Combination nutrient management for sustainable economically effect on onion (*Allium cepa* L.) seed production at Maitsebri, Northern, Ethiopia

ABSTRACT

*Field experiment was conducted at Shire-Maitsebri Agricultural Research Center research station, located in northern Ethiopia to study the combination nutrient management for sustainable economically effect on onion (*Allium cepa L.*) seed production during 2016/17 dry season under irrigation. Bombay Red onion variety was used for the study. The treatments consisted five combination of NP fertilizer rates {0, 25 %, 50 %, 75 % and 100 % of recommended NP fertilizer rates (69 kg N and 92 kg P_2O_5 ha^{-1})} and four rates of vermicompost (0, 2.5, 5.0, 7.5 t ha^{-1}). The experiment was laid out in a factorial arrangement using randomized complete block design with three replications. Data were collected on onion seed production and its partial budget analysis. The highest seed yield per hectare (1462.5 kg ha^{-1}) were obtained from plants grown at 75 % of RDF with vermicompost at 2.5 t ha^{-1} which were about 263% higher than seed yield from unfertilized control plot. The highest net benefit (Birr 443693.5 ha^{-1}) was recorded from application of 75 % of RDF with 2.5 t ha^{-1} vermicompost. It can, thus, be concluded that the combined application of 75 % of RDF with vermicompost at 2.5 t ha^{-1} can improve yield and quality of seed of Bombay Red onion variety in the study area.*

Keywords: Combination, economically, Onion, NP fertilizers, Vermicompost, benefit

1. INTRODUCTION

"Onion (*Allium cepa* L.) is rank second among all vegetables in economic importance after tomatoes in the world" [10] [15] [6]. "Onion is reasonable source of micro food, nutrient, mineral, salt and vitamins, hence used by all section of society. It has nutritional value to human diets that helps alkaline reaction in our body and important in neutralizing the acid substance produced during the course digestion of meat, cheese and primarily consumed for its unique flavor or for its ability to enhance the flavor of other foods. It is also used in processing industry for dehydration in the form of onion flakes and powder" [19] [18].

"Ethiopia is also endowed with favorable climatic conditions for seed production of various vegetable crops ranging from tropical to temperate. The ranges of vegetable crops grown from true seed are diverse but the most commonly produced by small scale farmers include tomato, onion, capsicum, cabbage, carrot, beet root, shallot and melons" [1].

"The vegetable production sector in Ethiopia relies mainly on imported seeds except the very limited ones such as hot pepper and kale that has been traditionally produced. Most vegetables produced from imported seed do not perform very well due to poor germination and adaptability problems" [5]. "Onions are usually grown from seed production are important for onion bulb production" [2]. However, the average yield of onion in Ethiopia specially in Tigray region, particularly in the study area was decreased due to loss of soil fertility, soil type, location, pollinating insect activity and production methods. Onion seed production is one of the most important and potential area in the success of onion production that can bring a high economic benefit for small scale farmers. Therefore, the aim of this research was studying the combination nutrient management of inorganic NP fertilizers and vermicompost on seed production and on its partial budget analysis under irrigation on Tselemti woreda, Northern Ethiopia.

2.MATERIALS AND METHODS

The field experiment was conducted at Shire-Maitsebri Agricultural Research Center research station, northern Ethiopia, during the dry season of 2016/2017. 'Bombay Red' onion variety was one of the most commonly and widely used variety in Northwestern Zone of Tigray. The sources of the NP fertilizers were urea (46 % N) and Triple Super Phosphate, TSP (46 % P_2O_5) for supplying nitrogen and phosphorus, respectively. The vermicompost was obtained from Shire Agricultural Collage.

Soil of the study area is characterized by Sandy clay loam with textural classes of 50 % sand, 23 % silt, and 27 % clay content. The soil has a pH of 6.7, total nitrogen of 0.0798 %, organic carbon content of 1.263 %, available phosphorous 4.75 mg kg^{-1} and potassium 1.3 cmol (+) kg^{-1} (Table 2). Generally in the study area, a Vegetable crop in rain fed agricultural production is not well known but using irrigation in dry season is mostly available and get good yied.

