Ministry of Agriculture, Livestock and Irrigation
Department of Agriculture, Kayah State

Productivity and seed quality of Sesame (*Sesamumindicum* L.) by fertilizations with organic and inorganic sources of fertilizers

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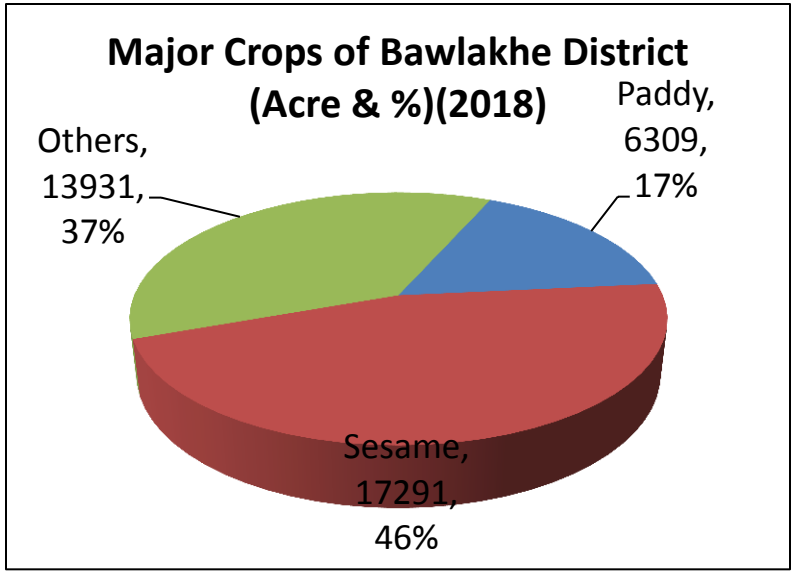
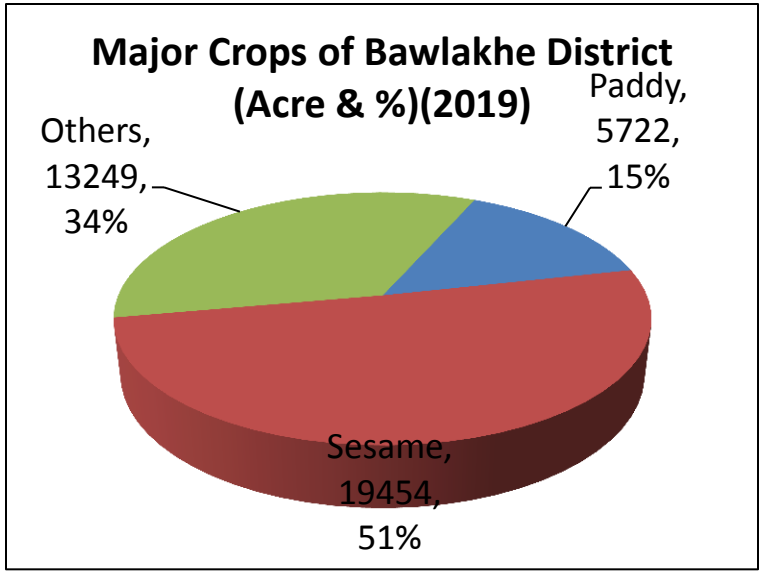
CONTENTS

Introduction…..

Climate and Agro-ecological Condition

- Rainfall <30 inches, uneven precipitation and high temperature in Sesame growing season (June ~ Sep)





Introduction……

Rationale

- Sesame is major crop in Bawlakhal District, sown as monsoon crop and total sown area is 7000 hectares in 2018 and 7876 hectares in 2019.
- Average yield 0.67 MT/hectare.
- Sesame cultivation is heavily depend on :
  - Rain fed crop production systems
  - Natural soil fertility and rarely used chemical fertilizers
- Farmers mostly rely on organic manure and usually apply chicken manure for production of sesame crop.
- Initiating Myanmar GAP and Organic product to increase market competitiveness.
- GAP (2018- 557 Acre, 2019- 904 Acre), Organic (841 Acre)
- Probable improvement of yield and quality of sesame crop by the application of organic manures on sesame in form of crop residues and animal manures was reported by Anyanga *et al.*, 2001 and Bedigian, 2003.

Purpose

To evaluate the comparative effect of application of organic and inorganic fertilizations on growth, yield and seed quality in sesame crop.

Materials and Methods

Location &Time

- Two experiments were carried out at a farmer's field with a program of farmer participatory research situated at Shanpaing village, Bawlakhal Township, Kayah State.

