Effects of Nitrogen, phosphorous (inorganic fertilizers) and Farm Yard Manure on growth, yield, yield components and oil contents of Sesame (Sesamum indicum L.) at Assosa district, Beneshangul Gumuze Region, Ethiopia

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Abstract: The research was conducted to study the effect of NP and FYM on growth, yield, yield components and oil content of sesame. The research consisted of four main treatments and three replications laid out in randomized complete block design (RCBD). Four levels of NP fertilizers (0-0, 30-15, 60-30, and 90-45 kg ha^{-1}) and four levels of FYM (0, 2.5, 5, and 7.5 t ha^{-1}) were used under drill sowing method. For the used fertilizers; Urea, DAP and FYM were the main source of nitrogen and P_2O_5 respectively. Abasena improved sesame variety which was collected from Pawe Agricultural Research Center was selected for the study and it also provided better yield. All necessary vegetative and generative parameters including oil content were collected timely and data analyses also done among treatments. Parameters were investigated includes; days to 50% emergency, days to 50% flowering, date to maturity, number of plants per plot, plant height (m), number of branches per plant, number of capsules per plant, total biomass (kg ha^{-1}), seed yield (kg ha^{-1}), thousand seed weight (g), harvest index(%) and oil content (%). The analysis of variance (ANOVA) for each studied parameter was computed by statistical analysis system (SAS) and separation between mean for treatments was done by using the least significant difference (LSD) test. Among NP and FYM levels 60-30 kg ha^{-1} with 5t ha^{-1} in drill planting method gave maximum seed yield (750 kg ha^{-1}) and maximum seed oil content (60%). The profitability obtained from the selected treatment was 3.78 and generally all treatments were indicated economically profitable. As recommendation, combination of 60-30kg ha^{-1} NP and 5t ha^{-1} FYM trial should be practiced widely with 6 kg ha^{-1} seed rate under drill sowing method. Generally, the study was statistically significant, which indicated that there was yield and oil content variation among different levels of NP and farmyard manure.

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Introduction

Sesame (Sesamum indicum L.) is an ancient oilseed crop of the world (Weiss, 1983). It is a small farmer's crop in the developing countries in the small plots (Gulhan and *et al.*, 2004). It had earned a poetic label "Queen of Oilseeds" because seeds have high quality poly- unsaturated stable fatty acids, which offer resistance to rancidity. Moreover, seeds were a rich source of edible oil (48-55 %) and protein (20-28%) (Nagaraj, 1995) consisting of both methionine and tryptophane, vitamin (niacine) and minerals (Ca and P). Sesame seed has pronounced antioxidant activity there by offer higher shelf life called "seeds of immortality".

Sesame is an excellent rotation crop of cotton, corn, peanut, wheat, and sorghum (Ray Langham and *et. al* March 2008). On fertile soil the crop may reduces nematode populations that attack cotton and peanut, improves the soil texture and moisture retention then reduces soil erosion. The composted sesame leaves left on the soil binds the ground; retains soil moisture better for planting the next crop; enhance drought resistant; tolerant to insect pests and diseases; and increases the yield of the following crops. By far sesame responds well to most nitrogen nutrients than the others. Fresh farm yard manure naturally which contains more nitrogen and other macro and micro nutrients than the inorganic fertilizers. Because of extensive farm land, natural forests which are the major input of organic manure were deforested and lead to soil degradation.

Integrated use of nutrients through organic and inorganic sources in a balanced proportion for sustainable production of sesame was emphasized among others by USDA (1980), Pannase et al. (1995), Tiwari et al. (1995), Hegde (1998) and Deshmukh et al. (2002). Narkhede *et al*. (2001) reported that application of nitrogen, phosphorous and potassium 40 kg N, 30 kg P_2O_5 and 20 kg K_2O ha^{-1} in combination with the application of FYM 10 t ha^{-1} produced significantly more seed yield of sesame than the application of inorganic fertilizers NPK (40 kg N, 30 kg P_2O_5 and 20 kg K_2O ha^{-1}) applied in combination with different levels of micronutrients and control. In

an experiment on integrated nutrient management in sesame, Duhoon *et al*. (2001) reported that sesame yield was significantly improved by application of fertilizers in combination with organic manures in different soil types (Vertisols, Alfisols and Inceptisols). Among the management practices, planting methods and fertilization are the most important factors in determining yield of sesame (Subramanyan and Arulmozhi, 1999). Therefore it was aimed to increase the production of sesame through applying optimum level of inorganic and farm yard manure fertilizers supplementing with improved agricultural practices (minimum tillage, contour farming, date of planting, depth of planting, protection etc).

