RESEARCH ARTICLE

Effects of blended(NPSB) fertilizer rate on growth, yield,and yield component of onion (*Allium cepa L.*) varieties at jimma condition by WOLKITE, ETHIOPIA

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ABSTRACT

Onion (*Allium cepa L.*) is of the most important vegetable crops produced on large scale in Ethiopia. A field experiment was conducted to evaluate the effect of blended NPSB fertilizer rate on the growth and yield of onion varieties during 2018/2019 cropping season. The experiment was laid out in an RCBD with three replications. The study consisted of four levels of NPSB fertilizer rate (0, 62.5, 125, and 187.5 kg ha^{-1}) and three onion varieties. Data were collected for growth and bulb yield parameters. The main effect of blended NPSB and onion varieties influence only the harvest index significantly ($p<0.001$). Blended NPSB fertilizer and onion varieties were interacted to significantly ($p<0.001$) influence all parameters. The highest value for each response variables were recorded at variety Nafis with NPSB at rate of 125 kg ha^{-1}. The highest marketable bulb yield of 35.1 t/ha was recorded in response to 125 kg ha^{-1} of NPSB with Nafis. However, as the experiment was done for only one season and single location, it has to be repeated over seasons and locations to make a conclusive recommendation by including urea and organic fertilizer.

Key Words: *Blended fertilizer, Dry matter, Harvest index, Partial budget, Bulb, marketable-yield*

INTRODUCTION

Onion (*Allium cepa* L.) is considered as one of the most important vegetable crops produced on large scale in Ethiopia and also occupies an economically important place among vegetables in the country [1]. *Allium cepa* as bulb onion is cultivated in all countries of tropical Africa including Ethiopia [2]. According to Abdissa, et al. [3] onion is important in the daily Ethiopian diet and all the plant parts are edible, although the bulbs are widely used as a seasoning or a vegetable in various dishes. It is grown primarily for its bulb which is used for flavoring the local stew; 'wet' [4,5]. It is also used as a preservative and medicine [6]. It is one of the richest sources of flavonoid in the human diet and flavonoid consumption has been associated with a reduced risk of cancer, heart disease, and diabetes [7-10]. Ethiopia has a great potential to produce onion throughout the year both for local consumption and export [11].

Onion production is facing various problems which contribute to a low level of production and productivity. Among various constraints lack of appropriate agronomic packages, shortage of seeds of improved varieties, and high costs of chemical fertilizers [12-14]. According to CSA (2018) [15], for private farmers' holdings in 'Meher' season 2017/2018, the total area coverage by onion crop in the country was 31673.21 ha, with a total production of 2,938,875.85 Qts with average productivity of 9.28th ha^{-1}. This is a very low yield compared to the world average of 19.7th ha^{-1} (FAO, 2012) [16]. Onion productivity could be increased substantially through the use of improved cultivars and optimum use of fertilizers [17].

Most research work so far focused on Nitrogen and Phosphorus requirements of crops and, hence, limited information is available on various sources of fertilizers like S, Zn, B, and other micronutrients. Therefore, the application of other sources of nutrients beyond urea and DAP, especially those containing S, Zn, B, and other micro-nutrients could increase crop productivity (Ethio SIS 2014) [18].

It is important to increase the productivity of crops along with desirable attributes through production management practices and application of other sources of nutrients beyond the blanket recommendation of urea and DAP, especially those that contain sulfur and other micronutrients (Ethio SIS, 2014) [18]. Except for the blanket recommendation of nitrogen and phosphorus found in urea and DAP, the effect of other fertilizers on growth, yield components, and yield performance of onion is not known, even though the new blended fertilizers introduced by ATA (agricultural transformation agency) based on soil test such as NPSB (18.9% N, 37.7% P_2O_5, 6.95% S and 0.1%B) are currently being used by the farmers in the study area. This fertilizer is not recommended based on the crop requirement rather than soil-based nutrient defiance. So blanket recommendation rate for production and productivity of onion is not affordable for smallholder farmers due to the cost of chemical fertilizer. Hence, there is a need to develop a site-specific recommendation on the fertilizer rates and varieties to increase production and productivity of onion. Therefore, this study was undertaken with the following objectives.