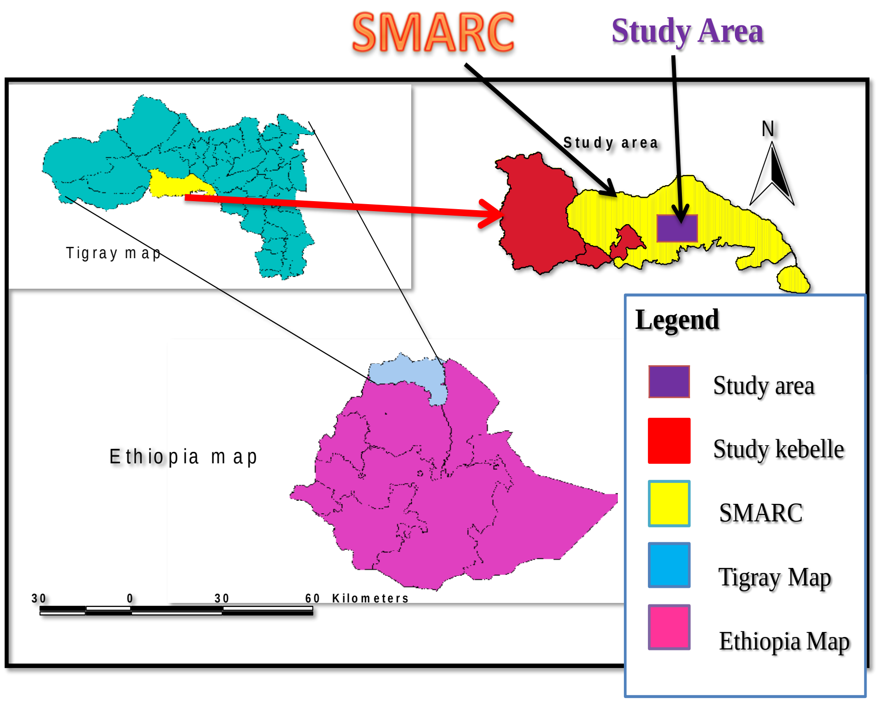

Figure 1. Maps of the Country, Region and Study area of Shire-Maytsebri Agricultural Research Center (SMARC)

Soil Sampling and Analysis

Soil sampling was done before planting as well as after harvesting. Soil samples were collected randomly from the entire experimental field following a zigzag fashion from 0 to 30 cm depth using an augur. Before planting, five soil samples were taken from the top soil layer and composited in a bucket to represent the site and 20 composited samples were collected from the 60 plots for each treatment combination after harvesting. It was made one kg each composite sample. A determination of some selected soil physical and chemical properties was carried out based on the composite sample. The composite soil sample was air dried, crushed with wooden pestle and mortar to pass through a 2 mm sieve size for the analysis of physical and chemical properties. Total nitrogen, available phosphorus, potassium, organic matter, organic carbon, soil pH, Cation exchange capacity (CEC) and soil texture was determined in the laboratory from the sample submitted.

“Soil pH was measured in 1:2.5 soil-water ratios using an electrodes pH meter. Texture of the soil was determined by sedimentation method” [11]. “Organic carbon content of the soil was determined by Walkley and Black method” [22]. Available phosphorus was estimated following the standard procedure of [17]. “Total nitrogen was estimated by the Kjeldahl method” [13]. “Exchangeable potassium was determined with a flame photometer after extraction with 0.5 ammonium-acetate” according to [12].

Vermicompost Analysis

Vermicompost was also analyzed before applying in the soil to determine the following soil properties in the laboratory from the sample submitted. Total nitrogen, available phosphorus, exchangeable potassium, organic matter and Organic carbon content using similar procedures for the soil analysis.

3. Data Collection

Data analysis: The collected data was subjected to analysis of variance (ANOVA) using Gen Stat 14th edition statistical software according to [7] statistical procedure. Data on the seed quality test were also subjected to analysis of variance for CRD. Mean comparison was done using least significant difference (LSD) at 5% probability level.

