times per treatment. Data were collected on wheat grain yield and yield components. Economic analysis was also performed by estimating the costs of alternative uses of organic and inorganic fertilizers as well as grain and straw prices. The results showed that the application of organic fertilizer in combination with recommended rates of inorganic NP significantly increased the grain yield of food wheat over the application of 100% mineral NP alone and the control. The application of 2.84t/ha vermicompost in combination with 50% recommended rates of NPS+urea fertilizers increases 0.58t/ha wheat yield difference over the application of 100% recommended rate of inorganic NPS alone. It can be concluded that the application of 2.84t/ha vermicompost with 50% recommended rate of inorganic NPS fertilizers has maximum rate of return and can improve soil fertility status and increase the yield of wheat than other treatments. This experiment has to be repeated over seasons and locations to make conclusive recommendations for the study area.

Keywords: Organic, Inorganic Fertilizers, Improves, Wheat Yield

1. Introduction

Soil Fertility decline is a big issue in agriculture of Ethiopia, because the livelihood of the rural population (85%) directly relies on it. Integrated nutrient application not only ensures the supply of essential nutrients to plants but also has some positive interactions to increase nutrient use efficiency and thereby reduce environmental hazards [18]. In Ethiopia low input agricultural production systems, poor agronomic practices in intensive rained farming systems dependent on the use of animal power and absence of proper land use policies have forced soil fertility degradation. Soil fertility degradation has been described as the most important constraint to crop production and food security in the country. As a result, inorganic fertilizers are commonly supplied to the crop. However, continuous and sole use of inorganic fertilizers may lead to chemical soil degradation and shortage of other nutrients which are not supplied through chemical fertilizers [10].

Furthermore, excessive use of chemical fertilizers may cause environmental pollution and alter ecosystem balances that are emerging as one of the major environmental problems [25]. In addition, the price of inorganic fertilizers is increasing and becoming unaffordable for resource poor smallholder farmers. On the other hand, the country has a high population of livestock and farm yard manure, considerable amounts of organic materials. As a result, the use of combined inorganic and organic fertilizer should be required to increase the yield of staple food crops such as wheat and maintain the environmental sustainability. Therefore, this study was initiated to investigate the effects of combined application of organic and inorganic fertilizers on yield and yield components of wheat and to determine optimum rates of combined application of organic and inorganic fertilizers to improve crop productivity. Moreover, the specific objectives of this study were:

Objective

To evaluate the effects of organic and inorganic fertilizers on yield and yield components of wheat

To determine the optimum rate of organic and inorganic fertilizers for maximum benefit.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted in Lume district, east Shoa Zone, Oromia Regional State. The experimental site was 7 km to the South of Modjo the capital town of the district, 32km South South East of Adama and 84 km from Addis Ababa. The area geographically located in 08° 28’ 0’’N and 39° 26’ 0’