General objective

To assess the effect of blended NPSB fertilizer rate on growth, yield components and yield of onion varieties under Jimma condition

Specific objectives

To determine the optimum rate of blended NPSB fertilizer for Jimma Area.

To recommend the best performed onion varieties for the study area.

To evaluate the economically feasible rate of blended NPSB fertilizers for high yield of onion.

MATERIALS AND METHODS

The study was conducted at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) research site, under irrigation.It is located (70^{o} 33'N, 360^{o}, 57' E, and 1710 m above sea level. The annual mean daily maximum and minimum temperatures of the site are 28.2^{o}C and 12.7^{o}C, respectively and the mean daily maximum and minimum relative humidity are 92.1 % and 49.4 %, respectively. The area receives an annual rainfall of 1495 mm. The soil of the experimental site is well-drained clay loam soil and also the area is surrounded by some plants which are used as windbreaks (BPEDORS, 2000) [19].

Experimental materials

Three different Onion cultivars namely Adama Red, Nafis, and Nasik Red were obtained from Melkassa Agricultural Research Center (MARC) [20]. A

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blended fertilizer called NPSB was used as fertilizer material obtained from the JUCAVM soil laboratory.

Seedbed preparation and seedling raisings

Seedlings were raised, on three raised beds with the size of 1.2 × 5 m^2, sown at a seeding rate of 4 kg /ha at 10 cm distance between rows, lightly covered with soil and mulched with grass for 15 days until seedlings were emerged (2-5 cm from the soil). Each bed was fertilized with 100 g of Urea and managed for about six weeks and they were transplanted to the main experimental plots (EARO, 2004) [21].

Experimental design, treatments, and treatment combinations

The experiment was laid out in randomized complete block design (RCBD) with three replications. The size of each plot was 2.4 × 3 m^2 (7.2 m^2) accommodating ten rows (two single and four double rows). The recommended spacing of 40 × 20 × 5 cm was maintained for all plots. The treatments were consisting of a factorial combination of four rates of NPSB fertilizer (0, 62.5 kg, 125 kg, and 187.50 kg h^{-1}) and three different onion varieties (Adama Red, Nafis, and Nasik Red).

Data Collection: Ten plants were randomly selected and tagged for data collection. The outer single rows at both sides of the plot and one plant at both ends of the rows were considered border plants. An external single row of the outer double rows at both sides of the plot was used for distractive samples.

Growth parameters

Plant height (cm); number of leaves/plant and length of leaves (cm): Were collected from ten randomly selected plants and the mean value was computed for further analysis.

Date of maturity: The number of days was counted starting from seedling transplanting to 80% leave falls.

Yield components

Length of the bulb (cm), Diameter of the bulb (cm): Sample plants were measured from the root to the top using vernier caliper (0-150 mm) and the mean values were computed for further analysis.

Average bulb fresh weight (g), total biomass dry weight (g): The mean bulb weight of ten randomly selected bulbs at harvest was computed and used for further analysis. This was done by summing up the aboveground dry biomass and the bulb dry weight.

Marketable yield, Unmarketable yield (t/ha): The weight of such bulbs obtained from the net plot area of each plot was measured in kilogram using scaled balance and expressed as t/ha.

Total bulb yield (t/ha): Total yield of onion was obtained by summing up marketable and unmarketable bulb yields and expressed as t per ha (Guesh Tekle et al.). Calculated by using the equation

$$\text{Yield per hectare in t} = \frac{\text{Total yield per plot (kg)} \times 10{,}000\ \text{m2}}{\text{Net area of the plot (m2)} \times 100\text{'kg}}$$

Harvest index (%): Refers to the ratio of bulb dry weight to total dry biomass of a plant and it was calculated as

$$\frac{bulbdryweight}{totaldrybiomass}x100 = \text{economical yield/biological}$$

RESULTS AND DISCUSSION

Effect of blended NPSB fertilizer rate and onion varieties on growth parameters

Plant height: Result from the analysis of variance revealed that the main effects of blended NPSB fertilizer and varieties significantly ($P<0.05$) influenced plant height of onion. Similarly, the two factors significantly interact to influence plant height. The highest plant height (65.7 cm) was recorded with the application of 187.5 kg ha^{-1} blended NPSB fertilizer rate combined with Naïfs, On the other hand, the lowest plant height (44.1 cm) was recorded at the rate of zero kg/ha combined with Adama Red. This result indicated that the mean height of the plant shows a significant difference as further increase in NPSB rate from 125 to 187.5 kg ha^{-1} Nasik Red (Table 1).

