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# Assessment of Yield, Yield-related Traits and Drought Tolerance of Linseed Genotypes (*Linum usitatissimum* L.)

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**ABSTRACT: A field experiment was conducted during *rabi* 2022-23, to study the drought tolerance in different genotypes of linseed under rainfed and irrigated condition genotypes NL 367, NL 371, NL 407, NL 408, RL 18114, BAU 2021-06, T 397, JLS 95 (C), LSL -93 (C), PKV NL- 260 (LC) were studied. The experiment was laid down in Randomized Block Design with ten genotypes and three replications at research farm of AICRP on Linseed and Mustard, College of Agriculture, Nagpur. It is important to screen and identify the drought tolerant and widely adoptable genotypes in respect to yield and yield contributing traits, which could perform uniformly under different environmental condition. The aim of this work was to study the drought tolerant associated morpho-physiological traits and yield of linseed under rainfed and irrigated condition. Observations about morpho-physiological parameters like plant height, number of branches plant$^{-1}$, number of capsule plant$^{-1}$, relative water content, root volume, root length and chlorophyll content (SPAD) were also estimated. Observations on yield traits like grain yield plot$^{-1}$ ha$^{-1}$. Seven genotypes of linseed with three checks were evaluated in Randomised Block Design for 13 morphological characters under two environments, irrigated and rainfed during *rabi* 2022-23. Significant differences were observed among the genotypes for all the characters studied under both the conditions. Recorded Genotypes PKV NL 260 followed by LSL 93 (C) NL 367 and NL 408 were significantly enhanced morpho-physiological traits and yield of linseed under rainfed condition, when compared with national check T-397 and rest of the genotypes under study.**

**Keywords:** Linseed, drought tolerance, yield, Morpho-physiological parameters.

## INTRODUCTION

Linseed (*Linum usitatissimum* L.) belongs to genus *Linum* of the family Linaceae. The somatic chromosome number of the cultivated species is 2n=30. It is a multipurpose crop valued for its seed oil, fiber, probiotic and nutraceutical properties. It is a crop adopted to different environments and agro ecologies.

Drought is one of the prevailing environmental conditions that induce adverse effects on the plant growth. The role of drought stress is more for the growth and productivity of the crop than other stresses, especially that the recent climate changes increase the risk of this situation (Mahfouze *et al*. 2017).

In flax growing regions, the yield is vulnerable to drought and high temperature where the effects are pronounced at seed germination. The primary growth of the seedling is one of the most sensible stages which is a reaction to the environmental stress. This stage has a determining role on suitable and the final function of the plant. Development of stress tolerant varieties/cultivars has been a major objective of many breeding programmes. However, success has been limited by inadequate screening techniques and lack of genotypes that illustrate apparent differences in response to well-defined environmental stresses. Yield has been the foremost criteria for such programmes and is a very complex trait in terms of genes number controlling it. This trait is also largely influenced by the environmental factors that cause selection for such less effective traits.

## MATERIALS AND METHODS

The present research was conducted at Research farm of All India Co-ordinated Research Project on Linseed, College of Agriculture, Nagpur. The material for present study consisted of 7 genotypes (NL 367, NL 371, NL 407, NL 408, RL 18114, BAU 2021-06 and T

397) along with three checks (JLS 95, LSL 93 and PKV NL 260). Seven genotypes along with three checks were evaluated in Randomized Block Design in 3 replications during the year 2022-23 with the net plot size was 18 $m^2$. The number of rows $plot^{-1}$ was ten in rainfed and irrigated conditions with spacing between row to row 30 cm and plant to plant 5 cm. The data was reported on 7 seed yield and its contributing characters *viz*., days to 50% flowering, number of branches $plant^{-1}$, plant height (cm), number of capsule $plant^{-1}$, root volume ($cm^3$), seed yield $plant^{-1}$ (g) and seed yield $plot^{-1}$ (kg/ha). The data for all the morpho-physiological characters was recorded on randomly selected 5 competitive plants in the middle 4 rows of each plot in all 3 replications except days to 50% flowering, where data was recorded on plot basis. The recommended package of practices for raising of linseed crop in Vidarbha region of Maharashtra was followed to raise a healthy crop. Relative water content (%) it was computed by using the Barrs and Weatherly formula (1962) and the drought tolerance efficiency (%) was calculated by using the formula suggested by Fisher and Wood (1981).