Materials And Methods

Study to determine inorganic fertilizers (NP) and farm yard manures effects on growth, yield, yield components and oil contents of sesame (*Sesamum indicum* L.) was carried out at Assosa district, Benshangul Gumuz Regional State, Ethiopia. Total available soil nitrogen was estimated by alkaline permanganate oxidation method as outlined by Subbaiah and Asija (1956) and Kjeldahl 1883 (organic + inorganic N). Available phosphorus content of soil sample was estimated by Bray and Kurtz P-1 0.025 N HCl and 0.03N NH_4F method (Jackson, 1967). The study soil was clay loam with total N 0.17%, organic carbon 3.33%, available P 0.33ppm and CEC 23.09. The research was laid out at Randomized Complete Block Design (RCBD) with three replications. The net plot size was 11m x 39.5m (434.5m^2). The study was conducted from four levels of NP 0-0, 30-15, 60-30, and 90-45kg ha^{-1} and four levels of FYM 0, 2.5, 5, and 7.5 ton ha^{-1} under drill sowing method. The space between rows and plants were 40cm and 10cm respectively. A composite soil sample was taken from the depth of 20 cm before sowing and analyzed for its physical and chemical properties.

Sesame variety "Abasena" was Sown on June 14, 2015 on well prepared fine seed bed using a recommended seed rate 6 kg ha^{-1}. Fertilizers (FYM) were applied two weeks ago before planting and NP (in the form of Urea and DAP) as side drilled. Half of nitrogen level and full of phosphorous level was applied for every plot during planting time and half of the remaining nitrogen was applied as top dress after 45 days of planting. Hoeing was done twice to keep the crop free from weeds. All other agronomic practices were kept constant and uniform for all the treatments.

Growth and yield parameters such as plant height at maturity, number of capsules plant-1, number of seeds capsule-1, thousand seed weight, seed and oil yield were recorded using standard procedures during the course of these studies. The seed oil contents were determined by using Nuclear Magnetic Resonance (NMR) spectrometer and expressed in percentage with the help of Soxhlet Apparatus in the laboratory of Holleta Agricultural Research Center, Ethiopia. Data collected for growth and yield parameters were arranged and checked by using program Microsoft excels for analysis. The analysis of variance (ANOVA) for each study parameter was computed using Statistical Analysis System (SAS 9.2) program package. Mean separation was made by using the list significance difference (LSD) test for treatments showing statistically difference at 0.01 or 0.05 probability level.

Result And Discussion

Effects of NP Fertilizers and FYM on Growth Parameters of Sesame

As indicated in materials and method; days to 50% emergence, days to 50% flowering, date to maturity, number of plants per plot, plant height, and number of branches per plant was considered as growth parameters. Responses of these growth parameters to NP fertilizers and FYM under row sowing method was presented and discussed below under this section one after another.

Days to 50% emergence

Under row sowing method, days to 50% emergence of sesame was very significantly ($P < 0.01$) affected both by NP - FYM fertilizers and their interactions (Table 1 & 2). Days to 50% emergence of sesame was slightly increased with the increase of NP fertilizers and FYM levels (Table 1). Days-to-50% emergence increased from 5.00 to 5.90 as NP fertilizers increased from 00 to 90-45 kg ha^{-1}. Similarly, as the FYM fertilizer levels increased from 0-0 t ha^{-1} (the control) to 7.5 t ha^{-1}, days-to-50% emergence increased from 5.33 to 6.41. The combination effects of both fertilizers were increased the days-to-50% emergence up to 6.89 (Table 2). Unless the nutrients were subjected to leaching particularly nitrogen would showed significant result in days to 50% emergency. This finding has got similarity result with the finding earlier reported by Brady (1984).

Days to 50 % flowering

Days-to-50% flowering of sesame was also influenced by NP fertilizers and FYM application as well as by their interactions (Tables 3 and 4). Under row sowing method, FYM significantly ($P < 0.05$) influenced days-to-50% flowering, while NP fertilizer levels and their interaction were showed differences very significantly ($P < 0.01$) for days-to-50% flowering of sesame (Tables 3 and 4). Under row sowing method days-to-50% flowering was 80 from FYM, 81 days from NP fertilizers and it increased to 82 days from both interactions (Table 4).

