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Adaptation Study of Improved Linseed *(Linum Usitatisimum L)* Varieties at Kellem Wollega Zone, Haro Sabu, Ethiopia

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Abstract
The present study was envisaged to assess the adaptability of ten improved linseed varieties (Belay-96, Tole, Berene, Jeldu, Dibano, Kulumsa-1, CI-1652, CI-1525, Jitu and Kasa-2 and a local check at Haro Sabu Agricultural Research Center sub sites, to see their adaptability potential under western Oromia. These varieties were sown in RCBD with three replications during 2013/14 at Hawa Galan and Tabor sub sites. Combined analyses of data from the two experimental sites(Hawa Galan and Tabor)revealed very highly significant varietal differences ($P < 0.05$) in grain yield, and days to 95% maturity, and significant for plant height and capsules (balls) per plant. However, no significant varietal differences were observed in main branch per plant .The location effect was very highly significant ($P < 0.05$) for grain yield, days to 95% maturity, and plant height and significant for main branch per plant. There were no significant differences between the two locations with respect capsules (balls) per plant. The replication across location effect was highly significant ($P < 0.05$) for grain yield and not significant for all other characters studied.
A variety x Location interaction effects was highly significant ($P < 0.05$) for grain yield and days to 95% maturity. However, there were no significant difference for variety*location interaction effects for plant height, main branch per plant and capsules (balls) per plant. Plant height ranged from 89.97 cm for Jitu to 79.4 cm for Local check. Days to 95% maturity range from 136.3 days for Jeldu to 121.67 for Dibano. Mean capsules (balls) per plant differ from 25.0 (Tole) to 13.9(CI-1652). Mean Number of primary branches per stand ranged from 5.23 (local check) to 3.1(jitu). Kulumsa-1 variety produced the highest seed yield (10.85 Qt ha-1) followed by Kasa-2, Dibano and Jitu. On the other hand, CI-1652 (5.78 Qt ha-1) showed the lowest.
Keywords: Linum usitatisimum L; varieties; adaptability

INTRODUCTION

Linseed *(Linum usitatisimum L)* (2n=30), is an important oilseed crop which belongs to the family linaceae having 14 genera and over 200 species. It is believed that this crop species may have originated from *Linum angustifolium* Huds (n=15), native to the Mediterranean region. The genus Linum has both cultivated and wild species. The wild species have little economic value. The crop is predominantly self pollinated, but out crossing (less than 2%) occasionally results from insect activity (Adefris et,al 1992). On the basis of growth habit, two types (long stemmed and short stemmed) are recognized. Long stem linseed produces a high quality fiber but the oil content of the seed is relatively low. On the other hand, short-stemmed linseed bears larger seeds of high oil content and has a branching tendency (Legesse 2010).

In Ethiopia, linseed is the third important oilseed next to sesame and NOUG both in terms of acreage and total production. Annually, a total of 112,760 tons of linseed is harvested from

about 117,000 ha of land, and as such the crop accounts for over 13% of the total cultivated area and over 15% of the total production of oilseeds in the country (CSA 2012). Linseed is the second major oil seed crop next to NOUG in the highlands of Ethiopia (Adugna, 2000). .Ethiopia is considered as a centre of diversity for linseed. It is known for its high quality oil, and its use as a raw material for agro - industries. Linseed is grown for oil production and shows high variability in flower color, plant height, flowering and maturity periods, and capsule size and wilt resistance.

Linseed requires cool temperatures during its growing period to produce good yields. The mean temperature can range from 10 to 30°C although the crop grows best within 21 and 22°C (Adugna, 2000). In Ethiopia, linseed has been cultivated for two primary purposes, seed and oil use. It has traditionally been used for food and as a cash crop since ancient times. It is now grown primarily for food and to generate revenue, either in local markets or by export. For food, the seeds are usually roasted, ground, mixed with spices and water, and served with various local breads. It is also consumed in soups, with porridges and cooked potatoes, etc. Limited amounts are also pressed locally for its edible oil, which is often blended with other high quality vegetable oils. As a result, linseed is currently becoming popular worldwide for its functional food products (MOA, 1998).