**Drought Tolerance Study.** Relative water content was calculated by the method of Barrs and Weatherly formula (1962).

$$\text{RWC}\,(\%) = \frac{\text{Fresh weight} - \text{oven dry weight}}{\text{Turgid weight} - \text{oven dry weight}} \times 100$$

and

Drought tolerant efficiency was calculated by using the formula of Fischer and Wood (1981). According to this formula as below:

$$\text{DTE}\,(\%) = \frac{\text{Yield under stress}}{\text{Yield under no stress}} \times 100$$

## RESULTS AND DISCUSSION

The analysis of variance for experimental design were analysed and mean squares for different characters are presented in (Table 1). The mean squares due to treatments were significant for all the thirteen characters studied *i.e.* days to 50% flowering, days to maturity, plant height, number of branches $plant^{-1}$, number of capsule $plant^{-1}$, root volume, root length, 1000 seed weight, chlorophyll cont. (SPAD) at 50% flowering stage and chlorophyll cont. (SPAD) at capsule stage, seed yield $plant^{-1}$, seed yield $plot^{-1}$ and drought tolerance efficiency. Highly significant differences among the varieties were observed for all the thirteen characters under all three environments. These results revealed that substantial variation existed among the genotypes in all the environments studied. Similar to these results Sagolsem *et al.* (2013) also reported significant genotype × environment interaction for most of the characters of different genotypes under different environment.

The analysis of variance revealed that the genotypes differed significantly for all the characters in both rainfed and irrigated condition. The mean performance of all the traits were affected either on the higher or lower side due to stress. The significant variability among the genotypes for yield and yield component under normal and stress condition were also reported by Sadaqat *et al*. (2003); Singh and Choudhary (2003).

The results on the effect of moisture stress on different traits are presented in (Table 2). The highest days to maturity was recorded by the genotype NL 407 (117.22 days) followed by NL 408 (115 days) and NL 371 (114.67 days) without stress condition. Under-stress condition for highest days to maturity was recorded by the genotype NL 407 (111.57 days) followed by NL 408 (110.56 days) and NL 371 (110.89 days). Similar to this result Singh and Chaudhary (2003) also reported for highest days to maturity under normal condition on the basis of mean performance of genotypes.

The least mean (under stress) plant height within the genotypes was recorded in LSL 93 (check) (34.27 cm) followed by JLS 95 (check) (39.54 cm), T 397 (43.94 cm). The maximum plant height within environment was recorded by NL 371 (70.16 cm) followed by BAU 2021-06 (63.88 cm) and NL 408 (59.87 cm) as shown in Table 4. In accordance with this result Singh and Chaudhary (2003); Mohammad *et al.* (2012); Mirshekari *et al.* (2012) also reported that the mean performance of genotypes for plant height were identified maximum under normal irrigation and minimum for the cut irrigation. Capsules $plant^{-1}$ was observed to be the most sensitive water stress. NL 407 and LSL 93 (check) produced highest number of capsule $plant^{-1}$ followed by NL 371, NL 408 and NL 407 whereas genotype JLS 95 (check) recorded lowest number of capsule $plant^{-1}$ followed by PKV NL 260 (check) and T 397however, found at par with each other. Similar kind of results also noted by Mohammad *et al.* (2012) that the number of capsule $plant^{-1}$ was highest under full irrigation whereas reduced under stress condition.

Studies on association of soil mass with root as indicated by root volume revealed significant reduction with stress application. The interaction between moisture stress and genotypes were also significant. The minimum root volume was exhibited by genotype PKV NL 260 (check) (3.60 $cm^3$) under stress and (3.06 $cm^3$) without stress conditions. PKV NL 260 (check) recorded highest chlorophyll content (SPAD) followed by RL 18114 and NL-367 whereas genotype NL 408 and LSL 93 (check) recorded lowest chlorophyll content (SPAD) at capsule stage followed by T 397. The genotype NL 371(19.62 cm) without stress and under stress (14.92 cm) recorded the maximum root length. RL 18114 (29.03%) followed by LSL 93 (check) (27.97%), T 397 (26.57%) genotypes exhibited maximum per cent increase for root length. Mostafavi (2011); Raza *et al.* (2017) also reported highest stress tolerance index for root length.