Sesame flowers have five petals with the lower petal, being longer, forming what is known as the lip. The lip is folded over the top of the flower keeping it closed to around sunrise; when it opens it forms a running strip for bees (Langham, 2007). Flowers are produced in the leaf axils, each leaf axil bearing up to 3 white, yellow, pink, or purple flowers. The fruits are erect capsules, which form from flowers in the leaf axle about 4-6 ponds pair to the top of the plant. Some germplasm lines, particularly from China, have been found to have to have five capsules per leaf axil in many nods; two lines were found to have seven capsules per leaf axil (Langham, 2007).

Date to maturity

Date-to-50% maturity of sesame was influenced by NP fertilizers and FYM application as well as by their interactions (Tables 3 to 4). Under row sowing method, FYM significantly ($P < 0.05$) influenced date-to-50% maturity, while NP fertilizer levels and their interaction were showed differences very significantly ($P < 0.01$) for date-to-50% maturity of sesame (Tables 3). Under row sowing method, increasing of NP fertilizer rates from 0-0 kg ha^{-1} (the control) to 90-45 kg/ha resulted in increasing date-to-50% maturity of sesame very significantly from 108 to 123 days (Table 3). The interaction effect showed very significant ($P<0.01$) differences for days to maturity of sesame. As the interaction effects of NP fertilizers and FYM increased from 00-0 to 7.5 t ha^{-1} date-to-50% maturity also increased from 109-134 days (Table 3). Date to maturity of this study indicates similar result with the findings of (Ashri, 2007).

Although sesame grows well in long-day areas, it is generally considered as short-day plant. It flowers in about 45 days under 10 hour day length. Long-term selections in regions with different day length and light intensity have genotypes with different photoperiod requirements (Ashri, 2007). Some cultivars are day neutral, such as the cultivar *Venezeuela 51*. Depending on the cultivar, the crop matures in 75 to 150 days after sowing.

Number of plants per hectare

Number of plants per hectare did not show any significant ($P>0.05$) differences with NP fertilizers, FYM and their interaction. In this study, the number of plants per hectare of sesame was recorded from 108611 to124583 across FYM, 108609 to 124579 across NP fertilizers (Table 3) and 10653 to 124591 across the interaction of integrated fertilizers (Table 4). Generally there was no any change in the number of plants with the increase level of main and integrated fertilizers.

Plant heights (m)

Under row sowing method, plant height of sesame show slight significant ($P>0.05$) response to the main effects of fertilizers and interaction (Tables 3 to 4). The tallest plant height of 2.25m was recorded from the interaction effect of NP and FYM, whilst the shortest plant height 0.30m was recorded from main effects of FYM (Table 2). Results showed that, plant height and height to first capsule were significantly affected by nitrogen and phosphorus application, which agrees with the findings of Adam (1986) and Osman (1986). Sesame is an annual plant which depend on the cultivar, various in height from 0.5m to 2m; however, varieties that has 1.0m to 1.5m height are more common (Ashri, 2007). It has a large tap-root which can reach up to 990cm in length and dense surface mate of feeder roots, which makes it drought tolerant.

Number of branches per plant

Main effects of NP and all interaction factors shows slight significant difference ($P<0.05$) on number of branches per plant were as FYM only did not showed any significant ($P > 0.05$) influence in the number of branches per plant (Table 3 to 4). Despite of insignificant differences among treatments for number of branches per plant (Table 3), the highest number of branches (12) was recorded from the integrated interactions of NP and farmyard manure fertilizers.

Growth and yield parameters such as plant height, number of branches per plant, total dry matter and leaf area index have also been reported to be significantly increased with fertilizer application; the result was showed similar response with the reports of Gnanamurthy *et al*. (1992), Osman, (1993), Ishawar *et al*. (1994), Mankar and Satao, (1995) in that nitrogen application was significantly increased both the growth and yield of sesame.

Effects of NP Fertilizers and FYM on Yield Parameters of Sesame

Number of capsules per plant, total biomass (kg ha^{-1}), seed yield (kg ha^{-1}), thousand seed weight (g) and harvest index (%) of sesame experiment result to NP fertilizers and FYM were presented and discussed here below orderly.