The usage of improved seeds is one of the most efficient ways of raising crop production, but in Ethiopia less than 10 percent of farmers use improved seeds. (FAO, 2010).

Lack of access to improved varieties in western Ethiopia is the main problem that hampers production of this crop. The present study was envisaged to assess the adaptability of improved linseed varieties that gives best yield under agro ecology of western Oromia.

MATERIALS AND METHODS

The experiment was conducted on ten linseed varieties (Belay-96, Tole, Berene, Jeldu, Dibano, Kulumsa-1, CI-1652, CI-1525, Jitu and Kasa-2 and a local check. These varieties and check variety were sown in RCBD with three replications during 2013/14 at Haro Sabu Research Center Sub-Site Hawa Galan and Tabor, Ethiopia. Experimental unit comprised

Six rows of 3 meters length with row-to-row distance of 20 cm and plant-to-plant

distance of 10 cm. Data were recorded for grain yield and its components including days to 95% maturity, plant height (cm), number of primary branches per plant, and number of capsules per plant. The data were subjected to statistical analysis using SAS 9.1 computer software. The significance of means differences were tested by Duncan's Newman Multiple Range Test (DNMRT) as stated in Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

Analysis of variance

The results of analysis of variance based on randomized complete block design experiments for Hawa Galan and Tabor sub-sites location are presented in Appendices 1 and 2, respectively and for combined one is presented in Appendices 3. Under Hawa Galan (Appendix 1), the mean of squares due to varieties were highly significant for days to 95%maturity and yield. The same trend was observed under Tabor (Appendix 2), where varieties showed highly significant difference for days to 95% maturity and yield.

Mean performance

Differences in mean performance of the linseed varieties for the characters studied

Under Hawa Galan and Tabor sub-site are presented in Tables 1 and 2 respectively and the combined mean is presented in Table 3.

The results indicated that the differences among the means of the linseed varieties for the studied traits were significant at 5% probability level for all experimental conditions, except

Plant height and Capsules per stand under Hawa Galan site. Whereas, all studied traits were significant at 5% probability level for all experimental conditions in Tabor sub-site.

Plant height ranged from 96.77 cm for Dibano to 85.13 cm for Local check under Hawa Galan site. Whereas, under Tabor condition, the highest height was recorded from Kasa-2 (85.47 cm) and the lowest height was 73.27 cm from CI-1525.

Days to maturity ranged from 134.67 days for Jeldu to119.0 days for Dibano under Hawa Galan and 134.0 for Jitu to 124.33 days for Dibano under Tabor sub-site.

Mean capsules (balls) per plant varied from 24.0 for (Tole) to 14.47 (Kulumsa-1).under Hawa Galan site, even though they are not statistically different.

Whereas, Mean capsules (balls) per plant varied from 26.0 (Tole) to 10.53 (CI-1525) under Tabor sub-site,

Mean Number of primary branches per stand ranged from 5.73(local check) to 3.80(kasa-2) under Hawa Galan site and 5.13(Dibanno)to 2.40(Jitu) under Tabor.

Under Hawa Galan site, where most of the tested varieties produced their highest yield, Dibano variety produced the highest seed yield (12.03 Qt ha-1) followed by Kasa-2, Jitu and Kulumsa-1. On the other hand, CI-1652 showed the lowest.

Under Tabor site, Kulumsa-1 variety produced the highest seed yield (12.23 Qt ha-1) followed by Jeldu and Kasa-2. On the other hand, Tole showed the lowest.

Variations in grain yield and other agronomic traits

Combined analyses of data from the two experimental sites(Hawa Galan and Tabor)revealed very highly significant varietal differences ($P < 0.05$) in grain yield, and days to 95% maturity, and significant for plant height and capsules (balls) per plant. However, no significant varietal differences were observed in main branch per plant (appendix 3).