This result was in agreement with many scholars like Hamady [22] who reported that that increasing phosphorus fertilizer rates markedly increased foliage height of onion. Bhonde et al. [23] reported that Boron at different doses had remarkable effects on the production of leaf, plant height, root numbers, germination percentage, and quality of onion seed. Similarly, Schunemann et al. reported that Sulfur is an essential element required by onions to achieve optimum development. Abdissa et al. [3] reported that the application of 69 kg N ha^{-1} increased plant height by about 10% over the unfertilized check. Plant height increased almost linearly with increasing S [24,25].

Leave number: The analysis of variance revealed that the main effect of varieties and blended NPSB fertilizer rates and their interaction had highly significant ($P<0.01$) effects on the number of leaves per plant of onion. Plants with the highest mean leaf number were produced in response to application of the highest rate of NPSB fertilizer (125 and 187.5 kg ha^{-1}) combined with Nafis (12.3 and 12.6) respectively, the number of leaves of variety Nafis and blended NPSB fertilizer 125 kg ha^{-1} exceeded the leaf number of leaves observed from varieties Nasik and Adama Red with the same level of fertilizer ha^{-1} by about 22.8 and 26 % respectively (Table 1). This finding was in agreement with Hamady [22]. Bhonde et al. [23] reported that increasing phosphorus fertilizer rates markedly increased foliage height, number of leaves/plants in onion. The application of sulfur increased the number of leaves/plants [24,25].

Effect of blended NPSB fertilizer rate and varieties on yield related parameters

Bulb-diameter: The Result from analysis of variance revealed that the main effects of blended NPSB fertilizer and varieties significantly ($P<0.01$) influenced the bulb length of onion. Similarly, the two factors significantly interact with each other to influence bulb diameter. The increase in blended NPSB fertilizer level significantly increases the bulb diameter from the lowest value of 3.1 cm at the control and Adama Red to the highest value of 5.5 cm at 125 kg ha^{-1} combined with Nafis. The higher photosynthesis accumulation in the bulbs would ensure higher individual bulb weight and large bulb diameter which collectively increases the bulb yield of onion [26]. For example, the lowest and the highest mean bulb diameter value of Nafis were recorded at the level of zero kg ha^{-1} and 187.5 kg ha^{-1} respectively (Table 2). The mean bulb diameter value of Nafis at a rate of 125 kg ha^{-1} was exceeded by 40% over the control treatment. Ullah et al., [27], Muhammad et al. [28] reported that the application of an increasing rate of nitrogen fertilizer increases the bulb diameter of onion.

Bulb-length: The main effects of blended NPSB fertilizer and varieties significantly ($P<0.01$) influenced the bulb length of onion. Similarly, the two factors significantly interact to influence bulb length. The result shows that the mean bulb length of onion treated with NPSB at the rate of 125 kg ha^{-1} with the variety Nafis exceeded the bulb length of onion plants treated with zero and 62.5 kg NPSB ha^{-1} by about 27.8 and 13%, respectively (Table 2). This Result was in line with (Hamady, [22]) increasing phosphorus fertilizer rates markedly increased bulb length of onion. Begum et al. (2015) [29],

TABLE 1

Interaction Effect of blended fertilizer and onion varieties on growth parameters at Jimma during 2018/2019 cropping seasons

