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RESEARCH ARTICLE

Differential performance of early maturing linseed cultures in rainfed situations

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SUMMARY

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown for both fibre and seed. In India, eighty per cent of the oil produced is used by industries in manufacturing of paints, varnishes, printing pads and inks, coating oils and in leather and soap. It is a source of complete protein (all 8 essential amino acids), complex carbohydrates, vitamins, minerals and natural source of Omega-3 (Alfa linolenic acid) and Omega-6 fatty acids. To evaluate and screen different elite cross derivatives under rainfed conditions, State Preliminary Yield Trials were conducted with Randomised Block Design with three replications during *Rabi* 2007-08 to 2010-11 at AICRP on Linseed, Jashipur, Odisha. Two high yielding early cross derivatives *viz.*, OL 98-13-1 and OL 98-6-2 were evaluated in ten different coordinated testing centres of Zone III and Zone IV of the country during *Rabi*,2011-12. The seed yield of OL 98-13-1 found promising among all the entries and ranged between 437 kg/ha to 1299 kg/ha with highest zonal average seed yield of 849 kg/ha in Zone IV. It recorded yield advantage of 15.20 per cent over the national check variety T-397, 39.41 per cent over the zonal check JLS-9, 14.11 per cent over NL 97 and 11.56 per cent over the best check variety Sharda. Both the entries matured earlier in 104-105 days as against 109 days in the national check T397. The entry was also found to be moderately resistant to wilt in artificial inoculums conditions tested in four testing centres of the country. The culture was found promising for yield and duration with resistant to wilt, moderate resistant to Alternaria blight and bud fly and highly resistant to powdery mildew. This culture can be used in further crop improvement programme suitable for utera and rainfed situations.

Key Words : Linseed, OL 98-13-1, Yield, Disease score

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Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown for both fibre and seed. Almost every part of the plant is commercially utilized either direct or after processing for industrial, medicinal and nutritional purposes. Linseed is believed to have originated in an area East of the Mediterranean sea and from there it spread to Northern and Western parts of the World (Nagraj, 2009). In South-West Asia including Turkistan, Afghanistan and India, it is primarily grown for oil. On the other hand, it is traditionally cultivated for oil meant both for edible and industrial purposes. In India, the seed oil is directly used for human consumption as well as in value added forms like baked and fried foods stuffs, breads etc. Mostly, eighty per cent of the oil production is used in industrial sectors in manufacturing of paints, varnishes, pad and printing inks, coating oils and in leather and soap industries. The seed contains 30-45 per cent of fixed oil (Nagraj, 2009). The brown coloured seeds have lower oil content (40%) than fawn (40-42%) and yellow coloured seeds (Gill, 1989; Bhatta *et al*., 1985). It is a source of complete protein (all 8 essential amino acids), complex carbohydrates, vitamins, minerals and natural source of Omega-3 (Alfa linolenic acid) and Omega-6 fatty acids. Now a days, it is gaining popularity as a herbal source of Omega-3 fatty acids which have immense medicinal properties for human beings. The fibre produced

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from the plant stems is having good strength and durability and is blended well with wool, cotton, silk etc.

The crop is grown in *Rabi* season only. Tolerance to biotic and abiotic stresses is a very important characteristics of this crop. Because of this property the survival and cultivation of linseed is adopted in a wide range of tropical, sub-tropical and temperate regions. In India, this crop is grown with poor management practices, moisture stress and no or low input conditions due to which the average national productivity level is far below (408 kg/ha) to average world productivity of 867 kg/ha. Though India ranks first in area (3.59 lac ha) in the world, but stands at 5th place in terms of production after Canada, China, USA and Ethiopia (Annual Report, Linseed, 2012).

The overall climatic condition of the country is not favourable for linseed condition. Therefore, four distinct agro-climatic regions of the country have been identified as potential linseed growing areas as follows; Zone I : North-Western Plain Region, Zone II : Indo-Gangetic Alluvial Region including NEH region, Zone III : Central region and Zone IV : Penninsular as well as Southern region. Accordingly, the linseed growing states have been categorized as per their agro-climatic conditions and location in to different zones.

Zone I includes Himachal Pradesh, Haryana, Punjab, Jammu & Kashmir and Uttarakhand states. Zone II :Uttar Pradesh (excluding Bundelkhand), Bihar, Jharkhand, West Bengal and Assam states.Zone III: Uttar Pradesh (only Bundelkhand), Madhya Pradesh and Rajsthan states. Zone IV : Maharastra, Chhattisgarh, Odisha, Karnataka and Andhra Pradesh states.

The AICRP Centre, Jashipur, Odisha represents a true rainfed situation for conduct of experiments on linseed. The centre is also envisaged with developing breeding lines suitable for rainfed and utera conditions with early duration. The present experiment was conducted to evaluate and screen breeding lines suitable for rainfed situations with high yield and early duration.