Seed yield is influenced by morpho-physiological parameters such as plant height, total dry matter production, leaf area, number of seeds and test weight which are considered as yield contributing parameters. The maximum seed yield $plot^{-1}$ were recorded in best check genotype PKV NL 260 (LC). The range in seed yield $plot^{-1}$ was 830.525 kg/ha in genotype BAU 2021-06 to 628.495 kg/ha in genotype PKV NL-260 (LC) respectively. Kumari *et al.* (2019) also found that seed

yield exhibited significant positive association with number of pods plant$^{-1}$, seeds pod$^{-1}$, biological yield.

The most dependable diagnosis of drought tolerance is the direct method of studying the effect of drought under phytotron and/or field condition. Several methods have been used for measuring drought tolerance that is water potential, relative turgidity, diffusion pressure deficit, drought tolerant efficiency, root length etc. (Chhabra *et al.*, 1981).

**Table 1: Analysis of variance for various characters of linseed under rainfed and irrigated condition for three sowing dates.**

| Source of variation | d.f. | Mean Squares | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days to 50% flowering | Days to maturity | Plant height (cm) | No. of branches plant$^{-1}$ | No. of capsule plant$^{-1}$ | Root volume (cm)$^3$ | Root length (cm) | Seed yield plant$^{-1}$ | 1000 seed weight (g) | RWC (%) | Seed yield plot$^{-1}$ | Chlcont (SPAD) Fl.stage | Chlcont (SPAD) Capsule stage |
| **First sowing date 14 Nov. 2022E1 (Without Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 1.60 | 12.40 | 0.64 | 0.31 | 66.65 | 2.48 | 7.68 | 2.69 | 0.18 | 1.97 | 3083.09 | 40.79 | 104.94 |
| **Genotype** | 9 | 61.47** | 131.37** | 496.64** | 5.97** | 848.75** | 7.68** | 17.19** | 95.20** | 5.19** | 1113.18** | 293817.45** | 59.78** | 145.42** |
| **Error** | 18 | 1.82 | 3.96 | 39.27 | 1.25 | 151.19 | 0.88 | 4.36 | 3.92 | 0.11 | 1.05 | 7786.28 | 15.06 | 39.55 |
| **E2 (Under Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 0.40 | 3.60 | 1.06 | 1.25 | 3.35 | 0.85 | 0.70 | 0.90 | 0.05 | 1.98 | 2787.37 | 32.52 | 31.32 |
| **Genotype** | 9 | 108.03** | 63.37** | 349.05** | 7.14** | 389.94** | 1.63** | 4.64** | 37.32** | 4.06** | 747.37** | 115191.94** | 42.91** | 216.03** |
| **Error** | 18 | 1.96 | 6.04 | 41.91 | 0.62 | 96.46 | 0.37 | 1.22 | 1.75 | 0.02 | 2.65 | 5386.58 | 10.90 | 37.62 |
| **Second sowing date 28 Nov.2022E3 (Without Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 112.93 | 5.43 | 19.90 | 3.35 | 253.63 | 2.26 | 12.49 | 2.48 | 1.00 | 97.77 | 7641.67 | 17.71 | 47.51 |
| **Genotype** | 9 | 124.30* | 104.16** | 436.09** | 19.91** | 1229.99** | 23.96** | 26.97** | 119.31** | 5.67* | 793.02** | 368214.61** | 67.93** | 55.42** |
| **Error** | 18 | 35.45 | 5.73 | 32.47 | 1.11 | 249.46 | 2.67 | 4.89 | 4.91 | 1.97 | 1.53 | 15150.00 | 15.65 | 13.67 |
| **E4 (Under Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 25.90 | 20.83 | 19.28 | 0.88 | 8.88 | 2.08 | 4.00 | 4.45 | 0.87 | 36.30 | 13718.64 | 3.87 | 1.23 |
| **Genotype** | 9 | 146.70** | 95.78** | 241.72** | 3.98** | 377.61** | 9.34** | 23.56** | 44.89** | 4.44** | 107.08** | 138547.15** | 94.61** | 28.15* |
| **Error** | 18 | 7.68 | 7.17 | 39.79 | 0.76 | 96.41 | 1.10 | 5.84 | 1.27 | 0.40 | 5.06 | 3926.00 | 25.30 | 11.09 |
| **Third sowing date5th Dec 2022 E5 (Without Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 13.33 | 2.43 | 16.45 | 3.10 | 43.41 | 2.15 | 11.18 | 1.42 | 0.57 | 1.11 | 3649.81 | 1.28 | 61.20 |
| **Genotype** | 9 | 72.28** | 36.83** | 259.89** | 6.54** | 356.40** | 3.49** | 15.11** | 29.12** | 2.79** | 270.99** | 74701.39** | 73.99** | 150.72** |
| **Error** | 18 | 6.04 | 0.99 | 37.62 | 1.39 | 16.71 | 0.92 | 3.37 | 1.23 | 0.17 | 1.40 | 3734.03 | 14.76 | 36.05 |
| **E6 (Under Stress)** | | | | | | | | | | | | | | |
| **Replication** | 2 | 7.23 | 1.60 | 7.42 | 2.22 | 27.59 | 0.96 | 1.80 | 3.92 | 0.18 | 26.37 | 12095.00 | 14.90 | 3.02 |
| **Genotype** | 9 | 83.14** | 42.53** | 312.61** | 1.86* | 512.31** | 8.02** | 24.46** | 72.50** | 4.03** | 233.95** | 223756.12** | 57.48** | 91.49** |
| **Error** | 18 | 2.12 | 0.93 | 33.87 | 0.74 | 77.42 | 0.75 | 2.72 | 2.02 | 0.22 | 7.49 | 6232.96 | 15.24 | 18.90 |

