

Effect of nitrogen on flax (*Linum usitatissimum* L.) fiber yield at debre berhan area, Ethiopia

Abstract

A field experiment was conducted during at Debre Birhan Research Station. The experiment was laid out in randomized block design with three replication of six treatments (0, 46, 69, 92, 115 and 138N kg ha⁻¹). Flax fiber was rated in water for 15days and then after dried in shed. We comp bed and processed the fibr with prototype we made at the DBU. The result showed that all agronomic parameters were significantly correlated with nitrogen fertilizer level. The result showed that there was statistically significant response with nitrogen fertilizer rate. Agronomic parameters showed also an increasing trend to fertilizer rate levels. Increase of Nitrogen fertilizer rate increased the flax fiber length. About 58cm fiber length was obtained from 138kg N/ha fertilizer rate and the lowest was in the control treatment. Finally, we recommend that nitrogen fertilizer has great impact on flax growth, development and fiber length.

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Girma Taddese, Sintayehu Tenaye

AgriCollege/Plant Science Department, Debre Birhan University, Ethiopia

Correspondence: Girma Taddese, AgriCollege/Plant Science Department, Debre Birhan University, P.O.Box 445, Debre Birhan, Ethiopia, Email girmataddese@gmail.com

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Introduction

Flax (*Linum usitatissimum* L.) is an ancient crop grown for seed, oil and for the strong fiber produced in its stems. Flax is an annual herbaceous plant; flowers have five petals and contain up to 10 seeds. Flax grows under cool conditions, grows on clean, firm and smooth seedbed.¹

Approximately 7,000 years ago, ancient Egyptians domesticated flax and wrap their mummified dead with fabrics flax.² Dyed flax fibers were also discovered in a cave in Georgia dated to 34,000 BCE.

Berglund and Zollinger³ reported that flax grows very well on clay loams, and oilseed flax is poor competitor with weeds, when planted on wider row spacing. Applying high nitrogen rate increases vegetative growth, disease susceptibility and lodging. In contrast phosphorus and potassium are not critical for flax except in cases of extreme soil deficiency.⁴ More over Zinc is critical for flax growth and Zinc-deficient plants are chlorotic, and the primary terminal bud may die.⁵

Every part of the flax plant is at man's service; seeds provide oil for dyes, paint, cosmetics and floor coverings. The by-products of linen production are processed into a pulp used for banknotes or fiberboard.⁶

Flax must be uprooted to preserve the full potential of fiber of each plant. Following pulling, fiber flax must be retted to allow clean separation of the fiber from the stems. Water retting, where bundles of stems are submerged for retting by anaerobic bacteria, is one of the best but most expensive methods for separating flax fibers.

Based on Uddin and Kayaker⁷ assessment flax fiber is superior to other fibers, and fiber flax varieties are tall, and they are grown at very high density. The collected flax is processed with different tools to remove the woody stem core. Flax straw is a carbon-neutral fuel, and has heating value as that of coal. When paper fibers lose strength each time they are recycled, adding small amounts of flax fiber to paper pulp greatly increases the strength of recycled paper.⁸⁻¹⁰

The main component of flax, cellulose, is a natural polymer on earth.¹¹ Flax fibers are recyclable, biodegradable and carbon positive,

which flax plants absorb more carbon dioxide in the growth phase than they release during processing.¹²

Non-degradable composites, made from non-renewable resources are consuming oil resources.¹³ The bio-degradable fibers such as flax, jute and hemp are preferred, which are light weight, strong, resistant to corrosion, and have good sound and moisture absorption.¹²

The automotive and aerospace industries are using flax fiber to replace fiberglass in a wide range of fiber-reinforced composites, due to its high performance and light weight. Flax fiber also takes much less energy to produce than fiberglass and is biodegradable.^{2,14}

Fiber flax cultivars produce long fiber (line fiber, in the trade) and short fiber (tow). Long fiber is spun and woven to produce very high-quality linen fabric. Linen is used to make fine clothing, sheets, tablecloths, and other household goods. Linen yarn is used to make the very finest lace.¹⁵

Short fiber generally is blended with cotton or wool and spun into yarn to make a wide variety of apparel, upholstery, and carpet fabric.¹⁶

Getting quality organic fiber is becoming a great concern to supply the growing textile industries. The rapid population increase demands quality fiber products.

This study aimed to evaluate the potential development of flax fiber and oil quality (*Linum usitatissimum* L.) under the influence of rates of nitrogen application.