MATERIAL AND METHODS

OL 98-13-1, a derivative of the cross RLC 29 x R 1871 was evaluated for its yield potentiality, reaction to disease and pests and earliness under State Priliminary Yield Trials at AICRP on linseed, Jashipur, Odisha during *Rabi* 2007-08 to 2010-11. The breeding line was evaluated along with other eight identified uniform and high yielding cross derivatives with three checks *viz.*, OLC 10 (local), Sharda (zonal) and Indira Alsi 32 (national). The experiments in all the years were conducted with Randomised Block Design with three replications. Recommended package of practices were followed in all the years. Observations on days to 50 per cent flowering and days to maturity were taken on plot basis and for other characters like plant height, primary fruiting branches/plant, capsules/plant, seeds/capsule, 1000–seed weight(g) and seed yield(kg/ha), observations were recorded on ten random sample plants and appropriate statistical methods were applied for analysis of variance components of each year and pooled over years according to Al-Jibouri *et al*. (1958). The reaction of entries to diseases Alternaria blight and wilt were recorded as per the standard scales recommended by the Project Coordinating Unit (Linseed), ICAR (Annual Report, Linseed, 2008) as below.

Score / Grade	Disease intensity	Disease reaction
0	Free from disease	HR
1	1 to 10.0% infection	R
2	10.1 to 25.0% infection	MR
3	25.1 to 50.0% infection	MS
4	50.1 to 75.0% infection	S
5	75.1 to 100.0% infection	HS

Two high yielding early matured cross derivatives *viz.*, OL 98-13-1 and OL 98-6-2 were nominated for All India Coordinated Experiments under extra early maturing trial (EEMT) during *Rabi*,2011-12. The two elite breeding lines along with seven other elite cultures from different centres of the country were tested in four AICRP testing centres in Zone III (Sagar, Mauranipur, Hoshanabad and Durgapura) and six testing centres in Zone IV (Raipur, Nagpur, Raichur, Jashipur, Bilaspur and Latur) during *Rabi*, 2011-12 in Randomised Block Design with three replications.Recommended cultural practices were followed uniformly in all the testing centres. In Zone III, nine elite cultures were tested against one national check (T 397) and two zonal checks (JLS 9 and NL 97) where as one more zonal check (Sharda) was added in Zone IV in addition to all other checks as in Zone III.

RESULTS AND DISCUSSION

The basic pre-requisite for nomination of entries to All India Coordinated trials is the yield advantage over the zonal and national checks along with field resistance to major diseases and pests prevailing in that locality. The pooled data of State Preliminary Yield Trials reveled the yield advantage of the two entries OL 98-13-1 and OL 98-6-2 by 89-91per cent over the national check Indira Alsi 32 and 11-12 per cent over the zonal check Sharda and 54-56 per cent over the local check OLC 10 (Table 1).

The average seed yield (kg/ha) of the entry OL 98-6-2 ranged between 772 kg/ha in Durgapura to 1088 kg/ha in Sagar AICRP testing centres of Zone III. The zonal mean of this entry was recorded 879 kg/ha (Table 2). Similarly, the test entry OL 98-13-1 recorded lowest seed yield (811 kg/ha) in Durgapura to 949 kg/ha in Sagar testing centre with the over all zonal mean of 875 kg/ha. On the contrary, the national check T 397 recorded zonal average seed yield of 1033 kg/ha

as against the zonal checks JLS 9 (856 kg/ha) and NL 97 (957 kg/ha). In Zone III, no yield advantage was observed over the national check T 397 by both the entries.

In Zone IV, the entry OL 98-6-2 recorded zonal mean (pooled over six testing centres) of 752 kg /ha as against 737 kg/ha recorded in national check T 397 with yield advantage of only 2.04 per cent (Table 3). The zonal checks JLS 9, NL 97 and Sharda recorded zonal average seed yield of 609 kg/ha, 744 kg/ha and 761 kg/ha, respectively. However, the seed yield of the entry OL98-13-1 ranged between 437 kg/ha to 1299 kg/ha with highest zonal average seed yield of 849 kg/ha. It recorded yield advantage of 15.20 per cent over the national check T 397, 39.41 per cent over the zonal check JLS 9, 14.11 per cent over NL 97 and 11.56 per cent over the best check Sharda. Both the entries matured in 104-105 days as against 109 days in the national check T 397. Basing upon the yield

Table 1: Comparative performance of OL 98-13-1 and OL 98-6-2 pooled over years in state MLT

Name of the entry / variety	Pedigree	Days to maturity	Yield (kg/ha)	Yield advantage over checks (%)			Disease score			
				National (Indira Alsi 32)	Zonal (Sharda)	Local (OLC 10)	W	PM	AB	R
OL 98-13-1	RLC 29 x R 1871	104.0	974.45	89.01	11.22	54.27	2	0	1	0
OL-98-6-2	R 552 x R 1871	103.3	986.67	91.38	12.62	56.20	2	0	1	0
OLC 10 (Local check)		105.3	631.67				3	0	2	0
Sharda (Zonal check)		104.7	876.11				3	0	2	0
Indira Alsi 32 (National check)		107.0	515.56				3	0	3	0