The location effect was very highly significant ($P < 0.05$) for grain yield, days to 95% maturity, and plant height and significant for main branch per plant. There were no significant differences between the two locations with respect capsules (balls) per plant (appendix 3).The replication across location effect was highly significant ($P < 0.05$) for grain yield and not significant for all other characters studied.

A variety x Location interaction effects was highly significant ($P < 0.05$) for grain yield and days to 95% maturity. However, there were no significant difference for variety x location interaction effects for plant height, main branch per plant and capsules (balls) per plant.

Plant height ranged from 89.97 cm for Jitu to 79.4 cm for Local check. Legesse Burako(2010) reported that the average plant height for Tole was 67.3cm but under this study this variety's height goes up to 75.40cm . Whereas, Days to maturity ranged from 136.3 days for Jeldu to 121.67 for Dibano indicating that dibanno was early maturing variety while Jeldu was late maturing variety.

Mean capsules (balls) per plant varied from 25.0 for (Tole) to 13.9 for (CI-1652). Mean Number of primary branches per stand ranged from 5.23 (local check) to 3.1(jitu).

Kulumsa-1 variety produced the highest seed yield (10.85 Qt ha-1) followed by Kasa-2, Dibano and Jitu. Cherinet and Tadesse(2014) also reported that variety kulumsa-1 was best in seed yield, oil content and oil yield under north west Amhara region indicating the consistency of the variety to wide agro ecology. On the other hand, Legesse Burako(2010) reported that variety Tole can yield about 20.93Qt per hectare under central highland of Ethiopia, even though this variety has not consistency to the yielding ability under western Ethiopia .On the other hand, CI-1652 (5.78 Qt ha-1) showed the lowest and it strengthen the findings of Cherinet and Tadesse(2014).Moreover, the mean capsule(balls)per stand was very small for CI-1652 variety and since it was correlated with yield it may be the principal cause of low yield of this variety.

Table 1. Mean values of yield and yield components of linseed varieties at Hawa Galan

varieties	DTM	CPS	BRPS	PHT	YLDQ
Belay-96	130.67^{cbd}	21.6^{a}	5.47^{ab}	90.60^{a}	8.40^{b}
CI-1525	132.3^{b}	22.7^{a}	4.87^{abc}	87.93^{a}	7.50^{bc}
Berene	130.3^{cd}	19.6^{a}	4.80^{abc}	86.53^{a}	8.23^{bc}
Tole	130.3^{cd}	24.0^{a}	4.43^{abc}	85.27^{a}	8.33^{b}
Local	129.0^{d}	21.4^{a}	5.73^{a}	85.13^{a}	7.60^{bc}
Kulumsa-1	130.0^{cd}	14.47^{a}	4.27^{bc}	95.13^{a}	9.47^{ab}
Kasa-2	130.0^{cd}	17.67^{a}	3.80^{c}	92.47^{a}	11.23^{a}
Jitu	130.67^{cbd}	15.93^{a}	3.87^{c}	95.47^{a}	11.13^{a}
Jeldu	134.67^{a}	22.80^{a}	5.33^{ab}	92.47^{a}	7.90^{bc}
Dibano	119.0^{e}	22.33^{a}	5.13^{abc}	96.77^{a}	12.03^{a}
CI-1652	131.3^{bc}	14.73^{a}	4.60^{abc}	92.47^{a}	5.67^{c}
Lsd(5%)	1.82	12.38	1.34	11.93	2.64
SE(m)	1.13	52.84	0.62	49.03	2.40
Cv(%)	0.82	36.80	0.62	7.70	17.47

*Means with the same letter are not significantly different

PHT = Plant height, CPS = Capsules per stand, BRPS =Number of primary branches per stand,DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt)