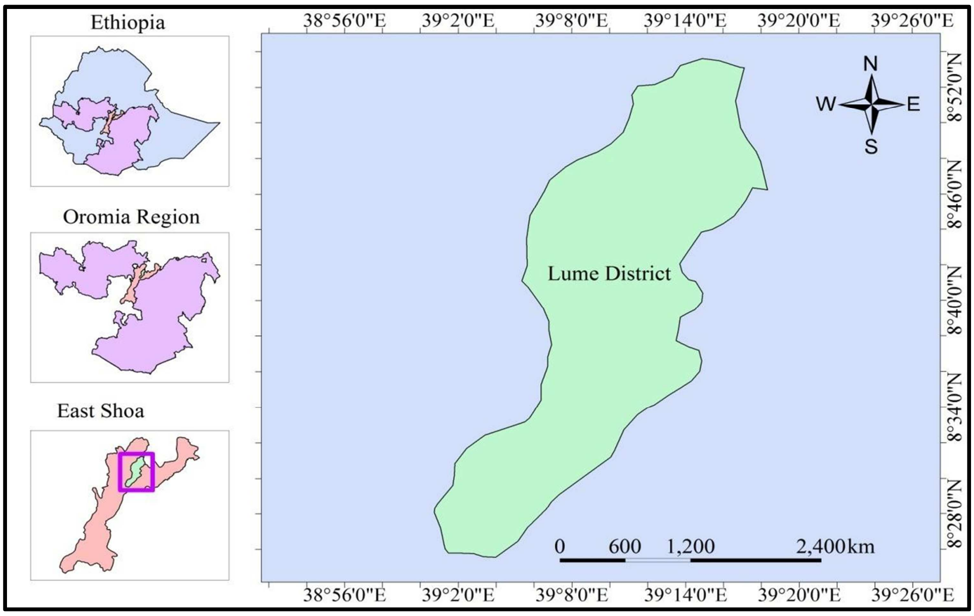

Figure 1. *Map of the Study Area.*

2.2. Experimental Materials

A bread wheat variety named *Ogolcho,* which was released by Kulumsa agricultural research center, was used as a test crop. It was a semi dwarf variety known for its high yielding potential and disease resistance. Urea used as a source of nitrogen and NPS as a source of P inorganic fertilizer and VC and conventional compost used as organic fertilizers for this experiment. Compost was prepared following the standard procedure for compost preparation [15]. Similarly, VC was produced by using earthworm and the same inputs ie. Cattle manure and straw as bedding for the VC and bulking in the composting process, in Adami Tulu Agricultural Research Center.

Compost samples were collected from well decomposed compost and VC before they were applied to the field. Then their N and P contents were analyzed in the laboratory using the standard procedure to determine the rate of application of each treatment, which was based on the recommended N equivalent rate for the test crop. The contents of N and P were 0.92% N and 1.72% P for VC, 1.2% N and 0.89% respectively, for conventional compost. The recommended inorganic fertilizer rate was 100%NPS and 100% urea/ha.

2.3. Experimental Design and Treatments

A field experiment was conducted on *Egersa* Farmers Training Center (FTC) in Lume *district* of East Shoa, Zone.

The area was purposely selected due to the high wheat production potential among the Pas of the *district* and the field was prepared for field trials before it was demonstrated for the farmers. The experiment consists of six treatments (Table 1).

Table 1. *Treatment and treatment combination.*

Treatments	Dose/ha
T1	5.64t/ha Compost
T2	5.68t/ha VC
T3	100% recommended NP fertilizers
T4	50% recommended NP fertilizers+2.82t/ha Cmp.
T5	50% recommended NP fertilizers+2.84t/ha VC
T6	Control (without fertilizer)

The above mentioned treatment combinations were prepared based on compost qualities and inorganic fertilizer recommendation of an area for the test crops. The experiment was laid down in randomized complete block design with three replications per treatment. The total treatment combinations of an experiment were 6*3 replication=18. The size of each plots were 3m*4m (12m^2) and the distance between plots and blocks was 0.5m and 150 kg seed rate was used with the 20cm distance between the rows.

2.4. Land and Seed-Bed Preparation

The field was plowed three times with local conventional oxen driven practices followed by manual seed-bed preparation and laid out according to experimental scheme. Before the application of the treatments to the experimental plot, soil samples were collected from each plot at the depth of 0-30 cm and mixed carefully to prepare one representative composite soil sample for analysis. Two weeks before planting the dried collected compost was mixed with the soil on randomly assigned experimental plots and half of the inorganic fertilizer (urea) applied at planting and half of them applied at tilling.

2.5. Soil Sampling and Laboratory Analysis

Soil samples were collected from each plot before treatment application and after yield harvest top representative composite soil samples also collected. These composite soil samples were used for analysis of selected physic chemical properties of soils following the standard laboratory procedures.

The textural classes of the soils were assigned using the textural triangle of the USDA. Bulk density (BD) was determined from undisturbed soil samples using core samplers. While, the average soil particle density (PD) 2.65g/cm^3 was used for estimating total soil porosity (TP) as:

$$TP\ (\%)\ = \frac{(1 -\ Bulk\ density\ (BD)}{Particle\ density\ (PD)} * 100\%$$

Organic Matter=1.724*Organic Carbon

$$Base\ Saturation\ (\%) = \frac{sum\ of\ exchangeable\ Bases}{CEC} * 100\%$$

The pH of the soil was determined using 1:2.5 soil samples to water ratio using a glass electrode attached to a digital pH meter. The EC was measured by a conductivity meter using the saturated extract1:2.5soil. Organic carbon content was analyzed with the oxidation of acid potassium di-chromate ($K_2Cr_2O_7$) Walkley and Black method and TN was determined by the micro Kjeldahl method with sulphuric acid. The Ava. P was determined by the Olsen's Method. The amount of exchangeable calcium and magnesium were measured in the leach of NH_4OAC with the standard series of Ca and Mg solutions by atomic absorption spectro photometer (AAS). Similarly, the amount of exchangeable sodium and potassium were measured in the leach of$NH_4OAC$with the standard series of Na and K solutions by flame photometer. CEC of the soil was measured after saturating the soil with acetic acid by ammonium acetate method. The micro nutrients were measured according to the DTPA-extractable method.

