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Assessment of seed hardening methods on growth and yield parameters in lentil (*Lens culinaris*)

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Abstract

The experiment was conducted in field and laboratory Department of Genetic and Plant Breeding SHUATS Allahabad UP during 2018, in order to standardize the best method of hardening specific to lentil. Seed hardening using T₀ Control, Hydration in water, KNO₃ (2%), NaCl (2%), (CaCl₂ 2%), KH₂PO₄ (2%), (Neem leaf Extract 5%) and Curry leaf extract- 5% for 8 hours. It was found that all the Hardening methods showed significant differences with the control and the highest germination percentage, seedling length, root length, shoot length, seedling dry weight, seedling fresh weight, number of nodules per plant, nodules fresh weight, nodules dry weight, number of pods per plant, number of seeds per plant, 100 seed weight and seed yield were observed for KH₂PO₄ hardening for 8 hours.

Keywords: Lentil method of hardening, duration, Nodulation quality, yield quality

Introduction

Lentil is a pulse crop that has been used in agricultural production for a great deal of human history. There is evidence of human consumption of lentils dating back to roughly 10,000 years ago, and it has been indicated that they were among the very first crops domesticated by humans.

Lentils are known for their high nutrient content and health benefits in humans. They have the third highest protein content of any legume, at 30% of their calories. They are also a great source of carbohydrates and high in fiber. Furthermore, they are high in content of important minerals and vitamins such as iron and zinc. Lentils also include essential amino acids isoleucine and lysine, making them a cheap source of protein in developing countries (Callaway *et al.* 2004) [3].

Lentil contains 20 to 25 percent protein, 59 percent carbohydrates, 1.8 percent oil and contents of iron, phosphorus, calcium and magnesium. Lentil also provides a considerable amount of vitamin A and B. It provides a balanced human diet and is a good substitute for animal protein. It is drought resistant crop. The crop needs phosphorus for obtaining good quality lentil. Thus the maximum yield can only be obtained by applying the optimum phosphorus dose per hectare. This study was, therefore, designed to determine the optimum phosphorus level in order to maximize grain yield of lentil.

Hardening is one of the methods of pre-sowing treatment to the seeds, which results in modifying the physiological and bio-chemical nature of seed so as to get the character that favours drought resistance. Hardening induces early germination, better root and seedling growth, reduces seedling mortality, increases crop population and thereby enhances the yield potential of the crop varieties (Prajapati *et al.* 2017) [4].

Material and Method

The present evaluation entitled "Assessment of Seed Hardening Methods on Growth and Yield Parameters in Lentil (*Lens Culinaris*)" was conducted during November- March 2017-18 in the experiment field and laboratory of Seed Science at the department of genetics and plant breeding, SHUATS Allahabad. Following treatments were used in this study:

For the preparation of solutions of the chemicals 2% NaCl, 2% CaCl₂, 2% KNO₃, 2% KH₂PO₄, 5% Neem Leaf Extract, 5% Curry Leaf Extract and Distilled water chemical was taken in a clean beaker. These chemicals were dissolved separately.

For the preparation of NaCl (2%) solution 20 (g.) NaCl was taken in a measuring flask made up to 1000 ml. and distilled water, while for CaCl₂ (2%) solution 20 (g.) CaCl₂ salt, KNO₃

(2%) solution 20(g.) and KH_2PO_4 (2%) 20(g) was taken in a measuring flask and made up to 1000 ml with distilled water. After preparation of solution of, CaCl_2 , KNO_3 , NaCl , KH_2PO_4 Neem Leaf Extract, Curry Leaf Extract were soaked in required solution for 14 hour at 25 °C temperature. Simultaneously seeds were soaked in distilled water sewed as control. After 14 hour of soaking the solution was drained out from the beaker and pre soaked seeds were air dried to original weight and then placed for germination in laboratory under controlled conditions.

Observation on seed yield and growth parameters viz. Plant height (cm), Days to 50 per cent flowering, Number of pods per plant, nodules per plant, nodules fresh weight, nodules dry weight, Number of grain per plant, 100 grain weight(g), Seed yield per plant (g), field emergence were recorded. Seed quality parameter viz. Germination(%), Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight (g) were recorded. The data were statistically analysed using ANOVA.

| Treatment no. | Treatments |
|----------------|---|
| T ₀ | Control |
| T ₁ | Hydration for 8 hr in water |
| T ₂ | Hydration with KNO_3 (2%) |
| T ₃ | Hydration with NaCl (2%) |
| T ₄ | Hydration with CaCl_2 (2%) |
| T ₅ | Hydration with KH_2PO_4 (2%) |
| T ₆ | Curry leaf (<i>Murraya koenigii</i>) leaf extract- 5% |
| T ₇ | Neem leaf extract – 5% |