Treatments		Variables		
Varieties	NPSB (kg/he)	PH	LN	DoM
Adama red	0	44.1^{g}	6.1^{f}	119.3^{cd}
	62.5	51.9^{e}	7.4^{de}	123.3^{c}
	125	56.3^{d}	9.1^{bc}	130.7^{b}
	187.5	57.3^{d}	9.9^{b}	139.3^{a}
Nafis	0	48.2^{f}	6.4^{ef}	90.7^{h}
	65.5	56.0^{d}	9.2^{bc}	94.7^{gh}
	125	63.5^{b}	12.3^{a}	98.3^{g}
	187.5	65.7a	12.6^{a}	111.7^{e}
Nasik red	0	46.9^{f}	6.4^{ef}	92.3^{h}
	65.5	53.5^{e}	8.3^{cd}	105.3^{f}
	125	57.6^{d}	9.5^{b}	109.3^{ef}
	187.5	59.8^{c}	10.1^{b}	116.0^{d}
LSD (5%)		1.78	1.07	4.09
CV%		1.92	7.08	2.19

Means followed by the same letter within a column are not significantly different at $p<0.05$ LN=leaf number, PH=plant height, LSD =List significant difference, CV=coefficient of variance DoM=date of maturity.

Verma et al. [30], Bhonde et al., [23], reported that the application of Zn and B had a significant positive effect on onion plant height, bulb diameter, and bulb length [31].

Average bulb-weight: The two factors interacted to influence this parameter significantly (P<0.01). Increasing the rate of blended NPSB fertilizer progressively increased the average bulb weight of the onion plants across the varieties. Thus, the highest average bulb weight was found in response to the application of 125 kg NPSB ha^{-1} and Nafis. However, the lowest average bulb weight was obtained at the lowest rate of blended NPSB (0 kg ha^{-1}) and Adma Red (Table 2). The response of average bulb weight of Nafis from zero to 125 kg NPSB /ha was exceeded over Adama red and Nasik red by 20.4 and 17.6% respectively whereat as an application of zero kg blended NPSB ha^{-1} exceeded the value by 11.7 and 5.4%. This result was in line with Muluneh et al. [32] reported that Onion plants supplied with 105:119.6:22 kg ha^{-1} N: P_2O_5: S fertilizer rate gave the highest mean bulb weight over the control. Abdissa et al., [3], Nasreen et al., [25] were reported that the application of an increasing rate of nitrogen fertilizer improves the bulb size and average bulb weight.

Total biomass dry weight: Interaction effect of NPSB application and varieties significantly influence the total biomass dry weight of the crop (P<0.01). Increasing the rate of blended NPSB fertilizer application progressively increased the total biomass dry matter yield of onion plants. Accordingly, the highest total biomass dry matter (11.1 and 11.2 g) was recorded in response to the application of 125 and 187.5 kg ha^{-1} NPSB blended fertilizer (Table 2). Abdissa et al. [3] reported that application of Nitrogen at a rate of 69 kg/ha increases the total dry biomass by 20% over the control. A similar result was reported by Mishu et al., [33], Nasreen et al., [25] dry weight of root, dry weight of the bulb, dry weight of shoot, dry weight of leaf, total dry matter (TDM) were increased significantly with increasing the application rate of sulfur fertilizer.

Effect of blended NPSB fertilizer rate and onion varieties on yield parameters

Total bulb yield: The main effect of blended NPSB as well as that of varieties significantly (P<0.01) influenced the total bulb yield of onion. Similarly, the interaction effect of NPSB fertilizer application and varieties significantly (p<0.05) influence the total bulb yield of onion. The total bulb yield obtained in response to the application of 125 kg NPSB ha^{-1} at the Variety Nafis exceeded the total bulb yield obtained from plants grown at zero application of the blended NPSB fertilizer with the same Variety was 63% (Table 3).

The result is in agreement with many scholars who reported that the application of plant nutrient elements individually or in the blended form significantly increases the yield of onion (Simon et al., [34], Hamady, [22], Mishu et al., [33], Hariyappa [35], Nasreen et al., [25]) reported that the highest bulb yield was achieved using Nafis variety with the application of 69 kg N/ha and 46 kg P_2O_5/ha.) Indicated that increasing phosphorus fertilizer rates markedly increased foliage height, total fresh bulb weight, marketable bulb yield and TSS%. José Novo et al. [36], Manna [37] also reported that the application of 0.5% boron significantly increased the yield [32]. Zaman et al. (2011) [38] indicated that the application of sulfur increase the yield of onion ha^{-1} and stimulate the enzymatic actions as well as chlorophyll formation, which promote the growth and development of plants.