2.6. Economic Analysis

To identify the optimum economic rate of fertilizer combinations, economic analysis was done using the [9] partial budget analysis methodology. To estimate economic parameters, wheat yield was valued at an average open market price of 16.00 Ethiopian Birr/kg and the costs of NP fertilizer were 15 and 16 Ethiopian Birr/kg, respectively. The costs of organic fertilizer were estimated per hectare. The potential responses of crop towards the added fertilizer ultimately determine the economic feasibility of fertilizer application [9] as follows:-

AJY=GAY-(GAY*0.15)

Where, AJY: adjusted yield down by 15% to reflect the difference between the experimental yield and yield of farmers and GAY:-gross average yield of each treatment in t/ha.

NB=GFB–TC

Gross field benefit (GFB): was computed by multiplying field/farm gate price that farmers receive for the crop when they sell it as adjusted yield.

GFB=AJY*field/farm gate price of a crop Total cost (TC): mean current prices of Urea 15 Ethiopian Birr/kg), NPS 16 Ethiopian Birr/kg and wage for VC, compost, phosphorus and nitrogen application were considered per hectare. Net benefit (NB):-was calculated by subtracting the total costs from the gross field benefit for each treatment.

The dominance analysis procedure as in [9] was used to select potentially profitable treatments from the range that was tested using the equation.

$$MRR\ = \frac{Change\ NI}{Change\ TVC} * 100\%$$

Where, NI: change in net income, TVC: change in total variable cost, MRR: Marginal rate of return Thus, (MRR) of 100% implies a return of one Birr one very Birr of expenditure in the given variable input.

3. Result and Discussions

Table 2. *Selected physic chemical properties of soil of the experimental site before treatment application.*

Physical Properties	Value
Sand (%)	47
Silt (%)	36
Clay (%)	17
Texture	Loam
Bulk Density (g/cm^3)	1.51
Total Porosity (%)	31.14
Soil Moisture (%)	22.19
Chemical Properties	

Physical Properties	Value
pH	7.49
EC (ds/m)	1.02
OC (%)	2.0
TN (%)	0.21
C: N%	9.52
Ava. P (mg/kg)	14.96
Ava. K (mg/kg)	34.31
Exchangeable bases (Cmol (+) kg^{-1}	
Ca	9.42
Mg	2.45
K	0.59
Na	0.13
CEC (Cmol (+) kg^{-1}	24.11
Micro Nutrients (mg/kg)	
Fe	0.75
Cu	0.16
Mn	0.68
Zn	0.16

3.1. Effect of the Combined Application of Organic and Inorganic Fertilizer on Soil Chemical Properties

The initial soil reaction of the experimental site (pH) was moderately alkaline with a pH of 7.49 according to [12]. The EC of the soil was 1.02 dS/m found under non-saline safe for crop production and the soil of the study site had 2% OC content (Table 3), which was moderate [40] indicating moderate potential of the soil to supply nutrients to plants through mineralization of organic matter. The moderate amount of soil OC might be due to small addition of manure and less aeration due to soil compaction. Therefore, regular application of organic fertilizer such as compost and VC is required for the study area.

TN has other very important soil parameters which was 0.21% before treatment application which is found under moderate amounts [40]. The moderate soil organic carbon content might also be an indicator of the low soil nitrogen as it is a major source of native mineral nitrogen for plant growth. So soil of the experimental site needs extra nitrogen which is required in large quantities for crop production and enough after combined application of organic and inorganic fertilizers. Ava. P is the second largely required nutrient next to nitrogen. It is found 14.96kg/mg which is medium in range, according to [9]. The third largely required is Ava. K and in the study area it was 34. mg/kg which is medium in availability before treatment application.

Table 3. *Effects of organic and inorganic fertilizers on soil pH, EC, OC, TN, Ava. P and Ava. K.*

Treatments	pH	ECdS/m	OC%	TN%	C: N	Ava. Pmg/kg	Ava. Kmg/kg
T1	7.23^{c}	7.23^{c}0.21^{c}	2.21^{b}	0.31^{d}	7.45^{b}	26.73^{b}	113.47^{d}
T2	7.17^{d}	7.17^{d}0.22^{c}	2.20^{b}	0.33^{c}	6.76^{c}	22.09^{c}	115.62^{c}
T3	7.52^{a}	7.52^{a}2.39^{a}	2.06^{c}	0.22^{e}	9.51^{a}	20.04^{d}	92.11^{e}
T4	7.12^{e}	7.12^{e}0.17^{c}	2.47^{a}	0.42^{b}	5.99^{d}	33.06^{a}	125.89^{b}
T5	7.07^{f}	7.07^{f}0.18^{c}	2.45^{a}	0.44^{a}	5.72^{d}	35.44^{a}	128.25^{a}
T6	7.42^{b}	7.42^{b}1.18^{b}	1.27^{d}	0.17^{f}	7.52^{b}	14.69^{e}	31.83^{f}
LSD	0.02	0.0180.72	0.052	0.01	0.62	1.78	1.96
CV%0.13	0.13	9.89	1.38	2.12	4.90	3.93	1.09