Material and methods

Description of the study area

The research was conducted at Debre Birhan University agricultural demonstration site. The site is located between 90° 30' N latitude and 39° 38' E longitudes and at an altitude of 2780m above sea level. The area receives mean annual rain fall of 1045.5 mm. The mean annual temperature is 18.61°C and a minimum of 5.2°C with the coldest season occurring between October and January; the mean relative humidity is estimated to be 10.9% and the soil is classified as Litosols and at foot slopes Vertic Cambisols in some localities.¹⁷⁻²¹

The experiment was laid out in a randomized block design (RCBD) with 3 replication and 6 treatments. The plot size is 1.5m X 2m. The treatment will consist of (0, 46, 69, 92, 115 and 138Nkg ha⁻¹). The flax cultivar namely Belay was the main flax variety. A distance of 0.6m between plot and 0.75m between block was established and seed was drilled on the row 10cm x10cm apart in intra row. For each agronomic parameter 10 guarded plants were taken randomly from each subplot for agronomic parameters. The recorded agronomic characters included as follows: Plant height (cm)/plant, Number of tillers/plant, Number of branch/plant, Branch height/plant (cm)/plant, Fresh Weight (g)/plant, Dry weight (g)/plant, Number of pod per plant or capsule.

For flax fiber length determination about 10 plants were harvested from each plot. After harvesting they were retted in water for 15days. After drying the retted flax fiber, it was dried in shade and combed with local made tools. The clean fiber length was measured with meter.

Data analysis

The experimental data was analyzed and summarized based on analysis of variance (ANOVA). A statistical analysis was done by using SPSS software version 20 and comparisons of means at 5% and 1 % level.

Results and discussion

Flax plant has several uses mainly for fiber, oil, cloth and cooking production. It was domesticated by Ancient Egyptian to wrap up mummies nearly 7000years ago.² Dying flax started in the cave of Gorgia in 34000 BCE. Cool climate is favorable for flax and demands clean seed bed.¹ That proves that North Shwea is also highly favorable for flax production. It is possible to cultivate flax on clay loam or silty loam soils with appropriate spacing both for oil and fiber production.³ Particularly Debre Birhan area is suitable for flax production. Application of high nitrogen increases vegetative growth, disease suitability and lodging.⁴ Our research on nitrogen fertilizer rate supports the above statement. Phosphorus and potassium are not critical for flax except in cases of extreme soil deficiency.⁴ Zinc is critical for flax growth and Zinc-deficient plants are chlorotic, as a result the primary terminal bud may die.⁵ In support to the above results we did not apply other fertilizers except nitrogen. We plant flax with the high density as reported by Uddin and Kayaker.⁷ The result showed that most of agronomic parameters correlated significantly among themselves (Table 1). However, early plant development growth did not show to different treatments.

Table 1 Statistical analysis

Parameters	Sum of squares	DF	Mean square	F	Sig.
PH*Trea	2362.75	5	472.55	6.272	0
NT*Trea	44.39	5	8.878	9.966	0
NB*Trea	436.548	5	87.31	9.206	0
BH*Trea	437.686	5	87.537	4.581	0.001
FW*Trea	110.275	5	22.055	3.533	0.038
DW*Trea	1811.892	5	362.378	1.771	0.2
FWI*Trea	3558.598	5	711.72	3.522	0.038
DWI*Trea	281.083	5	56.217	4.113	0.027
NPP*Trea	2221.794	5	444.359	5.522	0

Note: Trea, treatment; PH, plant height=(cm); NT, number of tillers; NB, number of branch; BH, branch height(cm); FW, fresh weight; DW, dry weight (g); NP, number of pod per plant or capsule

The Analysis of variances showed that plant height (cm)/plant, number of tillers/plant, number of branch/plant, branch height/plant (cm)/plant, fresh Weight (g)/plant, dry weight (g)/plant and number of pod per plant or capsule to nitrogen rate application. Generally flax plant height and branch height showed an increasing trend with nitrogen fertilizer rate (Figure 1). Similar trend was obtained for plant tillering, fresh and dry weight (Figure 2) (Figure 3). Increase of Nitrogen fertilizer rate increased the flax fiber length (Figure 4). About 58cm fiber length was obtained against 138kg N/ha fertilizer rate (Figure 4) and the lowest was in the control treatment.