Marketable yield: The main effect of blended NPSB fertilizer and varieties significantly (P<0.001) influenced the marketable bulb yield of the onion crop. The marketable bulb yield obtained in response to the application of 125 kg NPSB ha^{-1} at the Nafis exceeded the marketable bulb yield of plants grown with zero application of the blended NPSB fertilizer with a similar variety by 67% (Table 3). The result agrees with many researchers who reported that application of Nitrogen, Phosphorous, Sulfur, and Boron in their single and blended form have a significant effect on the growth and yield parameters of onion [3,25,27,39-42].

Unmarketable yield: Moreover, significant (P<0.001) variations were observed in this parameter in response to the main effects of both NPSB fertilizer rate and varieties. The highest value of unmarketable bulb yield (2.8 t and 2 t /ha) was recorded in zero kg blended NPSB fertilizer application and the Variety Nasik Red and Adam Red respectively (Table 3). On the other hand, the minimum unmarketable bulb yield was obtained both when onion plants were fertilized with 187.5 kg NPSB ha^{-1} and Nafis, varieties. These might be due to the synergetic effect of the applied nutrient nitrogen phosphorus, sulfur, and boron. Manna et al., [43] reported that foliar application of boron with zinc significantly increases the marketable and total yield of onion.

Harvest index: The main effect of blended NPSB fertilizer significantly (P<0.01) and that of varieties were significantly (p<0.05) influenced the harvest index of the onion crop. On the other hand, the interaction effect of blended NPSB fertilizer application and varieties were not significantly influenced the harvest index onion. The highest value (59%) and (60%) of harvest index were recorded with fertilizer application at the rate of 125 and 187.5 kg/ha respectively and the lowest value (48%) was recorded at the control (Table 4). The reduction in harvest index at a lower rate of NPSB fertilizer might be due to the total biomass increased more than the economic yield of the crop and the reduction of bulb yield. Simon et al. [34] indicted that the application of nitrogen and phosphorus fertilizer with Nafis significantly increases the harvest index.

Partial budget analysis: The different costs of this experiment which include cost for blended NPSB fertilizer, seed, and labor cost for blended NPSB fertilizer application were used for this calculation. The purchasing price of blended NPSB and seeds was 13.79 Birr kg^{-1} and 3000 Birr kg^{-1} respectively. The cost for daily labor during the season was 60 Birr per day. The field price of onion during the harvesting season was 8-birr kg^{-1} and the cost of fertilizer transport was included**.**

All the variable costs were subtracted from gross benefit to obtain net benefit. The highest net benefit of 246522.74 ha^{-1} with a marginal rate of return (MRR) of 4125.13% was obtained in response to the application of 187.5 kg blended NPSB ha^{-1} combined Nafis which was followed by the maximum

TABLE 2

Effect of blended NPSB fertilizer rate and varieties on yield contributing parameters of Onion during 2018/2019 cropping season