Means within column followed by the same letters are not significantly different at P ≤ 0.05; LSD= Least significant difference, CV=Coefficient variation; VC= Vermicompost, T1 = 5.62t/ha Compost, T2 = 5.64 t/ha VC, T3 = 100% NP inorganic fertilizer, T4 = 2.82 t/ha Compost+50% NP fertilizers, T5 = 2.84t/ha VC + 50% NP fertilizer, T6 = Control (without fertilizer)

The highest and lowest pH values were 7.52 and 7.07 were recorded from full doses of inorganic fertilizer and the combined application of 2.84t/ha VC with 50% recommended NPS + urea fertilizers respectively (Table 3). This might be due to the combined application of organic and inorganic fertilizer which lowered the soil pH to neutral range owing to the release of H^+ ions via microbial decomposition of organic fertilizersAccording to [12], the soil at this experimental site from the combined application of 2.84t/ha VC with 50% recommended NPS + urea fertilizers can be rated as moderately alkaline that does not require treatment with gypsum in order to reduces soil pH and is optimum for crop production. The present result was agreement with the of [37] who reported that a reduction of soil pH occurs when green manure or farmyard manure was used in alkaline soils.

After the harvest of wheat yield, the combined application of organic and inorganic NP fertilizer significantly (P<0.01`) increased the soil OC content. The highest soil OC content 2.47% was recorded from the plots treated with combined application of 2.82t/ha compost with 50% recommended inorganic NPS + urea fertilizers and the lowest organic carbon 1.27% was from the control plots (Table 3). The increased OC content might be due to higher soil OM added through compost application. The result was in line with [41] who reported that the application of NP along with VC in wheat fields gave significantly higher soil OC content (5.6%) after harvest over the application of inorganic NP alone.

The highest TN (0.44%) was recorded for the plots treated with combined application of 2.84t/haVC with 50% recommended NPS + urea fertilizers. Where as, the lowest TN (0.17%) was recorded from control plots (Table 3). This combined application of VC with NPS fertilizer increases the total nitrogen content by 50% over recommended inorganic NP fertilizer. This might be due to high nitrogen content of organic fertilizers, as there was no fertilizer applied to the control plots, this could also be attributed to previous cropping systems practiced by the farmers prior to the experiment. The result is in line with [5] who revealed that combined use of NP and compost increased soil TN by 31% compared to the sole application of inorganic NP fertilizers.

Phosphorus (P) is the most important limiting plant nutrient next to nitrogen for crop production. The combined applications of organic and inorganic fertilizers significantly affect Av. P in soil as compared to 100% recommended NPS inorganic fertilizer and the control.

The highest and lowest Ava. P (35.44mg/kg and 14.69 mg/kg) was obtained from the application of 2.84t/haVC in combination with 50% recommended NP + urea fertilizers and control plots (Table 3) respectively. This result was in line with, [39] who reported the height concentration of Ava. P in soils (17.22mg/kg) was realized from the combined application of 15t/ha compost and 100 kg/ha P_2O_5 as compared to the control plot.

Potassium is needed in large quantities by many crops next to nitrogen and phosphorus. Available potassium was significantly affected by the combined application of organic and inorganic fertilizers. The highest Ava. K of 128.25mg/kg was recorded for plots treated with combined application of 2.84t/haVC in combination with 50% of recommended NPS + urea fertilizers and the lowest Ava. K 31.83mg/kg were obtained from the control (Table 3). The increase in Av. K with the application of VC might be due to the K from the organic sources and also could be due to higher microbial activities in the soil which increased their rate of non-exchangeable or fixed-K forms into available forms.