Number of capsules per plant

FYM level did not show any significant ($P>0.05$) differences in increasing number of capsules per plant, whereas; NP fertilizer and their interaction has shown significant ($P < 0.05$) difference under row sowing method (Table 5 to 6). As observed from main effects across NP fertilizers the highest and lowest number of capsules per plant (160.12 and 193.53) obtained were due to increasing compound fertilizer levels. From the two way interactions the lowest number of capsules (161.25) was produced from zero level and the highest number of capsules (194.98) was produced from 60-30 NP kg ha^{-1} and 5 t FYM ha^{-1} level of application. Slight increment of number of

capsules per plant goes with parallel increment with FYM and NP fertilizers levels.

This work was more agreed with the work of Imayavaramban et al. (2002) found that application of nitrogen increased number of capsules, plant height and seed yield but there was no much significant response when phosphorus was applied more.

Table 1. Mean main effects of NP and FYM fertilizers on growth parameters of sesame under drill sowing method

Main factor	**Growth parameters**					
FYM (t/ha)	DE	FP	DM	NPH	PH	NB
0	4.33^{c}	69.67^{c}	107.66^{c}	108611	0.75^{d}	7.20
2.5	5.83^{b}	78.00^{b}	119.00^{b}	122361	1.00^{b}	8.16
5	6.41^{a}	80.17^{a}	119.50^{b}	118195	1.60^{c}	8.91
7.5	6.41^{a}	80.00^{a}	125.66^{a}	124583	1.90^{a}	6.00
Level of significance	**	*	*	ns	*	ns
LSD%	0.50	0.16	0.44	2222	0.17	1.38
NP(kg/ha)						
00	4.00^{c}	65.87^{d}	106.66^{c}	108609	0.30^{d}	7.30^{c}
30-15	5.62^{b}	76.61^{c}	118.68^{b}	122368	0.85^{c}	8.45^{b}
60-30	5.89^{a}	79.40^{b}	119.54^{b}	118209	1.15^{b}	9.21^{a}
90-45	5.90^{a}	81.00^{a}	124.58^{a}	124579	1.65^{a}	6.20^{d}
Level of significance	**	**	**	ns	*	*
LSD%	0.12	1.03	0.44	2211	0.10	1.38
CV (%)	0.47	6.21	0.44	19.72	9.07	17.50

Means within a column followed by the same letter(s) are not significantly different at P < 0.05.
*Where; ** shows very significance at P < 0.01, * shows significant at P < 0.05, DE = Days to 50% emergency, FP=Days to 50% flowering, DM=Date to maturity, NPH= Number of plants per hectare, PH= Plant height (m), NB=Number of branches per plant, NP= Nitrogen and phosphorous inorganic fertilizers, and FYM= Farm yard manure (fresh cow dung).*

Table 2. Mean of interaction effects of NP and FYM integrated fertilizers on sesame growth parameters

Interaction	**Growth Parameters**					
FYM (t/ha) * NP (kg/ha)	DE	FP	DM	NPH	PH	NB
00-0	4.23^{c}	70.16^{d}	108.66^{d}	108653	0.70^{d}	7.12^{c}
30,15-2.5	5.86^{b}	78.66^{c}	114.50^{c}	122372	1.00^{c}	8.10^{b}
60,30-5	6.01^{a}	80.00^{b}	129.66^{b}	118199	1.95^{b}	9.91^{a}
90,45-7.5	6.89^{a}	88.28^{a}	134.00^{a}	124591	2.25^{a}	6.16^{d}
Level of significance	**	**	**	ns	*	*
LSD%	0.32	1.27	5.32	2209	0.11	3.38
CV (%)	5.12	8.92	0.44	20.72	9.07	19.50

Means within a column followed by the same letter(s) are not significantly different at P < 0.05.
*Where; **= Showed very significant at P < 0.01, *= Significant at P < 0.05, ns= non-significant, DE = Days to 50% emergency, FP=Days to 50% flowering, DM=Date to maturity, NPH= Number of plants per hectare, PH= Plant height (m), NB=Number of branches per plant.*

Total biomass (kg/ha)

Total biomass show significant (P < 0.05) difference in the increase of NP and FYM levels and from their interactions (Table 5 & 6). As level of NP and FYM fertilizers increased from control to the highest level, the total biomass also increased from 1372.5 to 1598.3 kg ha^{-1} (Table 6). However; the highest total biomass was obtained from 90,45kg ha^{-1} NP and 7.5 t ha^{-1} FYM fertilizers. The interaction level relatively showed higher total dry biomass than the main effect (field observation). Nitrogen increased photosynthetic pigments content and photosynthesis rate, which in turn increased the amount of metabolites, synthesized and consequently resulted in higher dry matter accumulation in leaves and partitioned to seeds. These results are in harmony with those reported by Parasuraman and Rajagopal (1998) and also agree with the findings of Hossein *et al*. (1995), working on the stages of development, growth and yield of sesame as influenced by nitrogen application resulted in maximum dry matter accumulation, crop growth rate, and leaf area index were recorded at higher nitrogen levels while the highest seed yield was obtained from 60 kg N ha^{-1} application.