Note: *, ** = significance at 5% and 1% level respectively.

**Table 2: Mean performance of linseed genotypes for days to maturity under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Days to maturity | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | | |
| | | Without Stress | Under stress | Without Stress | Under stress | Without Stress | Under stress | Mean (Without Stress) | Mean (Under stress) |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | |
| 1. | NL 367 | 106.00 | 102.00 | 108.00 | 100.00 | 108.00 | 98.00 | 107.33 | 100 |
| 2. | NL 371 | 114.00 | 115.00 | 118.00 | 106.67 | 112.00 | 111.00 | 114.67 | 110.89 |
| 3. | NL 407 | 122.00 | 116.00 | 114.67 | 115.67 | 115.00 | 103.00 | 117.22 | 111.57 |
| 4. | NL 408 | 116.00 | 113.00 | 119.00 | 116.67 | 110.00 | 102.00 | 115 | 110.56 |
| 5. | RL 18114 | 108.00 | 109.00 | 118.00 | 109.00 | 108.00 | 104.00 | 111.33 | 107.33 |
| 6. | BAU 2021-06 | 113.00 | 110.00 | 111.00 | 106.67 | 109.00 | 100.00 | 111 | 105.55 |
| 7. | T 397 | 107.00 | 109.00 | 112.33 | 106.00 | 111.00 | 99.00 | 110.11 | 104.66 |
| 8. | JLS 95 (Check) | 114.00 | 107.00 | 119.00 | 109.00 | 101.67 | 102.00 | 111.56 | 106 |
| 9. | LSL 93 (Check) | 102.00 | 109.00 | 117.67 | 108.00 | 110.00 | 100.00 | 109.89 | 105.66 |
| 10. | PKV NL 260 (Check) | 101.00 | 103.00 | 101.00 | 99.00 | 107.00 | 99.00 | 103 | 100.33 |
| | Mean | 110 | 109 | 113.87 | 107.67 | 109.17 | 101.80 | | |
| | **S.E (m) ±** | 1.15 | 1.42 | 1.38 | 1.55 | 0.57 | 0.56 | | |
| | **C.D (5%)** | 3.41 | 4.22 | 4.11 | 4.59 | 1.71 | 1.66 | | |
| | **C.V (%)** | 1.80 | 2.25 | 2.10 | 2.49 | 0.91 | 0.95 | | |