Table 2. Mean values of yield and yield components of linseed varieties at Tabor

varieties	DTM	CPS	BRPS	PHT	YLDQ
Belay-96	132.0^{c}	16.08^{abc}	3.40^{abc}	76.47^{bcd}	4.70^{e}
CI-1525	134.0^{b}	10.53^{c}	3.13^{bc}	73.27^{d}	5.10^{de}
Berene	132.0^{c}	20.47^{abc}	4.43^{ab}	81.07^{abcd}	7.90^{b}
Tole	133.0^{bc}	26.0^{a}	4.43^{ab}	75.40^{bcd}	4.30^{e}
Local	133.0^{bc}	25.93^{a}	4.73^{ab}	73.67^{d}	5.10^{de}
Kulumsa-1	132.0^{c}	15.93^{abc}	3.33^{abc}	81.0^{abcd}	12.23^{a}
Kasa-2	133.0^{bc}	19.73^{abc}	4.87^{ab}	85.47^{a}	8.07^{b}
Jitu	134.0^{a}	13.67^{bc}	2.40^{c}	84.47^{ab}	7.17^{bc}
Jeldu	138.0^{b}	21.07^{ab}	4.20^{abc}	78.07^{abcd}	8.10^{b}
Dibano	124.33^{d}	16.40^{abc}	5.13^{a}	73.47^{d}	6.50^{bcd}
CI-1652	134.0^{b}	13.07^{bc}	4.43^{ab}	81.80^{abc}	5.90^{cde}
Lsd(5%)	1.09	10.39	1.93	8.03	1.77
SE(m)	0.41	37.22	1.28	22.23	1.07
Cv(%)	0.48	33.74	28.11	6.00	15.19

*Means with the same letter are not significantly different. PHT = Plant height, BPS = Capsules per stand, BRPS =Number of primary branches per stand,,DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt.)

Table 3. Mean values of yield and yield components of linseed varieties combined over location

varieties	DTM	CPS	BRPS	PHT	YLDQ
Belay-96	131.3[ed]	18.8[abcd]	4.4[ab]	83.5[abc]	6.56[cde]
CI-1525	133.17[b]	16.6[bcd]	4.0[bc]	80.6[bc]	6.3d[e]
Berene	131.17[e]	20.03[abcd]	4.57[ab]	83.8[abc]	8.07[bc]
Tole	131.67[cde]	25.0[a]	4.3[bc]	80.3[bc]	6.32[de]
Local	131.0[e]	23.67[ab]	5.23[a]	79.4[c]	6.35[ed]
Kulumsa-1	131.0[e]	15.2[cd]	3.8b[c]	88.07[a]	10.85[a]
Kasa-2	131.5[ed]	18.7[abcd]	4.4[ab]	88.97[a]	9.65[ab]
Jitu	132.3[bcd]	14.8[cd]	3.1[c]	89.97[a]	9.15[ab]
Jeldu	136.3[a]	21.9[abc]	4.77[ab]	85.27[abc]	8.0b[cd]
Dibano	121.67[f]	19.37[abcd]	5.13[a]	85.12[abc]	9.27[ab]
CI-1652	132.67[bc]	13.9[d]	4.47[ab]	87.13[ab]	5.78[e]
Lsd(5%)	1	7.96	1.13	7.06	1.71
SE(m)	0.74	46.62	0.95	36.76	2.16
Cv(%)	0.65	36.09	22.14	7.15	18.73

*Means with the same letter are not significantly different.PHT = Plant height, CPS = Capsules per stand, BRPS =Number of primary branches per stand,, DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt)

CONCLUSIONS AND RECOMENDATIONS

Generally, the present study entails the presence of significant variations among linseed varieties. Results revealed that Kulumsa-1 showed to be best performer variety followed by Kasa-2, Jitu and Dibano. Hence if the above mentioned varieties are demonstrated and popularized to the small scale holder farmers, they can boost the income of pro poor farmer.

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REFERENCES.

Adugna Wakjira (2000). Assessment of tissue culture drived regenerants of linseed (*Linum usitatissimum* L.*)* in Ethiopia. M.S.c. Thesis. Department of plant breeding, faculty of Agriculture, University of the Free State, Bloemfontein, South Africa. RLD FOOD PRO .