Table 3. Mean main effects of NP and FYM fertilizers on yield and yield parameters of sesame

Main Factor	**Yield Parameters**					
FYM (t/ha)	NC	TB	SY	TSW	HI	OC
0	163.25^{d}	1369.7^{d}	480.6^{d}	2.90^{c}	35.09^{b}	43.36^{d}
2.5	184.58^{b}	1486.4^{c}	500.1^{b}	3.03^{b}	33.75^{c}	46.46^{c}
5	194.58^{a}	1549.6^{b}	575.5^{a}	4.04^{a}	37.14^{a}	57.23^{a}
7.5	177.42^{c}	1593.9^{a}	483.3^{c}	3.10^{b}	30.32^{d}	50.26^{b}
Level of significance	*	*	*	*	*	*
LSD%	9.34	43.65	0.52	0.09	0.66	1.32
NP(kg/ha)						
00	160.12^{d}	1364.5	480.6^{c}	2.84^{c}	35.22	42.46
30-15	185.68^{b}	1475.2	560.4^{b}	3.02^{b}	37.99	44.40
60-30	193.53^{a}	1541.3	619.8^{a}	3.83^{a}	40.21	50.12
90-45	171.42^{c}	1585.8	479.7^{d}	2.98^{b}	30.25	40.87
Level of significance	*	ns	*	*	ns	ns
LSD%	7.32	14.21	0.64	0.10	0.68	2.01

Means within a column followed by the same letter(s) are not significantly different at P < 0.05.
*Where; ** shows very significance at P < 0.01, * shows significant at P < 0.05, ns= none significant, NC=Number of capsules, TB=Total biomass (kg ha^{-1}), SY=Seed yield (kg ha^{-1}), TSW=Thousand seed weight (g), HI= Harvest index (%), and OC = Oil content (%).*

Table 4. Mean of interaction effects of NP and FYM integrated fertilizers on yield and yield components and oil contents of sesame

Interaction	**Yield Parameters**					
FYM (t/ha)* NP(kg/ha)	NC	TB	SY	TSW	HI	OC
00-0	161.25^{d}	1372.5^{d}	484.9^{d}	2.94^{c}	35.33^{b}	51.34^{d}
30,15-2.5	178.49^{c}	1489.4^{c}	512.2^{c}	4.46^{a}	34.39^{c}	54.46^{c}
60,30-5	194.98^{a}	1551.3^{b}	750.4^{a}	4.04^{a}	48.37^{a}	60.36^{a}
90,45-7.5	186.28^{b}	1598.3^{a}	568.6^{b}	3.68^{b}	32.05^{d}	57.96^{b}
Level of significance	*	*	*	*	*	*
LSD%	6.45	46.23	23.65	0.41	1.54	1.67
CV (%)	20.29	11.89	14.03	3.81	21.90	16.84

*Means within a column followed by the same letter (s) are not significantly different at P < 0.05. Where; ** shows very significance at P < 0.01, * shows significant at P< 0.05, ns= none significant, NC=Number of capsules, TB=Total biomass (kg ha^{-1}), SY=Seed yield (kg ha^{-1}), TSW=Thousand seed weight (g), HI= Harvest index (%), and OC = Oil content (%).*

Seed yield (kg/ha)

Seed yield of sesame show significant ($P < 0.05$) influence with the increases of main factors and interaction effect of NP and FYM (Table 5 & 6). However; the seed yield of sesame was relatively showed considerable improvement while the level of NP and FYM increase from control level to 90-45 kg ha^{-1} and 7.5t ha^{-1}. This shows similar result with the finding of Mondal et al. (1992). The highest seed yields were obtained from the interaction factor than the main factors. The highest seed yield (750.4 kg ha^{-1}) was recorded from the interaction level of 60-30NP kg ha^{-1} and 5t ha^{-1} FYM, and the lowest seed yield (480.6 kg ha^{-1}) was recorded from zero level of NP and FYM main factors (Anonymous,1997). As it was seen from this research the seed yield obtained due to different levels of FYM was almost similar with that of the level of interaction factor. Okpara *et al*. (2007) also found that application of 26.4 kg P ha^{-1} significantly increased the number of leaves per plant, number of seeds per capsule and seed yield per hectare.