Partial Budget Analysis

Partial budget analysis (PBA) was employed for economic analysis of inorganic NP fertilizer, vermicompost application and it was carried out for combined seed yield data. The potential response of crop towards the added fertilizers and price of fertilizers during planting ultimately determined the economic feasibility of fertilizers application. The economic analysis was computed using the procedure described by [4].

Gross average seed yield (kg ha^{-1}) (AvY): is an average yield of each treatment.

Adjusted yield (AjY): was the average yield adjusted downward by a 10 % to reflect the difference between the experimental yield and yield of farmers [11].

$$AjY = AvY - (AvY*0.1)$$

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

Total cost: was the cost of DAP, urea, vermicompost, cost for application and transportation used for the experiment. Their prices were based on 2016 price during planting. The costs of other inputs and production practices such as labor cost for land preparation, planting, weeding, crop protection and harvesting was assumed to remain the same or the difference was insignificant among treatments.

Net benefit (NB): was calculated by subtracting the total costs from gross field benefits for each treatment. **NB = GFB – total cost**

Marginal rate of return (MRR %): was calculated by dividing change in net benefit by change in cost which is the measure of increasing in return by increasing input.

$$\text{Marginal rate of return } (\%) = \frac{\text{Change in net benefit}}{\text{change in total cost}} \times 100$$

4. RESULTS AND DISCUSSION

Soil and Vermicompost (Vc) analysis before planting

The results of the composite soil and Vc analysis before and after planting are presented in Table 1&2. The results revealed that the pH of the composite soil and Vc samples were 6.7 and 6.9 respectively which are Neutral according to the rating of [3]. The optimum pH of the soil and Vc for onion seed production ranges between 6.0 to 8.0 [2] [9]. Accordingly, the pH of the experimental soil and Vc were conducive for onion seed production.

The total nitrogen as well as that of organic carbon contents of the soil was low according to the rating of [20]. The total nitrogen was low as it was < 0.15 %. These results indicate that there is not sufficient mineralized nitrogen in the native soil for uptake of the plant during growth [16]. Therefore, there was a need to apply mineral nitrogen fertilizer to grow the crop. However, the total nitrogen and organic carbon in vermicompost was high according to the rating of [20]. The organic carbon below 0.5 % is very low, 0.5-1.5 % is low, 1.5- 3.0 % is Medium/Moderate, greater than 3 % is high and organic Matter < 0.86 % is very low, 0.86-2.59 is low, 2.59-5.17 is Moderate and greater than 5.17 is high according to [20].

According to [17], the soil of the experimental site was low in available phosphorus. The available phosphorus was low as it was < 5 mg P kg^{-1} of soil. This shows that application of external source of phosphorus is important for seed production of onion. Vermicompost was moderate (8.67 mg kg^{-1}) source of phosphorus [17]. According to the rating of Hazelton and Murphy (2007), the soil of the experimental site and Vermicompost had high available potassium content, which is adequate for onion seed production and the total cation exchange capacity (CEC) of the testing site the soil was moderate and in vermicompost very high. The CEC was very high as it was > 40 cmol (+) kg^{-1}.

"Electrical conductivity (EC) of the experimental soil was non-saline. The EC rating non-saline below 2 ds m^{-1} salinity effects are mostly negligible, slightly saline 2-4 ds m^{-1} yields of sensitive crops are affected, moderately saline 4-8 ds m^{-1} yields of many crops are affected, highly saline 8-16 ds m^{-1} only tolerant crops yield satisfactorily and extremely saline >16 ds m^{-1} only very tolerant crops yield satisfactorily" [11].

The soil of the experimental site Exchangeable Calcium (Ca) and Magnesium (Mg) was very low according to the rating of FAO (2006). The rating of Exchangeable Ca below 2 mg kg^{-1} is very low, 10-20 mg kg^{-1} is high and greater than 20 mg kg^{-1} is very high and also the Exchangeable Mg below 0.3 mg kg^{-1} is very low, 3.0-8.0 mg kg^{-1} is high and greater than 8 mg kg^{-1} is very high. Vermicompost of the Exchangeable Ca and Mg was high rating of 10 and 8 mg kg^{-1} respectively [8]. Accordingly, the Ca and Mg ratio on the soil of the experimental site was balanced according to the [11]. Ca/Mg ratio rating <1 Ca deficient, 1-4 Ca low, 4-6 Ca and Mg balanced, 6-10 Mg low, >10 Mg deficient according to [11]. The soil of experimental site was 1.2 mg kg^{-1} Ca and 0.2 mg kg^{-1} Mg ratios 6, so Ca and Mg on the site was balanced.