- The study was collaborated with Department of Agriculture, Kayah State and Soil Science Research Section of Department of Agricultural Research (DAR).

- The soil type is loamy sand

- The experiments were conducted during 2018 and 2019 monsoon seasons.

Materials and Methods

Experimental Design and Field Management

- Randomized Complete Block Design with 4 replications

- Each plot size was 3.64m wide x 3.64m long
  Total field experiments was 26.36m x 17.27m.

- Plots within blocks were separated by crossing bunds to prevent water and fertilizer flow from one treatment to another. The treatments were as follow;

  1) T_1- No fertilization
  2) T_2-Cowdung manure (3ton ha^{-1})
  3) T_3-Poultry manure (3ton ha^{-1})
  4) T_4-*Gliricidia* leaves (3ton ha^{-1})
  5) T_5-Urea 94+Tsuper 63+Potash 31kg ha^{-1}
  6) T_6-Urea 126+Tsuper 63+Potash 63kg ha^{-1}

- Samonenat variety which is widely grown in Bwlatkhal District was used for both seasons. Life duration is 75-85 days.

Materials and Methods

Cultural Management Practices

- Land preparation was followed by the usual practices; plowing once, harrowing twice followed by final leveling.

- Straight chemical fertilizers - Urea, Triple Super Phosphate and Muriate of Potash

- Organic fertilizers (Cowdung, Poultry manure and *Gliricidia* leaves as green manure)

- Sowing Date
  19 June in 2018
  25 June in 2019

- Seed Rate - 9 kg/hactre

Materials and Methods

Time of Application	Dosage of Application			
	Organic Fertilizers	Urea	Muriate of Potash	Triple Super Phosphate
10 Days before sowing	Full			Basal
Basal(Sowing Time)	-	Half	Half	Full
Initial Flowering Stage(42-44 DAS)	-	Half	Half	-

- First time thinning and weeding was done at 14 days after sowing
- Second time thinning and weeding was done at 21 days after sowing leaving 10cm apart plant to plant spacing.
- Weeding was carried out whenever necessary.
- Harvesting was done on September 4, 2018 and September 18, 2019. In 2019 growing season,
- Trichoderma with a rate of 2 packages of Trichoderma (150g) with 4 gallons of water was used at 25 and 33 days after sowing to control sesame black stem rot and sesame phyllody diseases.
- Hot and humid condition favors a few incidences of these diseases during 2019 growing season although it is not a serious infection.

Materials and Methods

Data Collection

- Composite soil samples were collected from the 0-15 cm layer of the soil before the start of the experiment and after harvesting for the determination of soil pH, available N, P, K, SO_4-S, Zn, Fe and organic matter contents.

- Organic fertilizers (cowdung, poultry manure and *Gliricidia* leaves) used in this study were analyzed to evaluate their nutrient content

- Plant heights (cm), pod length (cm), number of primary branches per plant, number of pods per plant were determined from randomly selected ten plants. Biomass weight (wet) and seed yield were determined from randomly selected twenty plants at the time of harvesting.

Materials and Methods

Data Collection

- Free Fatty Acid (FFA) content was determined using test paper of AV CHECK bottle produced from Advantec Co. Ltd, Japan which is available at local market.

- Oil content was measured at Irrigation Water Quality laboratory of Water Utilization Research Section.

- The analysis for soil and organic fertilizer were done at Soil and Plant Analysis Laboratory, Soil Science Research Section, Soil Science, Water Utilization and Agricultural Engineering Division under Department of Agricultural Research.

Nutrient content of cowdung, poultry manure and *Gliricidia* leaves (Oven Dry Basis)

No.	Materials	Total N%	Total P%	Total K%	Total S%	Total Ca%	Total Mg %
1.	Poultry manure	1.36	2.59	0.65	0.83		
2.	Cowdung manure	1.90	0.52	2.34	0.70		
3.	Gliricidia leaves	3.20	0.28	2.00	0.25	0.81	0.82

Source: Laboratory Analysis Data, Soil and Plant Analysis Laboratory, Soil Science Research Section

Rainfall and Temperature (°C) during the two growing seasons at Bawlakhal Township