The result of this study was disagree with the findings of Deshmukh *et al.* (2002), Imayavaramban *et al.* (2002) and Thanunathan *et al.* (2002) studied the effect of integrated nutrient management in sesame on clay loam soils of Jabalpur under rainfed conditions. Results indicated that application of 50 per cent N through urea + 50 per cent N through FYM + 50 per cent P and 100 per cent K through fertilizers + phosphorus solubilizing bacteria (PSB) @ 500 g per hectare produced the highest seed yields. The improvement in seed yield was due to superior growth parameters (plant height and number of branches/plant) and yield attributing characters (capsules/plant, test weight of seeds and seed

yield/plant). Thanunathan *et al.* (2002).reported that application of FYM @ 12.5 t per ha + recommended dose of NPK favorably improved the growth, yield attributes and yield of sesame over recommended dose of NPK alone.

Thousand seed weight (TSW) (g)

Thousand seed weight was significantly ($P < 0.05$) influenced by main effect of NP & FYM and their interaction factor (Table 5 to 6). Almost similar and less weight was recorded from both main factors than the interaction factor. The highest thousand seed weight (4.46 g) was obtained almost from the lowest level of interaction and the lowest thousand seed weight (2.84 g) was obtained from zero level of NP (Table 5). From the other main factors, NP fertilizers also produced the highest thousand seed weight (3.83 g) due to the application of 60-30NP kg ha^{-1} (Table 5). Interaction factor was showed better positive response regarding thousand seed weight than the specific main factors (field observation). The highest thousand seed weight (4.46 g) was recorded from 30-15 kg ha^{-1} of NP fertilizers and 2.5t ha^{-1} (Table 6). This effect further resulted in poor dry matter accumulation in the plants of sesame planted without the use of fertilizers. The favorable effect of nitrogen fertilizer on TSW may be due to the reason that nitrogen stimulated plant growth such as plant height and number of branches per plant, which increased the amount of light energy intercepted by leaves Thanunathan *et al*. (2002).

Harvest index (%)

Harvest index was calculated from percentage fraction of seed yield (kg ha^{-1}) per total biomass (kg ha^{-1}). Harvest index did not showed any significant ($P > 0.05$) influence by any level of NP(Table 5) but showed slight significance ($P < 0.05$) influence with different levels of FYM fertilizer as well as from interaction factors (Table 5 to 6). The highest harvest index 48.37% and the lowest harvest index 30.25% was recorded from the interaction effect of 60,30NP kg ha^{-1} 5t FYM ha^{-1} and from main factor of NP 90-45 kg ha^{-1} respectively. The highest result of harvest index was the indicator of high yield than the dry biomass, which was resulted from optimum input of both integrated fertilizers.

Oil content (%)

From this project oil content of sesame was showed significantly ($P < 0.05$) influenced by NP, FYM and their interaction factors (Table 5 to 6). Oil content has direct relationship with thousand seed weight as observed from this laboratory output. The oil content recorded through different fertilizer levels were almost similar under both main factors, which means the highest oil content was about (60.23%) and the lowest was (52%). Under interaction factor the lowest oil content (51%) was recorded from zero level of fertilizers and the highest oil content (60.36%) was recorded just from 60-30 NP kg ha^{-1} and 5t ha^{-1} of farmyard manure (Table 6). The result was very synonym with the findings of (Ashakumary *et al*, 1999), in that sesame seeds contain 50-60% oil and 19-25% protein with antioxidants leginans such as sesamolin and sesamin which prevent rancidity and give sesame oil a long shelf life.