The soil is with 50, 23 and 27 % sand, silt and clay, respectively, which gave sandy clay loam soil texture. Onion can be grown in all types of soils. However, Loam, clay loam and sandy clay loam soils are best suited for onion seed production [2] [9]. Accordingly, the soil of the experimental site was conducive for onion seed production.

Table 1. Chemical and Physical characteristics of the experimental soil and vermicompost (Vc) before planting onion crop

No.	Chemical properties									Physical properties				
	pH	N (%)	OC (%)	OM (%)	P(mg kg^{-1})	K (cmol (+) kg^{-1})	CEC(cmol (+) kg^{-1})	EC(ds m^{-1})	Ca (mg L^{-1})	Mg (mg L^{-1})	Sand (%)	Silt (%)	Clay (%)	Textural class
1. SBP	6.7	0.0798	1.263	2.177	4.751	1.3	23.6	0.303	1.2	0.2	50	23	27	Sandy clay loam
Rating	Neutral	Low	Low	Low	Low	High	Moderate	Non-saline	V.low	V.low				
2. Vc	6.9	0.161	11.89	20.51	8.67	1.85	50	8.31	10	8				
Rating	Neutral	High	V.high	V.high	Medium	V.high	V.high	V.high	High	High				

Where, N = Total Nitrogen (%), OC = Organic Carbone (%), OM = Organic Matter (%), P = available Phosphorus (mg kg^{-1}), K = available potassium (cmol (+) kg^{-1}), CEC = Cation Exchange Capacity (cmol (+) kg^{-1}), EC = Electrical conductivity (ds m^{-1}), Ca = Calcium (mg L^{-1}) and Mg = Magnesium (mg L^{-1}).

Sourc: pH = Bruce and Rayment (1982), N (%), OC (%) and OM (%) = Tekalign (1991), P (mg kg^{-1}) = (Olsen *et al.*, 1954), K [Cmol(+) kg^{-1}], CEC (cmol (+) kg^{-1}) and EC (ds m^{-1}) = Hazelton and Murphy (2007), Exchangeable Ca and Mg, = FAO (2006).

Table 2. Chemical and Physical properties of the experimental soils after harvesting of the onion seed

No.	Treatments	pH	Rating	N (%)	Rating	OC (%)	Rating	OM (%)	Rating	P (mg kg^{-1})	Rating	K [Cmol(+)/kg]	Rating
1	$N_1P_1V_1$	6.8	Neutral	0.045	V. low	1.04	Low	1.895	Low	4.825	Low	1.10	High
2	$N_1P_1V_2$	7.4	S. alkaline	0.072	Low	1.643	Moderate	2.833	Moderate	9.285	Moderate	1.13	High
3	$N_1P_1V_3$	7.3	Neutral	0.131	Medium	1.771	Moderate	3.054	Moderate	10.237	High	1.04	High
4	$N_1P_1V_4$	7.4	S. alkaline	0.146	Medium	1.462	Moderate	2.520	Moderate	18.483	High	1.06	High
5	$N_2P_2V_1$	6.9	Neutral	0.127	Medium	1.590	Moderate	2.740	Moderate	9.005	Moderate	1.16	High
6	$N_2P_2V_2$	6.95	Neutral	0.146	Medium	1.695	Moderate	2.923	Moderate	21.706	High	1.08	High
7	$N_2P_2V_3$	7.5	S. alkaline	0.153	High	1.631	Moderate	2.813	Moderate	14.502	High	1.01	High
8	$N_2P_2V_4$	6.85	Neutral	0.154	High	1.552	Moderate	2.675	Moderate	15.166	High	1.10	High
9	$N_3P_3V_1$	7.1	Neutral	0.152	High	1.759	Moderate	3.033	Moderate	11.185	High	1.23	V.high
10	$N_3P_3V_2$	7.5	S. alkaline	0.154	High	1.789	Moderate	3.085	Moderate	14.028	High	1.19	High
11	$N_3P_3V_3$	7.13	Neutral	0.154	High	1.822	Moderate	2.795	Moderate	6.919	Moderate	1.16	High
12	$N_3P_3V_4$	7.3	Neutral	0.151	High	1.516	Moderate	2.613	Moderate	19.052	High	0.97	High
13	$N_4P_4V_1$	6.98	Neutral	0.152	High	1.530	Moderate	2.637	Moderate	12.796	High	0.92	High
14	$N_4P_4V_2$	6.87	Neutral	0.156	High	1.889	Moderate	2.913	Moderate	27.583	High	0.99	High