No.	Months	Rainfall						Temperature (°C)			
		Normal		2018		2019		2018		2019	
		day	mm	day	mm	day	mm	Min.	Max.	Min.	Max.
1	June	12	128.5	12	132.6	8	94.0	24.5	40.0	25.5	40.5
2	July	15	152.4	17	163.1	14	106.9	24.0	36.2	24.3	38.6
3	August	15	185.4	14	142.0	20	173.2	23.5	34.8	24.0	37.0
4	September	13	164.6	11	119.6	12	152.4	23.0	37.0	22.5	37.8
	Total	55	630.9	54	557.3	54	526.5	95	148	96.3	153.9

Sesame is a short day plant and for optimum growth and yield, it generally requires fairly hot conditions (25-27°C). Premature flower drop or production of sterile pollen may occur at temperatures below 15°C and above 40°C (Ranganatha *et al*., 2010)

Soil Analysis Data before and after experiment (2018)

Treatments	pH		Available N		Available P		Available K		Organic Matter	
	reaction	rating	mg/kg	rating	mg/kg	rating	mg/kg	rating	%	rating
Initial soil	6.7	Neutral	96	High	0.5	Low	307	High	3.43	High
After 2018 monsoon										
T1	6.98	Neutral	69	Medium	1.3	Low	248	Medium	2.49	Medium
T2	7.43	Neutral	64	Medium	1.6	Low	312	High	2.07	Medium
T3	7.27	Neutral	63	Medium	3.9	Low	257	High	1.31	Low
T4	7.18	Neutral	66	Medium	1.7	Low	262	High	1.36	Low
T5	7.03	Neutral	61	Medium	2.2	Low	268	High	1.76	Low
T6	7.14	Neutral	60	Medium	3.1	Low	283	High	2.04	Medium

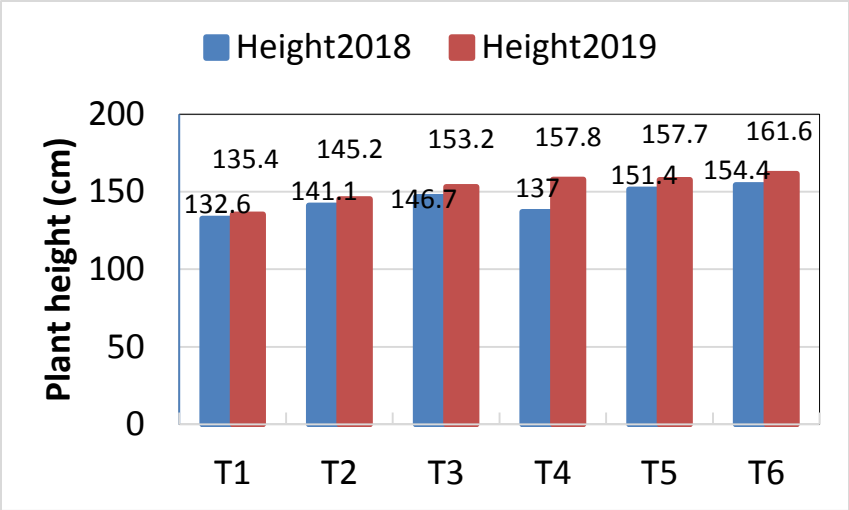
Treatments	Calcium Chloride Extractable SO_4-S		DTPA Extractable Zn		DTPA Extractable Fe		Texture%			Soil textural class
	mg/kg	rating	mg/kg	rating	mg/kg	rating	sand	silt	clay	
Initial soil	10	Medium	0.4	Deficient	23	Adequate	79	12	9	Loamy sand
After 2018 monsoon										
T1	6	Medium	0.8	Marginal	23	Adequate				
T2	7	Medium	1.3	Adequate	15	Adequate				
T3	6	Medium	1.1	Adequate	22	Adequate				
T4	7	Medium	1.2	Adequate	26	Adequate				
T5	6	Medium	1.2	Adequate	25	Adequate				
T6	7	Medium	0.5	Marginal	20	Adequate				

Soil Analysis Data before and after experiment (2019)

Treatments	pH		Available N		Available P		Available K		Organic Matter	
	reaction	rating	mg/kg	rating	mg/kg	rating	mg/kg	rating	%	rating
T1	6.95	Neutral	53	Low	1.4	Low	390	High	1.50	Low
T2	6.81	Neutral	50	Low	1.3	Low	452	High	1.32	Low
T3	6.89	Neutral	54	Low	16.2	Medium	367	High	1.50	Low
T4	7.06	Neutral	51	Low	1.8	Low	373	High	1.32	Low
T5	6.71	Neutral	53	Low	1.9	Low	411	High	1.51	Low
T6	7.21	Neutral	48	Low	1.8	Low	387	High	1.16	Low