Treatments	Variables						
Varieties	NPSB (kg/ha)	BL/cm	BD/cm	ABW/g	BDW/cm	AGDW/g	TBDW/g
7	0	3.6^{h}	3.1^{g}	42.2^{g}	1.8^{f}	1.97^{g}	3.8^{g}
	65.5	4.28^{f}	3.8f	54.6^{e}	3.1^{e}	2.6^{e}	5.7^{f}
	125	4.8^{cd}	4.6^{cde}	65.9^{c}	5.2^{b}	3.6^{c}	8.7^{c}
	187.5	5.0^{cb}	4.7^{cbd}	67.3^{bc}	5.2^{b}	3.6^{c}	8.8^{c}
Nafis Red	0	3.9^{g}	3.3^{g}	47.8^{f}	2.1^{f}	2.3^{f}	4.4^{g}
	65.5	4.7^{d}	4.2^{e}	60.6^{d}	4.6^{c}	3.5^{c}	8.1^{d}
	125	5.4^{a}	5.5^{a}	82.8^{a}	6.8^{a}	4.3a	11.1^{a}
	187.5	5.5^{a}	5.6^{a}	85.7^{a}	6.9^{a}	4.8a	11.2^{a}
Nasik Red	0	3.9^{g}	3.3^{g}	45.2^{fg}	1.9^{f}	2.01^{g}	3.9^{gh}
	65.5	4.6^{e}	4.4^{ed}	56.5^{e}	3.7d	2.9^{d}	6.6^{e}
	125	5.0^{bc}	4.9^{bc}	68.2^{bc}	5.2b	3.7^{bc}	9.5^{b}
	187.5	5.1^{b}	5.0^{b}	69.6^{b}	5.5b	3.9^{b}	8.9^{bc}
LSD (5%)		0.16	0.42	3.41	0.56	0.22	0.60
CV%		2.05	5.70	3.25	7.65	4.09	4.72

Means followed by the same letter within a column are not significantly different at p<0.05 BD bulb diameter, BL= bulb length, ABW=average bulb weight BDW=bulb dry weight, AGDW=above-ground dry weight, TBDW=total biomass dry weight, LSD=List significant difference, C=coefficient of variance

TABLE 3

The effect of blended NPSB fertilizer rate and varieties on the total bulb, marketable and Unmarketable bulb yield of onion during 2018/2019 cropping season

Treatments		Variables		
Varieties	**NPSB (kg/ha)**	**TBY t/ha**	**MY t/ha**	**UMY t/ha**
Adam red	0	11.1^{hg}	9.1^{hg}	2.0^{b}
	62.5	16.2^{e}	15.2^{e}	1.0^{e}
	125	27.5^{c}	26.7^{c}	0.8^{g}
	187.5	29.2^{bc}	28.5^{bc}	0.7^{h}
Nafis red	0	13.0^{fg}	11.4^{fg}	1.6^{c}
	62.5	20.8^{d}	19.8^{d}	1.0^{e}
	125	35.2^{a}	34.7^{a}	0.5^{i}
	187.5	36.9^{a}	36.5^{a}	0.4^{i}
Nasik red	0	9.6^{h}	6.8^{h}	2.8^{a}
	62.5	15.3^{ef}	13.9^{fe}	1.4^{d}
	125	30.62^{b}	29.7^{b}	0.92^{f}
	187.5	31.8^{b}	30.9^{b}	0.9^{gf}
LSD%		2.3	2.7	0.09
CV%		6.88	7.31	4.47

Means followed by the same letter within a column are not significantly different at p<0.05 TBY=total bulb yield, MY=marketable yield UMY=marketable yield LSD=List significant difference, CV=coefficient of variance

Table 4

Effect of blended NPSB fertilizer and varieties on harvest index of onion during 2018/2019 cropping season

Treat	**Variable**
Varieties	HI
Adam red	0.55^{b}
Nafis red	0.57^{a}
Nasik red	0.56^{ab}
LSD 5%	0.015
NPSB	
0	0.48^{c}
62.5	0.56^{b}
125	0.59^{a}
187.5	0.60^{a}
LSD 5%	0.0174
CV %	3.18

Means followed by the same letter within a column are not significantly different at (p<0.05) HI= Harvest index, CV =coefficient of variance, LSD= list significant difference

Table 5

Partial budget and MRR analysis for NPSB fertilizer rate and varieties of onion

Trt	**UAY kg/ha**	**AY kg/ha**	**GP ETB/ha**	**VC ETB/ha**	**NB ETB/ha**	**MRR%**
Nasik*0	6800	6120	48960	12000	36960	---
Adama*0	9100	8190	65520	12000	53520	---
Nafis*0	11400	10260	82080	12000	70080	---
Nasik*62.5	13900	12510	100080	14765.61	85314.39	1748.42
Adama*62.5	15200	13680	109440	14765.61	94674.39	1488
Nafis*62.5	19800	17820	142560	14765.61	127794.39	2086.86
Adam *125	26700	24030	192240	15534.75	176705.25	3484.98
Nasik*125	29700	26730	213840	15534.75	198305.25	4564.54
Nafis *125	34700	31230	249840	15534.75	234305.25	4646.02
Adama*187.5	28500	25650	205200	16277.26	188922.74	3169.35
Nasik*187.5	30900	27810	222480	16277.26	206202.74	4826.5
Nafis*187.5	36500	32850	262800	16277.26	246522.74	4125.13