Adefris TW, Getinet A, Tesfaye G (1992). Linseed breeding in Ethiopia. In: Oilseeds Research and Development in Ethiopia. Proc. of the First National Oilseeds Workshop 3-5 Dec. 1991. IAR, Addis Ababa, Ethiopia, pp. 41-50

Cherinet Alem and Tadesse Dessalegn, 2014. Study on Genotype X Environment Interaction of Seed Yield, Oil Content, Fatty Acid Profile and Stability Analysis of Yield Related Trait in Linseed (*Linum usitatissimum* L.) in North Western Ethiopia. *International Journal of Plant BreedingandGenetics,8:66-73.*

CSA(The Federal Democratic Republic of Ethiopia, Central Statistical Agency). Agricultural Sample Survey 2011/2012 (2004 E.C.) (September – December 2011). Volume I. Report on Area and Production of Major crops (Private Peasant Holdings, MEHER season).

Statistical Bulletin, May, 2012, Addis Ababa, Ethiopia

FAO/WFP (Food and Agriculture Organization, 2010). CROP AND FOOD SECURITY ASSESSMENT MISSION TO ETHIOPIA. Available at: *http://www.faostat.fao.org.*

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. 2nd Ed., John Willey and Sons. Singapore.

Legesse Burako (2010). Genetic Diversity Study of Linseed Genotypes on Acidic Soil at Bedi Trial Site, Central Highland of Ethiopia, MSc.Thesis. Addis Ababa University, Addis Ababa .

MoA (1998). Agro-Ecological Zones of Ethiopia, Addis Ababa, Ethiopia.

Robbelen G, Downey RK, Ashri A (1989). Oil Crops of the World, McGrawHill, New York.

Appendices

Appendix 1. Mean square values of yield and yield components of linseed varieties under Hawa Galan sub-site.

Source of variation	Degree of freedom	Mean Square				
		DTM	CPS	BRPS	PHT	YLDQ
Replication	2	0.03	4.24	1.96	5.76	18.88**
varieties	10	45.56.**	36.33.	1.21	52.053	11.00**.
Error	20	1.13	52.84	16.60	49.03	2.40
Cv(%)		0.82	36.80	0.62	7.70	17.47

*and ** = Means significant at 5% and 1% probability level, respectively. PHT = Plant height, CPS = Capsules per stand, BRPS =Number of primary branches per stand,, DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt), CV (%) = coefficient of variation.

Appendix 2. Mean square values of yield and yield components of linseed varieties under Tabor sub-site.

Source of variation	Degree of freedom	Mean Square				
		DTM	CPS	BRPS	PHT	YLDQ
Replication	2	0.21	178.01*	0.52	100.68*	5.71**
varieties	10	31.47**	76.41	2.14	59.35*	15.45**
Error	20	0.41	37.23	128.12	22.23	1.07
Cv(%)		0.48	33.74	28.11	6.00	15.19

*and ** = Means significant at 5% and 1% probability level, respectively. PHT = Plant height, CPS =Capsules per stand, BRPS =Number of primary branches per stand, DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt),CV (%) = coefficient of variation.

Appendix 3. Mean square values of yield and yield components of linseed combined over location.

Source of variation	Degree of freedom	Mean Square				
		DTM	CPS	BRPS	PHT	YLDQ
Replication	2	0.197	103.95	1.67	47.12	13.99**
Location	1	131.05***	46.08	8.73*	2525.89***	68.63***
varieties	10	74.95***	78.79	2.12*	77.89*	17.38***
Loc* varieties	10	2.079**	33.96	1.23	33.51	9.07**
Error	42	0.74	46.62	0.95	36.76	2.16
Cv(%)		0.65	36.09	22.14	7.15	18.73

* ,** and *** = Means significant at 5% ,1% and 0.1 probability level, respectively. PHT = Plant height, CPS = Capsules per stand, BRPS=Number of primary branches per stand, DTM = Days to 90% maturity, YLDQ =yield per hectare (Qt), CV (%) = coefficient of variation.