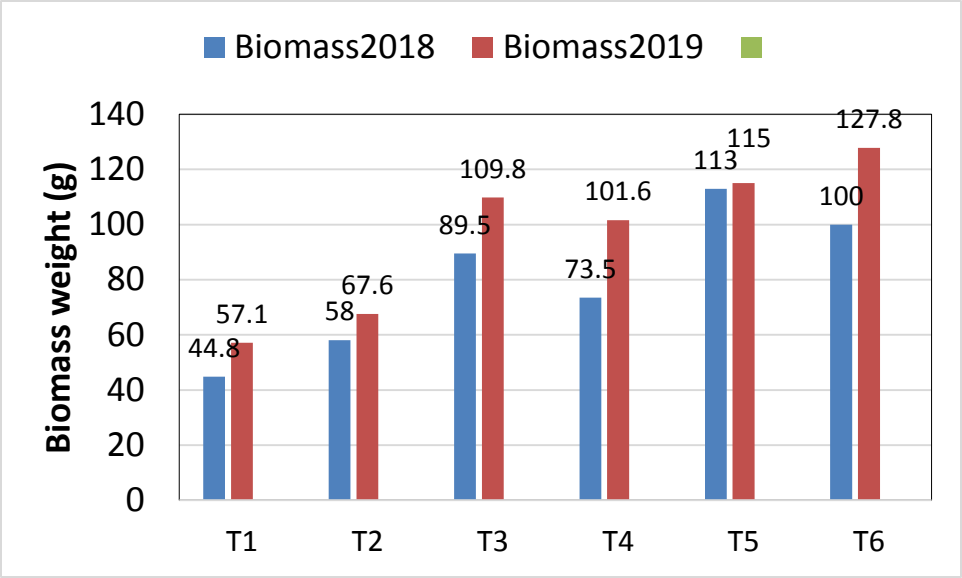
Treatments	Calcium Chloride Extractable SO_4-S		DTPA Extractable Zn		DTPA Extractable Fe	
	mg/kg	rating	mg/kg	rating	mg/kg	rating
T1	9.3	Medium	0.88	Marginal	17.8	Adequate
T2	6.4	Medium	0.93	Marginal	22.5	Adequate
T3	4.7	Medium	1.77	Adequate	21.2	Adequate
T4	4.7	Medium	0.98	Marginal	18.8	Adequate
T5	8.2	Medium	1.14	Adequate	17.8	Adequate
T6	8.2	Medium	0.90	Marginal	22.0	Adequate

Plant height (cm)(at harvesting time)



- Significant differences in plant height were found among the treatments for both years
- Application of inorganic fertilizers produced the highest plant height in 2018 and the lowest plant height was found in treatment with no fertilization.
- Application of animal manures and *Gliricidia* leaves did not differ significantly among them.
- During 2019 growing season, plant height was significantly affected by the application of organic and inorganic fertilizations.
- Control treatment (no fertilization) provided the lowest height and applications of poultry, *Gliricidia* leaves and inorganic fertilizers produced statistically similar heights although the highest height (161.6cm) was obtained from treatment of higher rate with inorganic fertilizer. This shows quick response of readily available chemical fertilizers to crop growth.
- Among the application of manures and G*liricidia* leaves, the tallest plant height (157.8cm) was obtained in the application of *Gliricidia* leaves. This result supported Babajide *et al.* (2012) who reported improved crop growth with application of green manuring with *Tithonia* (wild flower) plant compared with chemical fertilizer application. They also mentioned that green manuring regulates soil temperature, thus leading to improvement in crop performance.

Above ground biomass production



- Application of organic and inorganic fertilizers significantly increased biomass weights for both years
- In 2018, application of inorganic fertilizers (treatment 5 and 6) obtained higher biomass weight (113g and 100g) although their weights were not significantly different from applications of poultry manure and *Gliricidia* leaves.
- Among fertilizations of the organic materials, poultry manure treatment produced higher biomass amount (89.5g). This was attributed to high levels of nitrogen and phosphorus content in poultry manure released into the soil thus improving crop uptake for growth.
- Highly significant effect was found in biomass weight from application of organic and inorganic fertilization in 2019. The lowest weight (57.1g) was obtained from the crop with no fertilization treatment although there was no significant difference with treatment of cowdung application (67.6g).
- Green manuring with *Gliricidia* leaves and poultry manure application did not differ significantly in biomass weight together with chemical fertilizers treatments. This seems that green manuring and poultry manure application could have caused faster release of nutrients which improved uptake by sesame crop. In addition, having neutral soil pH and higher nitrogen and phosphorus content of *Gliricidia* leaves and poultry manure may result in improving the uptake of crop from the release of these nutrients. Babajide *et al*. (2012) recorded higher total biomass production from application of green manuring with *Tithonia* (wild flower) plant compared with the application of recommended rate of chemical fertilizer in sesame.