15	$N_4P_4V_3$	6.97	Neutral	0.155	High	1.794	Moderate	2.403	Moderate	16.682	High	1.06	High
16	$N_4P_4V_4$	6.89	Neutral	0.158	High	1.546	Moderate	2.665	Moderate	18.104	High	1.12	High
17	$N_5P_5V_1$	6.99	Neutral	0.148	Medium	1.600	Moderate	2.758	Moderate	16.493	High	1.07	High
18	$N_5P_5V_2$	7	Neutral	0.165	High	1.677	Moderate	2.892	Moderate	21.232	High	1.30	V.high
19	$N_5P_5V_3$	7.5	S. alkaline	0.169	High	1.847	Moderate	3.185	Moderate	21.991	High	1.12	High
20	$N_5P_5V_4$	6.99	Neutral	0.171	High	1.824	Moderate	3.140	Moderate	19.810	High	1.31	V.high

Where N_1P_1 = 0 kg N, TSP ha^{-1}, N_2P_2 = 37.5 kg N, 50 kg TSP ha^{-1}, N_3P_3 = 75 kg N, 100 kg TSP ha^{-1}, N_4P_4 = 112.5 kg N, 150 kg TSP ha^{-1}, N_5P_5 = 150 kg N, 200 kg TSP ha^{-1} and V_1 = 0 t ha^{-1}, V_2 = 2.5 t ha^{-1}, V_3 = 5.0 t ha^{-1}, V_4 = 7.5 t ha^{-1}, NP=Nitrogen (Urea) and Phosphorus (P_2O_5), Vc = Vermicompost, V = very, S = slightly

Sourc: pH = Bruce and Rayment (1982), N (%), OC (%) and OM (%) = Tekalign (1991), P (mg kg^{-1}) = (Olsen *et al*., 1954), K [Cmol(+)/kg] = Hazelton and Murphy (2007)

Continued-----

No.	Treatments	CEC(cmol (+) kg^{-1})	Rating	EC(ds m^{-1})	Rating	Ca(mg L^{-1})	Rating	Mg (mg L^{-1})	Rating	% sand	% silt	% clay	Soil Texture
1	$N_1P_1V_1$	40	High	0.45	Non-saline	10	Moderate	3	Moderate	50	26	27	Sandy clay loam
2	$N_1P_1V_2$	41	V.high	0.339	Non-saline	10	Moderate	6.2	High	38	38	24	Loam
3	$N_1P_1V_3$	42.4	V.high	0.381	Non-saline	10.6	High	6.4	High	40	38	22	Loam
4	$N_1P_1V_4$	42.4	V.high	0.38	Non-saline	9.2	Moderate	6.6	High	48	24	28	Sandy clay loam
5	$N_2P_2V_1$	48.6	V.high	0.352	Non-saline	8.8	Moderate	5.8	High	44	36	20	Loam
6	$N_2P_2V_2$	42.4	V.high	0.34	Non-saline	6.4	Moderate	6.2	High	48	30	22	Loam
7	$N_2P_2V_3$	40.2	High	0.369	Non-saline	10.6	High	6.4	High	46	38	16	Loam
8	$N_2P_2V_4$	36.6	High	0.329	Non-saline	6.8	Moderate	5.8	High	48	32	20	Loam
9	$N_3P_3V_1$	43.6	V.high	0.429	Non-saline	7.6	Moderate	6.2	High	50	28	22	Loam
10	$N_3P_3V_2$	43.2	V.high	0.453	Non-saline	8.4	Moderate	5	High	48	32	20	Loam
11	$N_3P_3V_3$	40.2	High	0.343	Non-saline	11.4	High	6	High	36	40	24	Loam
12	$N_3P_3V_4$	36.2	High	0.287	Non-saline	10	Moderate	6.6	High	46	36	18	Loam
13	$N_4P_4V_1$	46.2	V.high	0.377	Non-saline	10.4	High	7	High	52	28	20	Sandy loam
14	$N_4P_4V_2$	42.2	V.high	0.4	Non-saline	10.4	High	7.4	High	50	32	18	Loam