W: Per cent of plants affected by wilt; PM: Per cent of plants affected by Powdery Mildew; AB: 0-5 score for *Alternaria blight*; R: Per cent of plants affected by rust

Table 2: Seed yield and days to maturity of OL 98-6-2 and OL 98-13-1 in Zone III

Entry	Seed yield (kg/ha)					Days to maturity					Oil content (%)
	Sagar	Mauranipur	Hoshangabad	Durgapura	Zonal mean	Sagar	Mauranipur	Hoshangabad	Durgapura	Zonal mean	
OL 98-6-2	1088	817	840	772	879	110	109	110	123	113	37.70
OL 98-13-1	949	900	840	811	875	113	119	112	123	117	38.34
T 397 (NC)	1181	1256	963	733	1033	114	125	108	126	118	37.52
JLS 9 (ZC)	972	856	840	756	856	114	118	107	123	116	39.09
NL 97 (ZC)	1042	1311	864	611	957	116	116	109	129	118	38.46

Source: Linseed Annual Report, 2011-12, p-60

Table 3: Seed yield and days to maturity of OL 98-6-2 and OL 98-13-1 in Zone IV

Entry	Seed yield (kg/ha)							Days to maturity							Oil content (%)
	Raipur	Nagpur	Raichur	Jashipur	Bilaspur	Latur	Zonal mean	Raipur	Nagpur	Raichur	Jashipur	Bilaspur	Latur	Zonal mean	
OL 98-6-2	616	898	1153	473	633	736	752	121	102	111	113	105	87	105	35.05
OL 98-13-1	815	885	1299	437	961	694	849	111	101	103	110	108	88	104	35.67
T 397 (NC)	801	717	951	486	1078	387	737	117	102	110	111	118	93	105	35.64
JLS 9 (ZC)	567	542	953	360	683	546	609	114	99	114	114	116	92	108	35.42
NL 97 (ZC)	653	950	1361	252	611	639	744	113	104	116	113	111	91	108	35.95
Sharda (ZC)	815	783	787	523	1011	649	761	112	100	101	111	118	92	106	36.76

Source: Linseed Annual Report, 2011-12, p-61

Table 4 : Reaction of OL 98-6-2 and OL 98-13-1 to major insect pests in different locations

Entry	Alternaria blight			Wilt		Powdery mildew		Bud fly	
	Jashipur	Nagpur	Mauranipur	Jashipur	Mauranipur	Raichur	Nagpur	Mauranipur	Nagpur
OL 98-6-2	MR	MS	R	R	HR	HR	S	MR	MR
OL 98-13-1	MS	MS	HR	R	HR	HR	R	MR	MR

HR: Host Resistant (disease free), R: Resistant, MR: Moderately Resistant, S: Susceptible; MS: Moderately Susceptible,
Source: Annual Report, Linseed, 2011-12, pp-60-62

advantage of the entry over all the checks, OL 98-13-1 was nominated for 2nd year testing over six testing centres in Zone IV. The average yield advantage of the entry OL 98-13-1 over the best check Sharda (11.56%) tested over six locations in Zone IV (Table 3) during *Rabi*,2011-12 corroborates with the results obtained from the State Preliminary Yield Trials pooled over four years during *Rabi* 2007-08 to 2010-11 (Table 1).

In both the zones, the entry OL 98-13-1 was found earliest to flower and mature amongst all the test entries including the checks indicating its suitability both for utera and rainfed situations.

The average reaction of the entries OL 98-6-2 and OL 98-13-1 to major diseases and pests under natural field conditions were recorded over the locations which were summarized in Table 4. The entry OL 98-13-1 was also found to be moderately resistant to wilt in artificial inoculums conditions tested in four testing centres (Annual Report, Linseed, 2012, p-174).

The average oil content of OL 98-13-1 ranged between 35.67 per cent (Zone IV) to 38.34 per cent (Zone III) where as it ranged between 35.05 per cent (Zone IV) to 37.70 per cent (Zone III) in OL 98-6-2 (Table 4). The variation in oil content of the genotypes may be due to variation in agro-ecological and climatic conditions (Nagraj, 2009). The fatty acid profile of the culture OL 98-13-1 indicated that it contains palmitic (16:0) acid (6.97%), Stearic (18:0) acid (7.01%), oleic(18:1) acid (27.11%), linoleic (18:2) acid 13.82%), linolenic(18:3) acid 45.10 per cent and iodine (165.49).

The above results clearly reveled that both the cross derivatives OL 98-6-2 and OL 98-13-1 are early maturing with high to moderately resistant to major diseases and pests. The culture OL 98-13-1 was found promising both for yield and duration and is suitable for utera and rainfed situations of the country. These two cultures could be used in further crop improvement programme in future.

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