**Table 3: Mean performance of linseed genotypes for number of capsule plant$^{-1}$ under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Number of capsule plant$^{-1}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | | |
| | | Without stress | Under stress | Without stress | Under stress | Without Stress | Under stress | Mean (Without Stress) | Mean (Under stress) |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | |
| 1. | NL 367 | 47.00 | 49.00 | 66.80 | 56.20 | 57.80 | 61.40 | 57.2 | 55.53 |
| 2. | NL 371 | 77.00 | 60.80 | 87.80 | 75.93 | 67.40 | 65.00 | 77.4 | 67.24 |
| 3. | NL 407 | 81.40 | 59.60 | 74.60 | 60.60 | 85.80 | 70.40 | 80.6 | 63.53 |
| 4. | NL 408 | 49.40 | 32.40 | 114.60 | 82.60 | 57.80 | 75.40 | 73.93 | 63.46 |
| 5. | RL 18114 | 66.60 | 52.40 | 63.00 | 64.00 | 65.60 | 62.80 | 65.06 | 59.73 |
| 6. | BAU 2021-06 | 73.60 | 46.60 | 68.80 | 70.40 | 56.60 | 54.20 | 66.33 | 57.06 |
| 7. | T 397 | 45.00 | 42.60 | 89.00 | 76.20 | 69.40 | 46.80 | 67.8 | 55.2 |
| 8. | JLS 95 (Check) | 73.00 | 72.33 | 74.80 | 80.60 | 58.00 | 31.40 | 68.6 | 61.44 |
| 9. | LSL 93 (Check) | 30.80 | 58.60 | 44.80 | 81.60 | 66.00 | 71.00 | 47.2 | 70.4 |
| 10. | PKV NL 260(Check) | 53.40 | 61.60 | 50.00 | 51.60 | 44.20 | 63.20 | 49.2 | 58.8 |
| | Mean | 59.72 | 53.59 | 73.42 | 69.97 | 62.86 | 60.16 | | |
| | **S.E (m) ±** | 7.10 | 5.67 | 9.12 | 5.67 | 2.36 | 5.08 | | |
| | **C.D (5%)** | 21.09 | 16.85 | 27.09 | 16.84 | 7.01 | 15.09 | | |
| | **C.V (%)** | 20.59 | 18.33 | 21.51 | 14.03 | 6.50 | 14.63 | | |

**Table 4: Mean performance of linseed genotypes for root length (cm) under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Root lenght (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | Mean (Without Stress) | Mean (Under stress) | % increases (WS) |
| | | Without Stress | Under stress | Without stress | Under stress | Without Stress | Under stress | | | |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | | |
| 1. | NL 367 | 14.90 | 12.90 | 16.76 | 10.18 | 15.58 | 12.80 | 15.74 | 11.96 | 24.01 |
| 2. | NL 371 | 17.78 | 10.90 | 23.28 | 15.58 | 17.80 | 18.28 | 19.62 | 14.92 | 23.96 |
| 3. | NL 407 | 16.42 | 9.18 | 14.94 | 17.40 | 19.22 | 13.90 | 16.86 | 13.49 | 19.99 |
| 4. | NL 408 | 10.68 | 9.84 | 21.70 | 20.36 | 14.02 | 14.16 | 15.46 | 14.78 | 4.39 |
| 5. | RL 18114 | 17.40 | 9.10 | 20.36 | 15.28 | 15.98 | 13.75 | 17.91 | 12.71 | 29.03 |
| 6. | BAU 2021-06 | 11.92 | 11.02 | 18.18 | 15.16 | 15.36 | 12.18 | 15.15 | 12.78 | 15.64 |
| 7. | T 397 | 14.70 | 11.40 | 16.72 | 14.98 | 15.22 | 7.86 | 15.54 | 11.41 | 26.57 |
| 8. | JLS 95 (Check) | 11.94 | 12.00 | 21.00 | 15.68 | 12.47 | 9.98 | 15.13 | 12.55 | 17.05 |
| 9. | LSL 93 (Check) | 13.90 | 9.86 | 18.54 | 13.40 | 18.50 | 13.44 | 16.98 | 12.23 | 27.97 |
| 10. | PKV NL 260(Check) | 13.70 | 11.40 | 14.12 | 11.92 | 13.06 | 10.26 | 13.62 | 11.19 | 17.84 |
| | Mean | 14.33 | 10.76 | 18.56 | 14.99 | 15.72 | 12.66 | | | 20.65 |
| | **S.E (m) ±** | 1.21 | 0.64 | 1.28 | 1.40 | 1.06 | 0.95 | | | |
| | **C.D (5%)** | 3.58 | 1.90 | 3.80 | 4.15 | 3.15 | 2.83 | | | |
| | **C.V (%)** | 14.57 | 10.27 | 11.92 | 16.12 | 11.68 | 13.03 | | | |