15	$N_4P_4V_3$	38	High	0.4	Non-saline	8.8	Moderate	7	High	52	28	20	Sandy loam
16	$N_4P_4V_4$	40.4	High	0.421	Non-saline	9.2	Moderate	7.8	High	48	32	20	Loam
17	$N_5P_5V_1$	39.8	High	0.346	Non-saline	8.6	Moderate	6	High	44	34	22	Loam
18	$N_5P_5V_2$	48.6	V.high	0.399	Non-saline	6.4	Moderate	5.8	High	46	34	20	Loam
19	$N_5P_5V_3$	48	V.high	0.476	Non-saline	10.4	High	5	High	40	36	24	Loam
20	$N_5P_5V_4$	44	V.high	0.451	Non-saline	10.4	High	6.2	High	44	36	20	Loam

Where N_1P_1 = 0 kg N, TSP ha^{-1}, N_2P_2 = 37.5 kg N, 50 kg TSP ha^{-1}, N_3P_3 = 75 kg N, 100 kg TSP ha^{-1}, N_4P_4 = 112.5 kg N, 150 kg TSP ha^{-1}, N_5P_5 = 150 kg N, 200 kg TSP ha^{-1} and V_1 = 0 t ha^{-1}, V_2 = 2.5 t ha^{-1}, V_3 = 5.0 t ha^{-1}, V_4 = 7.5 t ha^{-1}, NP=Nitrogen (Urea) and Phosphorus (P_2O_5), Vc = Vermicompost, V = very

Sourc: CEC (cmol (+) kg^{-1}) and EC (ds m^{-1}) = Hazelton and Murphy (2007), Exchangeable Ca and Mg, = FAO (2006).

Partial Budget Analysis

In this study, the partial budget analysis (PBA) was made to determine the most economically acceptable treatments (combinations) by estimating the costs and benefits based on the current market price of onion seed, NP fertilizers and the spreading costs of vermicompost for the cropping season at the study area, following [4], partial budget analysis guidelines.

The average yields of 20 treatments were adjusted down wards by 10 %. This is for the reason that, researchers have assumed that using the same treatments the yields from the experimental plots and farmers' fields are different, thus average yields should be adjusted downward. In addition to this, to obtain the gross field benefits, it is essential to know the field price value of one kg of onion seed during harvesting time. Then finally, adjusted yield was multiplied by field price to obtain gross field benefit of onion seed. To estimate the total costs, mean current prices of urea, TSP and vermicompost were collected at the time of planting and market price of onion seed was taken at harvest (Table 3).

The partial budget analysis based on the current market price of economic yield (output) and prevailing price of inputs during the production period, the highest net benefit of Birr 443,693.5 with the lowest cost Birr 16,994 was recorded from the combination of 51.75 N: 69 P_2O_5 kg ha^{-1} in conjunction with 2.5 t ha^{-1} VC with the marginal rate of 1864% or Birr 18.64. This means that for every Birr 1.00 invested for every 51.75 N: 69 P_2O_5 kg ha^{-1} with 2.5 t ha^{-1} VC, growers can expect to recover the Birr 1.00 and obtain an additional Birr 18. 64. Followed by net benefit of Birr 228,214.5 ha^{-1} from 69 N: 92 P_2O_5 kg ha^{-1} fertilizers alone with the marginal rate of 1728% and by net benefit of Birr 360,008.5 ha^{-1} from the combination of 34.5 N: 46 P_2O_5 kg ha^{-1} with 2.5 t ha^{-1} VC marginal rate of 1498%. However, the lowest net benefit (126,882 Birr ha^{-1}) was received in the control treatment (Table 3).