3.2. Days to 75% Heading

The analysis of variance revealed that organic and inorganic fertilizer had significant ($P<0.05$) influence on crop at days to 75% heading of wheat compared with control plots (Table 4). The longest duration to reach 75% heading (61.60) was observed in combined application of 2.82t/ha compost + 50% recommended NP fertilizers (Table 4). However, the minimum duration of 75% heading (59.29) was recorded in the control treatments. This might be due to organic fertilizer releases its nutrients slowly relative to inorganic sources and the elongated days to heading due to the increased rates of nitrogen might be attributed to the role of nitrogen plays in promoting vegetative growth. This finding was in agreement with the result of [23] who reported that combined application promoted vegetative growth, leading to prolonged days to heading. Similarly, this result is in line with [33] who reported early flowering with an increase in the rate of N application in rice. [32] also showed that application of adequate readily soluble inorganic fertilizers leads to extended vegetative growth delaying days to heading of wheat when combined with organic fertilizer. Moreover, the present results support the previous findings of [14, 24] who pointed out that more nitrogen availability will extend the vegetative growth of the crop. On the other hand, wheat plants that received no nitrogen headed earlier than those that received nitrogen as a result of the physiological consequence of N deficiency, which led to stunted and early completion of the life cycle [13]. Consequently, the stunted leaves become chloroticus the lack of N limits the synthesis of protein and chlorophyll.

3.3. Plant Height

The plant height is an important growth character directly linked with the productive potential of the plants in terms of fodder and grain yield. The analysis results of the present study showed that all the treatment increased plant height significantly over control (Table 4). The tallest plants (79.96cm) were observed in the plots treated with the combined application of 50% recommended inorganic NP fertilizer and 2.84t/ha VC (Table 4). On the other hand, the lowest plant height (64.43cm) was obtained from the control plot. Considering the maximum height in VC plus mineral fertilizers combination, the mineral fertilizers fulfill the N requirements at early growth stages while, VC enhanced crop growth by releasing adequate amount of nutrients in the later stages. The present study was in harmony with [20] who reported that application of mineral fertilizer alone or combined with fertilizer organic increased plant height significantly due to the major role of nitrogen in cell division; cell expansion and enlargement which ultimately affect the vegetative growth of wheat plant particularly plant height. In agreement with this result of [2] found that the maximum wheat plant height of (89.4cm) at maximum application of 69 kg/ha N combined with organic fertilizers. Similarly, this study agreed with [18] pointed out that the maximum plant height of (65.5cm) for wheat at maximum application rate of 92 kg ha-1 of nitrogen.

3.4. Days to Maturity

The analysis of variance shows that the effects of organic and inorganic fertilizer application significantly ($P<0.05$) influence days to 90% physiological maturity of wheat (Table 4). The results showed that wheat plants that received 2.82t/ha compost combined with 50% recommended inorganic NP fertilizer required 3% more duration to reach 90% physiological maturity than wheat plants grown in the control plots. This might be attributed to the role of compost in promoting vegetative growth. On the other hand, the control treatment led the wheat plants to earlier attainment of 90% physiological maturity, followed by treatments with 100% recommended inorganic NP fertilizer (Table 4).

This was in line with findings of [16] that nitrogen promotes vegetative growth there by delaying plant maturity. This might be due to the fact that organic fertilizer contains slowly released nitrogen at the later growth stage. [7] also reported that the extended days to physiological maturity of bread wheat from 158.75 to 152.96 days as nitrogen rates increased from zero to the maximum combined application of both organic and inorganic fertilizers. The result was also supported by the findings of [11] who reported that higher N levels resulted in sustained leaf photosynthesis and extended days to maturity.

***Table 4.** Effects of organic and inorganic fertilizers on wheat growth properties.*

Treatments	Days to Emergency	Plant Height /cm/	Days to maturity
T1	60.1^{ab}	77.43^{ab}	99.36^{ab}
T2	61.15^{ab}	79.32^{ab}	99.65^{ab}
T3	61.39^{ab}	76.55^{ab}	98.52^{bc}
T4	61.60^{a}	75.11^{b}	99.74^{a}
T5	61.19^{ab}	79.96^{a}	98.85^{ab}
T6	59.29^{b}	64.43^{c}	97.42^{c}
$LSD_{0.05}$	2.18	4.41	1.20
CV	2.02	3.28	0.68

Means within column followed by the same letters are not significantly different at P≤0.05; LSD=Least significant difference; CV=Coefficient variation, T1= 5.62t/ha Compost, T2= 5.64t/ha VC, T3= 100% inorganic fertilizer, T4=2.82t/ha Compost + 50% NP fertilizers, T5= 2.84t/ha VC + 50% NP fertilizers, T6= Control (without fertilizer)

3.5. Number of Tillers per Plant

The effect of inorganic and organic fertilizer was significant (P<0.01) on tiller number produced per plant compared to control treatment. The maximum number of tillers per plant (5.59), was produced by plants treated with the combined application of 50% recommended inorganic NP fertilizer combined with 2.82t/h a compost. The minimum number of tillers per plant (4.54) was produced at control plots (Table 4). This might be attributed to the rapid conversion of synthesized carbohydrates into protein and consequently increase in number and size of growing cells, ultimately resulting in an increased number of tillers [37].