UAY kg/ha= unadjusted yield in kilogram per hectare, AY kg/ha=adjusted yield in kilogram/hectare, GP (ETB/Ha)=Gross Profit in Ethiopian birr per hectare, TVC ETB/ha= total variable cost in Ethiopian birr/ha, NB ETB/ha= Net Benefit in Ethiopian birr/hectare, MRR= Marginal Rate of Return.
Note that; cost of seed =3000ETB/kg, labor cost for fertilizer application=60 ETB/ person /day; cost of NPSB=13.79 ETB/kg, cost of urea=13.31 ETB/kg, the field price of onion=8 ETB/kg

net benefit of 234305.25 birr and MRR of 4646.02% was obtained at the application of 125 kg blended NPSB with the variety Nasik Red. This means that for every Birr 1.00 invested in 125 kg NPSB with Nafis variety, growers can expect to recover the Birr 1.00 and obtain an additional 46.46 Birr. However, the lowest net benefit 36960 Birr ha^{-1} was obtained for the control treatment without the application of both NPSB and urea fertilizer with a variety of Adama Red. The minimum acceptable marginal rate of return (MARR %) should be between 50% and 100% CIMMYT (1988) [44]. Thus, the current study indicated that the marginal rate of return is higher than 100% except for the control treatments (Table 5). This showed that all the treatment combinations except the control are economically important as the MRR is greater than 100%. The three treatments are rejected because they are not economically attractive as their MRR is below 50%. Thus, applications of 125 kg blended NPSB ha^{-1} combined with Nafis variety are the most economically attractive as compared to the other treatments in the study area because of the highest net benefit and the marginal rate of return with low cost of production.

CONCLUSION

This study showed that plant height, leaf number per plant, leaf length, date of maturity, shoot dry matter per plant, dry total biomass yield, average bulb weight, bulb diameter, bulb length, bulb dry matter per plant, marketable bulb yield, unmarketable bulb yield, total bulb yield, However, harvest index was significantly affected due to the different rates of blended NPSB fertilizer.

From this study, significantly tallest plants, highest leaf number per plant, tallest leave length, highest shoot dry matter per plant, and dry total biomass were recorded in the treatment combination of the Variety Nafis and 125 kg ha^{-1} blended NPSB fertilizer. Similarly, the longer bulb length, wider bulb diameter, highest bulb fresh weight, bulb dry weight, highest marketable yield were recorded at a treatment combination of the variety Nafis and 125 kg blended NPSB fertilizer and 187 kg blended NPSB fertilizer. The highest value of all parameters at a rate of 125 and 187.5 kg blended NPSB fertilizer were statistically not different.

Therefore, the most economically attractive combinations for small-scale farmers with low cost of production and higher benefits were the application of 125 kg blended NPSB fertilizer in combination with Nafis is like the 1st option and Nasik Red with the same rate of blended NPSB as the 2nd option in the study area. However, for growers who have full resources (investors), the application of 187 kg NPSB fertilizer combined with Nafis is profitable with the higher cost of production and highest net benefit.

However, as the experiment was done for only one season and single location, it has to be repeated over seasons and locations to make a conclusive recommendation. An experiment should be done to test the effect of blended NPSB fertilizer with organic fertilizer and the nutritional profile analysis and the shelf life of onion due to blended NPSB fertilizer application in the future study. Since the concentration of nitrogen found in the blended form is very low as compared to the recommended rate for onion production, it needs to conduct further research with different rates of nitrogen with blended fertilizer to supply the right rate for onion production and productivity.

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