The minimum acceptable marginal rate of return (MARR %) should be between 50% and 100% [4]. Therefore, from the total 20 treatments only 11 treatments were considered for analysis of Marginal rate of return (MRR) (Table 2). The marginal rate of return indicates what farmers can expect to gain, on the average, in return for their investment when they decide to change from one practice to another. Thus, the current study indicated that marginal rate of return is higher than 100% (Table 2). This showed 10 treatments are economically important since the MRR is greater than 100%. Hence, the most economically attractive for small scale farmers with low cost of production and higher benefits were in response to the application of combination of 51.75 N: 69 P_2O_5 kg ha^{-1} with 2.5 t ha^{-1} VC. So, these could be considered by farmers to improve their income.

Table 3. Partial budget analysis due to the application of NP fertilizer and vermicompost on marketable seed yield of Bombay Red onion variety grown at Maitsebri

Treatments	N: P_2O_5 rates (kg ha^{-1})	Vermi compost (t ha^{-1})	Average Seed Yield (kg ha^{-1})	Adjusted seed yield (kg ha^{-1})	Gross Field Benefit (ETB ha^{-1})	Total cost (ETB ha^{-1})	Net benefit (ETB ha^{-1})	Marginal Return (MR)	Marginal rate of return (MRR %)
T_1	0	0	402.8	362.52	126882	0	126882	0	0
T_2	17.25: 23	0	454.7	409.23	143230.5	1578	141652.5	9.36	936
T_3	34.5: 46	0	527.8	475.02	166257	3006	163251	12.09	1209
T_4	51.75: 69	0	597.2	537.48	188118	4434	183684	12.81	1281
T_5	69: 92	0	743.1	668.79	234076.5	5862	228214.5	17.28	1728
T_7	17.25: 23	2.5	865.2	778.68	272538	14138	258400	9.3	930
T_8	34.5: 46	2.5	1192.3	1073.07	375574.5	15566	360008.5	14.98	1498
T_9	51.75: 69	2.5	1462.5	1316.25	460687.5	16994	443693.5	18.64	1864
T_{13}	34.5: 46	5	1448.6	1303.74	456309	28069	428240	10.73	1073
T_{18}	34.5: 46	7.5	1300.8	1170.72	409752	40566	369216	5.97	597
T_{19}	51.75: 69	7.5	1356.9	1221.21	427423.5	41994	385459.5	6.15	615

During experimental period the price of N = 14.40 ETB kg^{-1} N + 15.00 ETB transport + application 60.00 ETB 23 kg or 46 kg N ha^{-1}. Price of P_2O_5 = 17.76 ETB kg^{-1} P_2O_5 + 15.00 ETB transport + application 60.00 ETB 46 or 92 P_2O_5 kg ha^{-1}. Vermicompost = 12,500.00, 25,000.00 and 37,500.00 ETB (5 birr kg^{-1} of VC) for 2.5, 5.0 and 7.5 t ha^{-1} + 60.00 ETB for each application respectively and selling price of onion seed was 350 ETB kg^{-1}.

N.B: Urea was used as source of nitrogen and TSP as source of P_2O_5.

5. CONCLUSION

The field experiment was conducted to determine the combination nutrient management on sustainable economically effect on onion seed production and its partial budget analysis under irrigation at Shire-Maitsebri research station. The results revealed that the interaction effect of NP fertilizer and vermicompost had highly significant ($P<0.01$) seed yield per hectare. Thus, according to this study, maximum seed yield (1462.5 kg ha^{-1}) at 75 % of RDF NP fertilizer with vermicompost 2.5 t ha^{-1} produced 263% more seed yield per hectare. The highest net benefit (Birr 443693.5 ha^{-1}) was also recorded from application of 75 % of RDF with 2.5 t ha^{-1} vermicompost. So, to get better yield and higher economic benefit from onion seed productions farmers are suggested to use the combination rates of NP fertilizers at 75 % RDF x VC at 2.5 t ha^{-1}.

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