**Table 5: Mean performance of linseed genotypes for root volume ($cm^3$) under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Root volume ($cm^{3)}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | | |
| | | Without stress | Under stress | Without stress | Under stress | Without Stress | Under stress | Mean (Without Stress) | Mean (Under stress) |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | |
| 1. | NL 367 | 5.57 | 3.78 | 5.04 | 3.20 | 5.93 | 3.91 | 5.51 | 3.63 |
| 2. | NL 371 | 7.59 | 3.28 | 10.87 | 5.45 | 7.06 | 8.50 | 8.50 | 5.74 |
| 3. | NL 407 | 6.92 | 3.05 | 7.12 | 7.44 | 7.42 | 4.75 | 7.15 | 5.08 |
| 4. | NL 408 | 2.67 | 1.81 | 11.87 | 8.43 | 4.96 | 4.73 | 6.5 | 4.99 |
| 5. | RL 18114 | 5.46 | 2.42 | 7.42 | 4.90 | 6.09 | 4.59 | 6.32 | 3.97 |
| 6. | BAU 2021-06 | 4.89 | 3.64 | 7.14 | 5.79 | 7.02 | 4.30 | 6.35 | 4.57 |
| 7. | T 397 | 4.08 | 3.13 | 7.66 | 4.56 | 6.47 | 2.72 | 6.07 | 3.47 |
| 8. | JLS 95 (Check) | 4.27 | 4.17 | 9.95 | 6.50 | 6.90 | 2.82 | 7.04 | 4.49 |
| 9. | LSL 93 (Check) | 2.99 | 2.19 | 4.44 | 4.60 | 7.05 | 3.91 | 4.82 | 3.56 |
| 10. | PKV NL 260(Check) | 3.73 | 3.10 | 3.06 | 2.79 | 4.02 | 3.30 | 3.60 | 3.06 |
| | Mean | 4.82 | 3.06 | 7.46 | 5.37 | 6.29 | 4.35 | 6.19 | 4.26 |
| | **S.E (m) ±** | 0.54 | 0.35 | 0.94 | 0.61 | 0.55 | 0.50 | | |
| | **C.D (5%)** | 1.61 | 1.04 | 2.81 | 1.80 | 1.65 | 1.49 | | |
| | **C.V (%)** | 19.50 | 19.86 | 21.93 | 19.54 | 15.27 | 19.94 | | |

**Table 6: Mean performance of linseed genotypes for chlorophyll content (SPAD) at capsule stage under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Chlorophyll content (SPAD) at capsule stage | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | | |
| | | Without Stress | Under stress | Without stress | Under stress | Without Stress | Under stress | Mean (Without Stress) | Mean (Under stress) |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | |
| 1. | NL 367 | 38.53 | 41.73 | 37.92 | 44.67 | 40.24 | 37.21 | 38.89 | 41.20 |
| 2. | NL 371 | 30.85 | 27.97 | 39.56 | 47.23 | 37.17 | 41.15 | 35.86 | 38.78 |
| 3. | NL 407 | 34.02 | 31.27 | 39.93 | 43.42 | 33.00 | 41.36 | 35.65 | 38.68 |
| 4. | NL 408 | 33.61 | 21.93 | 34.23 | 40.17 | 25.43 | 32.07 | 31.09 | 31.39 |
| 5. | RL 18114 | 41.03 | 32.15 | 34.52 | 48.08 | 40.23 | 44.69 | 38.59 | 41.64 |
| 6. | BAU 2021-06 | 39.61 | 39.04 | 42.38 | 44.53 | 21.40 | 27.34 | 34.46 | 36.97 |
| 7. | T 397 | 26.29 | 21.56 | 39.42 | 41.25 | 28.16 | 35.20 | 31.29 | 32.67 |
| 8. | JLS 95 (Check) | 41.28 | 34.20 | 35.08 | 43.06 | 27.42 | 35.94 | 34.59 | 37.73 |
| 9. | LSL 93 (Check) | 23.17 | 20.36 | 30.11 | 39.62 | 41.93 | 31.06 | 31.74 | 30.34 |
| 10. | PKV NL 260(Check) | 44.58 | 43.82 | 44.50 | 39.37 | 30.58 | 41.72 | 39.89 | 41.64 |
| | Mean | 35.30 | 31.40 | 37.76 | 43.14 | 32.56 | 36.77 | 35.20 | 37.10 |
| | **S.E (m) ±** | 3.63 | 3.54 | 2.13 | 1.92 | 3.47 | 2.51 | | |
| | **C.D (5%)** | 10.79 | 10.52 | 6.34 | 5.71 | 10.30 | 7.46 | | |
| | **C.V (%)** | 17.82 | 19.53 | 9.79 | 7.72 | 18.44 | 11.82 | | |