In agreement with this result, [26] reported significantly the maximum number of tillers (389 per m^2) at application of 50kg/haNP. In line with this result [13] was also reported that the highest tillers per plant (5.58) at combined application of 32 kg/ha and 46kg/haP_2O_5 combined with VC in bread wheat. Similar results were reported by [40] who said that the maximum number of wheat tillers per plant (1.97) at N rate of 92 kg/ha fertilizer.

3.6. Number of Grain Per Spike

Considering grain per spike, all treatments produced significantly (P<0.01) higher grain per spike than control plots. The maximum numbers of the grains per spike (55.08) were obtained from the plots treated with the combined application of 50% recommended NP and 2.84t/ha of VC. The minimum number of grain per plant (41.45) was obtained from the control treatment (Table 5). The reason could be due to continuous supply of nutrients throughout the crop growing period starting from earlier to later growth stages from inorganic and organic sources, respectively.

This finding was in accordance with [5] who reported that the seed number per spike was remarkably increased as a result of applying organic manures and mineral fertilizer in combination. In harmony with this study, [23] has reported that application of organic fertilizers such as VC and compost increased the number of spikes produced per meter square by improving soil fertility, increased soil organic matter, enhanced microbial activities and improved soil structure. Similar result was reported by [18] that the combined application of organic and mineral fertilizers improved the early establishment of wheat through increased fertility grain per spike. In agreement with this result, [37] also reported that increasing the rates of both organic and inorganic fertilizers increases the number of grain produced per spike.

3.7. Spike Length

Spike length was another important yield component, which affects the number of grains pers pike. Application of both organic and inorganic fertilizer had a significant effect (P<0.05) on spike length over control (Table 5). The highest spike length (8.71cm) was recorded from 50% recommended inorganic NP fertilizer combined with 2.82t/ha compost followed by (8.10cm) due to the combined effect of 50% of recommended inorganic NP fertilizer and 2.84t/haVC, where as the shortest spike length (7cm) was observed from the control treatment (Table 5). This result showed the combined applications of mineral fertilizer and organic fertilizer which could help the plants to produce well developed spikes. This indicated that nitrogen and VC had a more pronounced effect on wheat spike length. This finding agreed with the finding of [29] who reported the highest spike length (7.7cm) for wheat at the rate of 50/150kg/ha of N and P_2O_5 respectively.

Similar results were also reported by [42] that longer spikes were obtained by the application of mineral fertilizer and organic fertilizer. [28] also pointed out that the longest spikes were recorded from the combined application of NP and compost. This result also supports the idea of [7] who reported that increasing N rate from 0 to 69 kg/ha increased spike length of bread wheat in combination with organic fertilizer.

***Table 5.** Effects of organic and inorganic fertilizer on yield and yield components of wheat.*

Treatments	Number of Tillers	Spike length /cm/	Number of Grain / spike	1000 grain Weight (g)	Grain Yield t/ ha	Straw Yield t/ha
T1	5.33^{ab}	8.16^{a}	53.02^{b}	43.86^{bc}	5.11^{d}	75.06^{c}
T2	5.18^{b}	7.92^{a}	53.52^{ab}	44.44^{b}	5.21^{cd}	76.12^{bc}
T3	5.13^{b}	8.63^{a}	55.08^{a}	42.58^{c}	5.35^{c}	77.23^{b}
T4	5.59^{a}	8.71^{a}	54.86^{ab}	46.71^{a}	5.75^{b}	79.32^{a}

Treatments	Number of Tillers	Spike length /cm/	Number of Grain / spike	1000 grain Weight (g)	Grain Yield t/ ha	Straw Yield t/ha
T5	5.33[ab]	8.10[a]	55.08[a]	47.74[a]	5.95[a]	80.73[a]
T6	4.54[c]	7.00[b]	41.65[c]	39.65[d]	1.53[e]	41.12[e]
$LSD_{0.05}$	0.39	0.88	1.96	2.25	1.78	1.78
CV%	4.23	6.15	2.12	1.77	2.08	1.40

Means within column followed by the same letters are not significantly different at P≤0.05; LSD=Least significant difference; CV=Coefficient variation, T1= 5.62t/ha Compost, T2= 5.64t/ha VC, T3= 100% inorganic fertilizer, T4=2.82t/ha Compost + 50% NP fertilizers, T5= 2.84t/ha VC + 50% NP fertilizers, T6= Control (without fertilizer)

3.8. Thousand Grain Weight

The applied organic and inorganic fertilizers significantly (P<0.01) improved the 1000 grain weight of seed over control (Table 5). The maximum 1000 grain weight (47.74g) was found in treatment where2.84t/ha VC combined with 50% recommended inorganic NP fertilizers, followed by (46.71g) from the plot which receives 50% recommended inorganic NP fertilizers combined with 2.82t/ha compost. In contrast, the lowest 1000 grain weight (39.65g) was recorded from the control plots (Table 5). This result was supported by [21] who showed that thousand grain weight to be significantly higher when 10t/ha with 80% of the recommended mineral fertilizer was applied. Similar works have been done by [1] who evaluated that they fulfilled the minimum acceptable kernel size (35g) which have no organic fertilizer. This result has also been reported by [42] who observed higher 1000 grain weight with the use of organic manure and mineral fertilizers.