Result and Discussion

The results of the present investigation entitled “assessment of seed hardening methods on growth and yield parameters in lentil (*lens culinaris*)” recorded during the experimental period has been analyzed statistically and the results were summarized below:

Growth and yield parameter

The data on growth and yield parameters of lentil revealed significantly higher plant height (38.62 cm) in seed hardening with 2% CaCl_2 , where as lower plant height in control (31.32

cm) at harvesting stage. This clearly indicates mode of action differs for the chemicals studied. Seed hardening with 2% CaCl_2 increased the plant height this may be due to redistribution of nutrient reserves leading to cell enlargement and increase in normal cell division. The early days to 50 % flowering (41.70) was exhibited by 2% KH_2PO_4 , while maximum days to 50 % flowering (47.17) was found in control. Maximum number of nodules per plant (26.26) was found in seed hardening with 2 % KH_2PO_4 . The lowest nodules fresh weight (9.69 g) was recorded in control, while highest nodules fresh weight (12.13) was found in 2% KH_2PO_4 .

The lowest nodules dry weight (3.19 g) was recorded in distilled water, while highest nodules dry weight (4.65) was found in 2% KH_2PO_4 . The lowest field emergence (87.66%) was recorded in distilled water, while highest field emergence (94.66) was found in 2% CaCl_2 . Maximum no. of pod per plant (71.06 cm), no. of seed per plant (1.6 seeds), 100 seed weight (5.22 g) and seed yield (2538.10 kg/ha.) was found with 2% KH_2PO_4 , while minimum no. of pod per plant (50.40 cm), no. of seed per plant (1.13 seeds) and seed yield (2044.90 kg/ha.) was found in control but minimum 100 seed weight (4.41 g) was found in treatment with distilled weight.

Seed Quality Parameter

All treatments showed more effect when compared to the treatment T₀ (control). The treatment T₅ KH_2PO_4 (2%) recorded highest significant effect on seed germination percent Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight among all the treatments. However control (T₀) recorded lower effect than all the treatments. Highest germination% (98.00%), seedling length (18.70 cm), root length (10.13 cm), shoot length (8.83cm), seedling dry weight (0.37gm) and seedling fresh weight (4.66 gm) was observed in 2% KH_2PO_4 . Minimum germination% (90.33 %), seedling length (16.03 cm), root length (8.53 cm), shoot length (7.30 gm), seedling dry weight (2.94gm) seedling fresh weight (2.57 gm) was observed in control.

Table 4.1: Effect of Different Treatment on growth and yield in Lentil

| Treatments | Plant height (cm) | Day to 50 % flowering | Number of nodules per plant | Nodules fresh weight | Nodules dry weight | Field emergence | Number of pods per plant | Number of seeds per plant | 100 seed weight (g) | Seed yield (kg/hac) |
|----------------|-------------------|-----------------------|-----------------------------|----------------------|--------------------|-----------------|--------------------------|---------------------------|---------------------|---------------------|
| T ₀ | 31.32 | 47.17 | 22.25 | 9.69 | 3.50 | 90.33 | 50.40 | 1.13 | 4.53 | 2,044.90 |
| T ₁ | 34.12 | 46.34 | 22.77 | 10.07 | 3.19 | 87.66 | 56.20 | 1.26 | 4.41 | 2,189.13 |
| T ₂ | 36.56 | 42.64 | 25.38 | 11.13 | 4.60 | 90.00 | 66.53 | 1.53 | 5.12 | 2,409.90 |
| T ₃ | 37.03 | 43.80 | 24.21 | 10.21 | 4.19 | 93.00 | 62.33 | 1.33 | 4.83 | 2,403.43 |
| T ₄ | 38.62 | 43.20 | 24.32 | 11.56 | 4.41 | 94.66 | 65.60 | 1.40 | 4.94 | 2,478.56 |
| T ₅ | 37.60 | 41.70 | 26.26 | 12.13 | 4.65 | 92.33 | 71.06 | 1.60 | 5.22 | 2,538.10 |
| T ₆ | 36.32 | 46.01 | 23.08 | 10.21 | 3.63 | 90.66 | 54.66 | 1.20 | 4.48 | 2,281.96 |
| T ₇ | 35.51 | 45.40 | 23.55 | 10.39 | 4.00 | 92.66 | 57.46 | 1.26 | 4.60 | 2,285.56 |
| Grand Mean | 35.88 | 44.53 | 23.98 | 10.67 | 4.02 | 91.41 | 60.53 | 1.34 | 4.77 | 2,328.95 |
| CD 5% | 2.92 | 0.63 | 1.20 | 0.62 | 0.48 | NS | 2.72 | NS | 0.44 | 78.14 |
| S E | 0.95 | 0.20 | 0.39 | 0.20 | 0.15 | 1.80 | 0.88 | 0.09 | 0.14 | 25.51 |
| CV | 4.61 | 0.80 | 2.84 | 3.29 | 6.78 | 3.41 | 2.54 | 12.75 | 5.29 | 1.89 |
| Max | 38.62 | 47.17 | 26.26 | 12.13 | 4.65 | 94.66 | 71.06 | 1.6 | 5.22 | 2,538.10 |
| Min | 31.32 | 41.70 | 22.25 | 9.69 | 3.19 | 87.66 | 50.4 | 1.13 | 4.41 | 2,044.90 |