Yield and other parameters

2018

No.	Treatments	Branches per plant	Capsules per plant	Capsule Length (cm)	1000 seed weight (g)	Yield (kg/ha)
1	No fertilization	2	27	3.3	2.8	730
2	Cowdung manure-3 ton ha^{-1}	2	36	3.6	2.7	725
3	Poultry manure-3 ton ha^{-1}	2	38	3.5	2.8	1028
4	*Gliricidia* leaves-3ton ha^{-1}	2	34	3.3	2.8	1025
5	Urea 94+Tsuper 63+Potash 31kg ha^{-1}	3	51	3.5	2.7	1391
6	Urea 126+Tsuper 63+Potash 63kg ha^{-1}	3	53	3.6	2.8	1338
	F-Test	ns	5%	ns	ns	5%
	$LSD_{(0.05)}$	-	16	-	-	457
	CV%	23.8	27.3	5.2	3.7	29.2

2019

No.	Treatments	Branches per plant	Capsules per plant	Capsule Length (cm)	1000 seed weight (g)	Yield (kg/ha)
1	No fertilization	2	28	2.9	3.3	1099
2	Cowdung manure-3 ton ha^{-1}	3	25	3.1	3.3	1280
3	Poultry manure-3 ton ha^{-1}	4	50	2.9	3.0	1811
4	*Gliricidia* leaves-3ton ha^{-1}	3	48	2.9	3.3	1703
5	Urea 94+Tsuper 63+Potash 31kg ha^{-1}	4	54	3.1	2.5	1654
6	Urea 126+Tsuper 63+Potash 63kg ha^{-1}	4	60	3.1	3.5	2011
	F-Test	1%	1%	ns	ns	1%
	$LSD_{(0.05)}$	0.5	17	-	-	476.9
	CV%	10.4	25.8	7.0	28	19.9

Yield and other parameters

- Significant difference in sesame seed yield was found for both growing seasons.
- In 2018, application of both inorganic fertilizer treatments produced numerically higher yields (1391 kg ha^{-1} and 1338 kg ha^{-1}).
- Khaled *et al.,* (2012) reported that application of fertilizers with high mineral contents enhanced their uptake by crops leading to increased yield in sesame crop.
- But they did not differ significantly with application of poultry and green manuring treatments.
- The crop with no fertilization produced significantly lower yield (730 kg ha^{-1}) together with the crop applied with cowdung (725 kg ha^{-1}). It seems that the status of soil nutrients before cropping favors enough for the growth for sesame nutrient requirement to produce this amount of yield in crop with no fertilization treatment.

Yield and other parameters….

- Similar result followed in the growing season of 2019. However, higher yield (2010 kg ha^{-1}) obtained only from treatment of higher rate with inorganic fertilizer.

- Poultry manure application gave higher yield (1811.3 kg ha^{-1}) than the other organic treatments. Green manuring with *Gliricidia* leaves produced comparable yield (1703 kg ha^{-1}) with the treatment of lower rate of inorganic fertilizer application (1654 kg ha^{-1}).

- This may be attributed to faster release of nutrients to enhance uptake of nutrients and maintaining of soil moisture from green manuring with *Gliricidia* leaves.

- Number of branches per plant did not differ significantly in the growing seasons of 2018 although numerically higher values were found in two inorganic fertilizer treatments.

Yield and other parameters…

- Significant differences in number of branches per plant were found in 2019. Four branches per plant were achieved in poultry manure and two inorganic fertilizer treatments.

- Cowdung manure and *Gliricidia* treatments produced same branches per plant.

- The lowest branches were found in the crop with no fertilization treatment. Finding of Babijige *et al.* (2012) reported similar number of branches per plant with application of green manuring and chemical fertilizer in sesame crop.

- Application of organic and inorganic fertilization significantly affected number of capsules per plant for both seasons
- The crop with no fertilizer produced the lowest number of capsules. Treatments of organic and inorganic fertilizations did not differ significantly each other in 2018.