Table 5. Simple correlation coefficients among yield, yield components and oil contents of sesame under drill sowing method

Parameter	DE	FF	DM	NPP	PH	NB	NC	TB	SY	TSW	HI	OC
DE	1.00	0.99**	0.05	0.06	0.40*	0.39	0.34	0.19	0.22	-0.08	0.21	-0.09
FF		1.00	0.03	0.08	0.45*	0.41*	0.36*	0.21	0.22	-0.07	0.19	-0.07
DM			1.00	-0.08	-0.05	-0.10	-0.01	-0.01	-0.21	0.04	-0.29*	0.05
NPP				1.00	0.13	0.02	-0.07	0.28*	0.23	0.24	0.19	0.22
PH					1.00	0.65	0.51	0.24	0.34*	-0.04	0.32*	-0.07
NB						1.00	0.89**	0.61**	0.74**	0.08	0.59*	0.09
NC							1.00	0.63**	0.73**	0.15	0.54**	0.19
TB								1.00	0.76**	0.24*	0.33	0.28*
SY									1.00	0.26*	0.84**	0.64**
TSW										1.00	0.11	0.72**
HI											1.00	0.78**
OC												1.00

*Where; ** = shows very significant at p < 0.01, * = shows significant at p< 0.05, ns = shows none significant, DE = Days to 50% emergency, FF= Days to 50% flowering, DM = Date to maturity, NPP = Number of plants per plot, PH = Plant height (m), NB = Number of branches per plant, NC = Number of capsules per plant, TB = Total biomass (kg ha^{-1}), SY = seed yield (kg ha^{-1}), TSW = Thousand seed weight (g), HI = Harvest index (%), and OC = Oil content (%).*

Correlation Analysis as Influenced by Fertilizer Levels

To examine the relationship between parameters correlation analysis has been carried out among the different parameters (Table 6). In row planting methods, plant height (PH), number of branches (NB), number of capsules (NC), dry biomass (DB), harvest index (HI) and thousand seed weight (TSW) were correlated positively and significantly ($P < 0.05$) with seed yield of sesame which indicate that they can contribute to the increment of seed yield productivity. Especially number of capsules per plant (r=0.73, 0.60), number of branches (r=0.74, 0.69) and total dry biomass (r=0.76, 0.72) appeared to be very important parameters as far as achieving highest sesame yield is concerned in both seeding methods. Days of emergency was highly correlated (r=0.99) with 50% flowering time and plant height (r=0.40) in drill seeding method while there was no association or negatively correlated with TSW and OC. Date to maturity was negatively correlated with all growth and yield parameters except with oil content. And also percentage of oil content was negatively correlated with date to emergency(r=-0.09), days to 50% flowering (r=-0.07) and plant height(r = -0.07. The study further showed that in drill seeding method, dry biomass of sesame positively and significantly correlated with number of branches (r=0.61, 0.48), number of capsules (r=0.63, 0.52), seed yield (r=0.76, 0.72) (Table 7).

Economic Analysis of NP Fertilizers and FYM Levels on Yield of Sesame

The total average variable cost includes seed cost, fertilizers cost, cost of oxen rent during land preparation and planting, labor cost, land rent, cost of different chemicals and transportation. Under this dill sowing method the total cost for hired labor was 3886.00 ETB ha^{-1} which included from site clearing up to threshing, where as costs of seed rats were estimated at 116.00 for 6 kg, Urea; were estimated at 278.40 for 30 kg, 556.80 for 60 kg, and 835.20 for 90 kg respectively, DAP; were estimated at 296 for 15 kg, 591.50 for 30 kg and 887.50 for 45 kg birr ha^{-1} and different chemical cost 659.00 ETB per hectare finally the fresh cow dung per kg estimated as one Birr. The highest total revenue (26250 ETB) analyzed was revealed that the average total cost of production ha^{-1} was 6933.60ETB and the average gross net benefit ha^{-1} was 19316.40 ETB. Therefore; the highest net benefit (19316.40 ETB) was obtained from 5t ha^{-1} of FYM and 60-30 kg ha^{-1} of NP fertilizers. The value of economic efficiency indicated that sesame seed production has an index of 3.78. This means that for every birr 1.00 spent in the production of sesame integrated fertilizers, birr 3.78 was realized as a net revenue.