3.9. Grain Yield

The effect of organic and inorganic fertilizer application significantly (P<0.01) on grain yield between treatments (Table 5). Thus, the highest grain yields (5.93t/ha) was obtained from the combined application of 50% recommended inorganic NP fertilizers with 2.84t/ha VC, followed by (5.75t/ha) from 50% recommended inorganic NP fertilizers combined with 2.82t/ha compost. On the other hand, the lowest grain yield (1.53t/ha) was obtained from control plots (Table 5). In line with this, the study conducted by [3, 27] revealed that the combined application of organic and mineral fertilizers ensured higher returns in wheat crop yields. Furthermore, [31] found that yield was increased by 35% when combined inorganic and organic fertilizers were applied. Likewise, the combined application of organic and inorganic nutrient sources improves synchronization between nutrient release and plant recovery thus, resulting in better crop growth than yield [19].

However, the lowest grain yield (2.6t/ha) was obtained under the control plots. The result was similar with research finding of [17] in Tigray Region showed that application of 6.4t/ha compost with mineral fertilizers produced 3.2t/ha higher grain yields of teff and barley than the control plots. In addition to this, [8] reported that grain yield of bread wheat significantly increased due to the main effect of nitrogen and phosphorus fertilization with compost obtained the highest wheat grain yields (4.44t/ha). This is more or less agreed with the finding of [36] who showed that application of VC along with mineral fertilizers produced significantly higher grain yield than the application of inorganic fertilizer alone.

3.10. Straw Yield

The analysis of variance illustrated that straw yield of wheat was significantly different between treatments (P<0.01) over the control plot (Table 5). The maximum straw yields (8.07t/ha) were obtained from the combined application rates of 50% recommended inorganic NP fertilizer with 2.84t/h VC (Table 5). The minimum straw yields (4.11t/ha) were recorded from the control plots. The significant increase in straw yield in response to the increased combined application of recommended inorganic NP fertilizer and VC. This might be attributed to the positive roles of organic and inorganic fertilizer enhancing growth and development of the crop as suggested above for grain yield. This result is in line with that of [33] who reported that straw yield was significantly increased by the application of organic fertilizers along with the application of inorganic fertilizers. The result of this study also supports the idea of [31] who reported that increased straw yield of wheat with increased NP fertilizers rates up to 90/45kg/ha when integrated with organic fertilizers. Similarly, [4] reported that N rate significantly enhanced the straw yield of wheat since N usually promotes the vegetative growth of a plant.

3.11. Economic Analysis

The partial budget analysis was done to identify the economic benefits of the proposed and tested rewarding treatments. Yield from on-farm experimental plots was adjusted downward by 15%*i e.*,10% for management difference and 5% for the plot size difference, to reflect the difference between the experimental yield and the yield that farmers could expect from the same treatment [14]. The highest grain yield (5.93t/ha) was recorded from the combined application of 50% recommended inorganic NP combined with 2.84t/ha VC and the lowest grain yield (1.53t/ha) was from the control treatment. The adjusted maximum and minimum grain yield were (5.05t/ha and 1.3t/ha) respectively, according to [9]. An average market grain price of wheat was (Ethiopian Birr 16 Kg/ha), farm gate price of NP P fertilizers (Ethiopian Birr 15 Kg/ha and 16 kg/ha) respectively and labor valued at 35 Ethiopian birr, per person per day was used for compost and VC estimation.

The economic analysis revealed that the highest net benefit of (Ethiopian birr 76932.5/ha was obtained from the application of 2.84t/ha VC plus 50% recommended inorganic NP fertilizers, where as the control treatment (plots without treatment) gave the lowest net benefit (18589/ha Ethiopian birr) (Table 6).