**Table 7: Mean performance of linseed genotypes for seed yield $plot^{-1}$(kg/ha) under stress and without stress under different dates of sowing.**

| Sr. No. | Genotypes | Seed yield $plot^{-1}$ ($Kg/ha^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st date of sowing | | 2nd date of sowing | | 3rd date of sowing | | | | |
| | | Without Stress | Under stress | Without stress | Under stress | Without stress | Under stress | Mean (Without Stress) | Mean (Under stress) | DTE (%) |
| | | E1 | E2 | E3 | E4 | E5 | E6 | | | |
| 1. | NL 367 | 449.98 | 378.88 | 927.75 | 612.20 | 622.20 | 857.75 | 666.64 | 616.27 | 80.11 |
| 2. | NL 371 | 788.86 | 711.09 | 1076.63 | 436.28 | 551.09 | 417.76 | 805.52 | 521.71 | 69.67 |
| 3. | NL 407 | 435.54 | 198.88 | 735.53 | 568.87 | 637.75 | 424.43 | 602.94 | 397.39 | 64.75 |
| 4. | NL 408 | 241.10 | 196.66 | 1685.50 | 965.52 | 269.99 | 465.54 | 732.19 | 542.57 | 77.81 |
| 5. | RL 18114 | 944.41 | 594.43 | 782.19 | 624.43 | 464.43 | 329.99 | 730.34 | 516.28 | 72.5 |
| 6. | BAU 2021-06 | 1203.29 | 622.20 | 1021.08 | 1138.85 | 569.98 | 427.76 | 931.45 | 729.60 | 71.19 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7. | T 397 | 458.87 | 335.55 | 1282.18 | 751.09 | 715.53 | 174.44 | 818.86 | 420.36 | 59.42 |
| 8. | JLS 95 (Check) | 851.08 | 693.31 | 675.53 | 902.19 | 433.97 | 92.22 | 653.52 | 562.57 | 66.37 |
| 9. | LSL 93 (Check) | 274.43 | 457.76 | 532.20 | 814.42 | 687.75 | 592.20 | 498.12 | 621.46 | 92.93 |
| 10. | PKV NL 260 (Check) | 682.20 | 629.98 | 617.76 | 589.98 | 281.10 | 969.97 | 527.02 | 729.97 | 94.09 |
| | Mean | 632.98 | 481.88 | 933.64 | 740.38 | 523.38 | 475.20 | | | |
| | **S.E (m) ±** | 50.95 | 42.37 | 71.06 | 36.18 | 35.28 | 45.58 | | | |
| | **C.D (5%)** | 151.37 | 125.90 | 211.14 | 107.48 | 104.82 | 135.43 | | | |
| | **C.V (%)** | 13.94 | 15.23 | 13.18 | 8.46 | 11.68 | 16.61 | | | |

## CONCLUSIONS

The genotypes of linseed in rainfed moisture stress condition showed significant variation in morpho-physiological parameters were recorded significantly higher values in PKV NL 260 followed by LSL 93 (C), NL 367 and NL 408 which are to be drought tolerant genotypes. None of the genotypes showed significant increment in yield attributing characters under rainfed moisture stress condition over best PKV NL 260 local check genotype. PKV NL 260 followed by LSL 93 (C), NL 367 and NL 408 recorded significantly highest values for yield and yield attributing traits, *viz.*, Yield and yield attributing characters (number of capsules plant$^{-1}$, test weight, seed yield plant$^{-1}$ and seed yield plot$^{-1}$), which are said to be drought tolerant genotypes**.** The genotype of linseed under rainfed moisture stress condition study, local check PKV NL-260 (LC) was significantly superior due to enhanced all morpho-physiological, chemical and biochemical and yield contributing characters.

## FUTURE SCOPE

Assessment of yield, yield-related traits and drought tolerance studies in linseed genotypes has future scope to identification of drought tolerant genotypes under changing climate scenario.

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**Conflict of Interest.** None.

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