Table 4.2: Effect of different treatment on vigour parameters in Lentil

| Treatments | Germination (%) | Root length (cm) | Shoot length (cm) | Seedling length (cm) | Seedling fresh weight (g) | Seedling dry weight (g) |
|----------------|-----------------|------------------|-------------------|----------------------|---------------------------|-------------------------|
| T ₀ | 90.33 | 8.53 | 7.30 | 16.03 | 2.57 | 2.94 |
| T ₁ | 92.66 | 8.50 | 7.46 | 15.96 | 3.13 | 3.15 |
| T ₂ | 96.00 | 9.80 | 8.03 | 17.73 | 4.32 | 4.35 |
| T ₃ | 95.00 | 9.26 | 8.23 | 17.50 | 4.21 | 4.45 |
| T ₄ | 95.33 | 9.40 | 8.16 | 17.56 | 4.47 | 4.50 |
| T ₅ | 98.00 | 10.13 | 8.83 | 18.70 | 4.66 | 4.63 |
| T ₆ | 91.66 | 9.10 | 7.50 | 16.50 | 3.54 | 3.45 |
| T ₇ | 93.33 | 9.26 | 7.86 | 17.13 | 3.94 | 3.82 |
| Grand Mean | 94.04 | 9.25 | 7.92 | 17.14 | 3.85 | 3.91 |
| CD 5% | 4.41 | 0.67 | 0.68 | 0.95 | 0.41 | 0.36 |
| S E | 1.44 | 0.22 | 0.22 | 0.31 | 0.13 | 0.11 |
| CV | 2.65 | 4.13 | 4.87 | 3.15 | 6.10 | 5.27 |
| Max | 98 | 10.13 | 8.83 | 18.7 | 4.66 | 4.63 |
| Min | 90.33 | 8.5 | 7.3 | 15.96 | 2.57 | 2.94 |

Summary

All the priming methods have positive influence on seed quality parameters of Lentil individually but the effect of seed hardening was found significant. Germination percentage was (98.0%) respectively were highest in T₅ (Hydration with KH₂PO₄ 2%) and it was significantly low in (control) seeds (90.33%). However seedling attributes were also positively influenced and highest seedling length (18.70 cm), root length (10.13 cm), shoot length (8.83cm), seedling dry weight (0.37gm) seedling fresh weight (4.66 gm) was observed in T₅ (Hydration with KH₂PO₄ 2%). Minimum seedling length (16.03 cm), root length (8.53 cm), shoot length (7.30 gm), seedling dry weight (2.94gm) seedling fresh weight (2.57 gm) was observed in T₀ (Control).

Maximum plant height (38.62) was recorded in T₄(Hydration with CaCl₂ 2%), days to 50% flowering (47.17) in T₀ (control), number of nodules per plant (26.26), nodules fresh weight (12.13), nodules dry weight (4.65), number of pod per plant (71.06), number of seed per plant (1.60), 100 seed weight (5.22 g) and seed yield (2538.10 kg/ha.) was recorded maximum in T₅ (Hydration with KH₂PO₄ 2%). Maximum field emergence (94.66) was recorded in T₄ (Hydration with CaCl₂ 2%).

Conclusion

On the basis of results obtained from the present experiment following conclusions are drawn.

Hardening increases the germination ability and vigour of lentil seeds, significantly in both lab and field condition. Hydration with KH₂PO₄ 2% significantly increased the germination percentage, seedling length, root length, shoot length, seedling dry weight seedling fresh weight, number of nodules per plant, nodules fresh weight, nodules dry weight, number of pod per plant, number of seed per plant, 100 seed weight and seed yield. These conclusions are based on the results of six months investigation and therefore further investigation is needed to arrive at valid recommendations.

It can be concluded from the present investigation that treatment T₄ (Hydration with CaCl₂ 2%) increase field emergence in compared with other treatments. Soaking of seed with KH₂PO₄ solution is advantageous to obtain healthy seedlings.

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