Table 6. *Partial budget and dominance analysis of wheat yield influenced by organic and inorganic fertilizer.*

Trt	GYt/ha	AJY. GY-15%	GGBETB	Coststhatvary (ETBha^{-1})			
				Fert	Labor	TVC	NBETB
T1	5.11	4.34	69504	-	3575	3670	65834
T2	5.21	4.43	70912	-	3670	3575	67337
T3	5.35	4.54	72512	3100	2000	5100	67412
T4	5.75	4.88	78224	1550	2337.5	3935	74289
T5	59.35	50.45	80720	1550	2385	3787.5	76932.5
T6	15.34	13.04	20864	-	2275	2275	18589

GY:-Grain Yield, AJY. GY:-Adjusted Grain Yield, GGB:- Grain Gross Benefit, TVC:-Total Variable Cost, NB:- Net Benefit, ETB:- Ethiopian Birr, Trt:- Treatment, VC=VerminCompost. The price of wheat was Ethiopian Birr 16/kg and the cost of 1kg of N fertilizer was Ethiopian Birr15/kg where as P was Ethiopian Birr16/kg; T1=5.62t/ha Compost, T2=5.64t/haVC, T3=100%NP inorganic fertilizer, T4=2.82t/ha Compost+50%NP fertilizers, T5=2.84t/haVC+50%NP fertilizer, T6=control (withoutfertilizer), Compost+50%NP fertilizers, T5=2.84t/haVC+50%NPf ertilizer, T6=control (withoutfertilizer)

The dominant treatments were eliminated from further economic analysis. To identify treatments with the optimum return to the farmer's investment, the marginal analysis was performed on non dominated treatments. For a treatment to be considered as an option to farmers, between 50% and 100% marginal rate of return (MRR) was the minimum acceptable rate of return [9]. The economic analysis further revealed that the application of 2.82t/ha compost with 50% recommended inorganicNP fertilizers provide the highest marginal rate of return (MRR) of 4662%, suggesting for each birr invested in wheat production, the producer would collect birr 46.62 after recovering his cost. So that MRR assumed in this study was 100%, the treatment with an application of 2.82t/ha compost with 50% recommended inorganic NP fertilizer gave rise to an acceptable MRR.

Table 7. *Marginal analysis of organic and inorganic fertilizer effects on wheat yields.*

Treatment	TVC	NB	MVC	MNB	MRR
T6	2275	67412	0	18589	0
T2	3537	65834	1300	67337	3749.8
T1	3670	74289	95	65834	D
T5	3787.5	76932.5	117.5	76932.5	9445.5
T4	3935	67412	147.5	74289	D
T3	5100	65834	1165	67412	D

TVC=Total variable cost, NB= MVC= Marginal variable cost, MRR=Marginal rate of return, T1=5.62t/ha Compost, T2=5.64t/haVC, T3=100%NP inorganic fertilizer, T4=2.82t/ha Compost+50%NP inorganic fertilizers, T5=2.84t/haVC+50%NP inorganic fertilizer, T6=control (withoutfertilizer)

4. Conclusion and Recommendation

Low soil fertility was one of the major limiting factors for wheat yield reduction. As a result, inorganic fertilizers are commonly supplied to the crop. However, continuous and sole use of inorganic fertilizers may lead to; deterioration in soil chemical, physical and biological properties. The study was conducted in Lume District of east Shoa Zone of Oromia National Regional State, with the following objectives:1) To evaluate the effects of organic and inorganic fertilizers on yield and yield components of wheat 2) To determine the optimum rate of organic and inorganic fertilizers for maximum benefit. The experiment was laid down in RBCD with three replications. The experiment consisted of six treatments: T1=5.64t/ha compost, T2=5.68t/ha VC, T3= 100% recommended NP fertilizers, T4=50% recommended NP fertilizers + 2.82t/ha compost, T5= 50% recommended NP fertilizers & 2.84t/ha VC, T6=Control. A composite surface (0-30cm depth) soil samples were taken from the experimental field before sowing for laboratory analysis of selected physic chemical properties of the soil. Two weeks before sowing the dried collected compost was mixed with the soil on randomly assigned experimental plots and half of the inorganic fertilizer (urea) applied at planting and half of them at tilling. The experiment indicated that there was a significant difference in all growth and yield component parameters such as: plant height, Days to maturity, Number of tiller, Spike length, 1000 grain seed weight and low days to emergency. The maximum grain yield 5.95t/ha was obtained from the combined effect of 2.84t/ha VC with 50% NP fertilizer and the lowest grain yield 1.53t/ha was from the control treatment. Likewise the maximum net benefit 76932.5ETB was recorded with this treatment with 9445.5% MRR. So in order to reduce the cost of inorganic fertilizer, for sustainable soil fertility management combined use of 2.84t/haVC with 50% NP fertilizer was the best option for bread wheat production in this area and this technology needs multi location and season repetition to make conclusive recommendations.

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