Yield and other parameters…

- In 2019, the crop with cowdung and no fertilization treatments gave the lowest capsule number. Higher number of capsules per plant produced from two inorganic fertilizer treatments for both years. Among organic fertilization treatments, poultry manure application produced statistically similar number of capsules with application of lower rate of fertilizer treatments in 2018 and all treatments obtained statistically similar number of capsules in 2019 growing season.

- Babijide *et al.* (2012) reported statistically similar number of capsules applied with green manuring and chemical fertilizer in sesame crop at one studied location.

- Capsule length did not show significant difference among the treatments for both growing seasons.

Nutrient content of sesame seed

No.	Treatments	Total N%	Total P%	Total K%	Total S%
1	No fertilization	3.28	0.62	0.51	0.22
2	Cowdung manure-3 ton ha^{-1}	3.23	0.66	0.55	0.23
3	Poultry manure-3 ton ha^{-1}	3.27	0.71	0.51	0.21
4	*Gliricidia* leaves-3ton ha^{-1}	3.20	0.54	0.47	0.22
5	Urea 94+Tsuper 63+Potash 31kg ha^{-1}	3.27	0.64	0.39	0.26
6	Urea 126+Tsuper 63+Potash 63kg ha^{-1}	3.36	0.69	0.60	0.21
	F-Test	ns	ns	5%	ns
	$LSD_{(0.05)}$	-	-	0.1	-
	CV%	6.1	11.7	13.6	21.7

- Application of organic and inorganic sources of nutrients was found to have significant effect on K concentration of sesame seed.
- Treatments of higher rate of inorganic fertilizer increased concentration of total N (3.36%), P (0.69%) and K (0.60%).
- Initial status of soil pH in neutral condition enhanced uptake of nutrient from inorganic fertilizer which is readily available. Poultry manuring gave higher P content (0.71%) compared with the other treatments.
- Nahar *et al.* (2008) and Mandal *et al.* (2009) reported that organic manures incorporated into soil decomposed and increased soil nutrient status thereby enhancing nutrient uptake by plants.

Effect on seed quality of sesame
Free Fatty Acid (FFA)

- In 2018, FFA content was measured 3 weeks after harvesting in 2018 and 3½ weeks after harvesting in 2019.
- There was no significant difference in FFA content for both seasons
- Poultry manuring and green manuring with *Gliricidia* leaves had lower FFA value compared with other treatments in 2018.
- For 2019 growing season, lower FFA values were found in organic fertilization treatments.
- Shakeria et al. (2015) evaluated the effects *of* nitrogen (N) *fertilizer* application rates (0, 25, *and* 50 kg N ha^{-1}) on three *sesame* cultivars *and* found that N application significantly decreased saturated *fatty acids*, but significantly increased unsaturated *fatty acids*.

No.	Treatments	FFA Score		Oil Content	
		2018	2019	2018	2019
1	No fertilization	2.1	2.0	46	43
2	Cowdung manure-3 ton ha^{-1}	2.0	0.8	47	50
3	Poultry manure-3 ton ha^{-1}	1.5	1.3	41	49
4	*Gliricidia* leaves-3ton ha^{-1}	1.5	1.2	42	51
5	Urea 94+Tsuper 63+Potash 31kg ha^{-1}	2.4	1.5	42	54
6	Urea 126+Tsuper 63+Potash 63kg ha^{-1}	2.0	1.8	40	60
	F-Test	ns	ns		
	$LSD_{(0.05)}$	-	-		
	CV%	43.9	52.0		

Conclusion

- The study has shown that fertilization with organic sources (poultry manure and *Gliricidia* leaves) produced comparable yield with application of inorganic fertilizers.

- Among organic fertilizers, poultry manuring gave higher yield compared with other organic treatments.

- Higher yield from green manuring with *Gliricidia* leaves, application of poultry manure and inorganic fertilizers was achieved due to higher values in plant height, aboveground biomass, numbers of branches and capsules per plant.

- Enhancing concentration of nutrients was observed by both applications of organic manures and inorganic fertilizers.

- No significant difference in FFA content for both years was observed and higher oil content from cowdung application was found in the growing season of 2018.

Conclusion

- Effect of poultry manuring on crop performance was more pronounced for both two years.
- Apart from poultry manure commonly used by farmers for sesame production, *Gliricidia* leaves can therefore be applied as green manure under loamy sand soil in Bawlakhal township.
- Both organic and inorganic fertilizations did not affect much on seed quality.

Thank you for your kind attention!