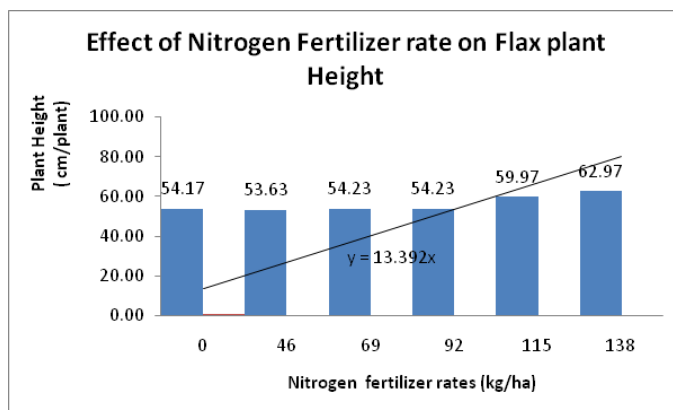


Figure 1 Effect if nitrogen fertilizer rate on flax plant height and branch height.

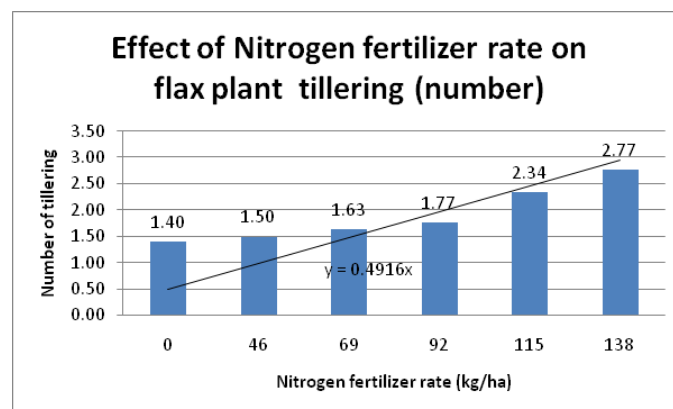


Figure 2 Effect if nitrogen fertilizer rate on flax plant tillering.

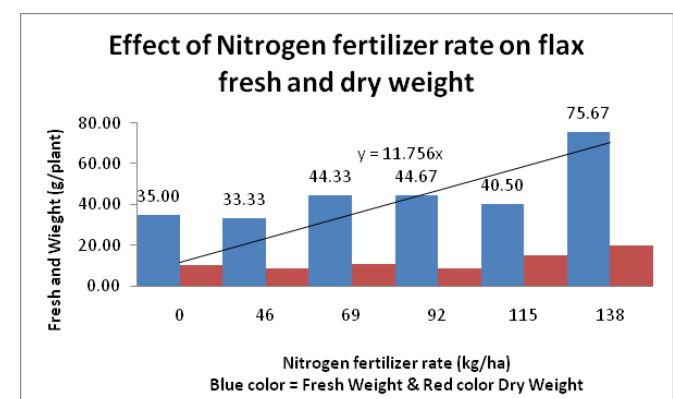


Figure 3 Effect if nitrogen fertilizer rate on flax plant fresh and dry weight.

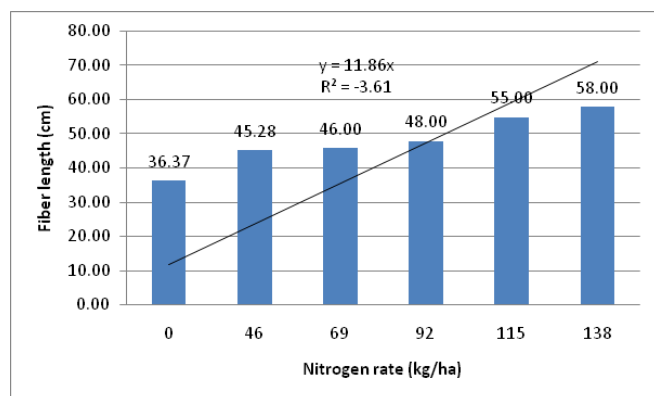


Figure 4 Influence of nitrogen rate on flax length.

Conclusion and recommendation

Flax is very important for its oil and its fiber is biodegradable which the current world demand focusing on bio-degradable material. Flax has several uses. To increase high yield of flax nitrogen fertilizer is critical. Our results supports also this there is an increase with nitrogen fertilizer rate. All measured agronomic parameters showed significant deference with nitrogen fertilizer rate. Increase of Nitrogen fertilizer rate increased the flax fiber length (Figure 4). About 58cm fiber length was obtained against 138kg N/ha fertgilizer ate (Figure 4) and the lowest was in the control treatment. We recommend for farmers that niting is possible in the future.

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None.

Conflict of interest

Author declares that there is no conflict of interest.

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