Table 6 Profitability obtained from NP and FYM integrated fertilizers under drill sowing method

Treatments NP XSR (kg ha^{-1})	Seed yield(kg ha^{-1})	Total variable costs, ETB ha^{-1}	Total revenue, ETB ha^{-1}	Net benefit, ETB ha^{-1}	Efficiency (TR/TVC)
0,0-0	485	3885.60	16975	13089.40	4.37
0,30-15	560	4833.60	19600	14766.40	4.05
0, 60-30	620	4359.60	21700	17340.40	4.98
0, 90-45	480	5307.60	16800	11493.40	3.16
2.5, 0-0	500	4935.60	17500	12564.40	3.54
2.5, 30-15	520	5409.60	18200	12790.40	3.64
2.5, 60-30	590	5883.60	20650	14766.40	3.51
2.5, 90-45	520	6357.60	18200	11842.40	2.87
5, 0-0	576	5985.60	20125	14139.40	3.36
5, 30-15	591	6459.60	20685	14225.40	3.20
5, 60-30	750	6933.60	26250	19316.40	3.78
5, 90-45	551	7407.60	19285	11877.40	2.60
7.5, 0-0	483	7035.60	16905	9869.40	2.40
7.5, 30-15	521	7509.60	18235	10725.40	2.43
7.5, 60-30	552	7983.60	19320	11336.40	2.42
7.5, 90-45	569	8457.60	19915	11457.40	2.35

Efficiency for (pi) for the i^{th} NP and FYM levels are mathematically expressed as: pi= TR/TVC; When pi>0, the production of the i^{th} FYM and NP levels are economically efficient. When pi<0, the production of the i^{th} FYM and NP levels are economically inefficient and when pi=0, the production of the i^{th} FYM and NP levels are said to be at the breakeven point.

To calculate the costs of production for sesame in a hectare of land, the considered components were cost of; land preparation, oxen rent, seeds with fertilizers, cost of fresh cow dung, and different

activities (cultivation, weeding, fertilizing, harvesting, threshing, transportation and storage). From the result it was concluded that all of the treatments were economically efficient from different magnitudes.

Conclusion

From the foregoing, it can be concluded that the growth, yield characters and oil contents measured were maximum at 5 t ha^{-1} of farm yard manure, 60 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}. Grain yield per hectare was optimized at 5 t ha^{-1} of farm yard manure, 60 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}. Applications of 5 t ha^{-1} of farm yard manure, 60 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}therefore; it seems to be the ideal rates of farm yard manure, nitrogen and phosphorus for increased yield of sesame in this agro ecology and is therefore recommended. Thus, in the light of the significant response of sesame to integrated fertilizers, further studies should be aimed for promoting micro-nutrients (sulfur) or irrigation cropping system and formulation of fertilization recommendation on soil test basis over location.

Biography

Tefera Teshome Negasa was born in 1977 G.C. at Eastern part of Wollega, Ethiopia. After he was reached at the age of education he had started the primary education around the birth area "Kidame Gebeya" from the beginning up to 8th grade in Dergu Régime 1983 – 1991 G.C. Tefera was born with Oromiffa mother tang and developed/practiced Amharic and English language through education and sharing cultural experience from other Ethiopian nations and nationalities, these was happened greatly due to deep acceptances of different cultures and ethnics of the country. Grade 8th national ministry exam result (86%) was best recorded and made him to join Harto secondary high school in 1992 G.C. After four years enrollment he was taken 12th grade ESLCE and recorded 3.00 GPA grades which helped him to join Wondo Genet College of Forestry and then graduated in Diploma level in 1995. After graduation, he had employed as DA in Beneshangul Gumuze Regional State, Kemash Zone, Agalo Meti Worreda. From 1998- 2004 G.C he has served the societies in his profession and joined Haromaya University for educational up grade in midcareer program in the field of agricultural extension from 2005 to 2007 G.C. After up grading educational back ground and developing scientific experience he has turned back to Beneshangul Gumuze and worked as team leader for the department of agricultural extension and also served the Region as focal person for agricultural sector support project (ASSP) in Belo jiganfoy woreda. From his hard work in regular and project implementation he had awarded the great national development merit from the former Ethiopian Prime Minister Meles Zenawi in 2009 G.C at Adama Tawn. From 2011 to 2012 G.C he has again joined Bahir Dar University to enroll the second degree in the field of Agronomy. After graduation he has joined Assosa University at 2013 G.C as lecture in the department of plant science and had been working for a year and then delegated as dean for the faculty of agriculture and natural resources. In addition to academic affairs, he has conducted different problem solving researches (1. Organic & inorganic fertilizers effect on growth, yield, yield components and oil contents of sesame, 2. characterization & classification of soil fertility-published), and community service projects (different trainings, CRGEP base line survey etc…) with Assosa University and Ministry of Environment, Forest & Climate Change (Ethiopia) in collaboration with UNEP and GIZ.

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