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Effect of foliar application of Iron, Boron and Zinc on seed quality of lentil (*Lens culinaris* Medik) in rainfed mid hills of Uttarakhand

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ABSTRACT
The results of the field experiment conducted during Rabi season of 2015-16 to study the effect of foliar application of micronutrients on seed quality of lentil under rainfed condition of Uttarakhand hills. The data revealed that RDF(N:P:K- 20:40:20 kg ha^{-1})+ Fe 50 ppm recorded significantly higher number of viable seeds, higher germination percentage in both standard germination test and accelerated ageing test. Speed of germination, growth index, cold test and cool germination were recorded maximum under RDF+ Fe 50 ppm.
KEY WORDS: *Lentil, Micronutrient, Iron, Boron, Zinc, Seed Quality, Accelerated ageing test, Cold test, Cool germination test*

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INTRODUCTION

Seeds are the foundation of agriculture. Technology has modernized much of farming's day-to-day operations, but without a steady supply of high-quality seed, yield and crop quality would be greatly decreased. Seed quality plays an important role in the production of agronomic crops. Characteristics such as trueness to variety, germination percentage, purity, vigour, and appearance are important to farmers planting crops.

Application of iron, zinc and boron has the potential to affect plant micronutrient nutrition both in the treated plant directly and in the progeny plants through enrichment of the seeds by micronutrient treatment of the parent. Foliar applications of micronutrient sprays prove to be best to achieve both [1].

MATERIAL AND METHODS

A field experiment was conducted during the Rabi season of 2015-16 at Crop Improvement Block, College of Forestry VCSG University of Horticulture and Forestry, Ranichauri, Uttarakhand. The soil was silty clay loam of medium depth with acidic pH having 0.75 % organic carbon, 225 kg ha^{-1}available N, 15 kg ha^{-1} available P and 405 kg ha^{-1} available K. The experiment was laid out in randomized complete block design (Single factor RBD) with eight treatments and three replications. The treatments comprised of T0- RDF (N:P:K- 20:40:20 kg ha^{-1}), T1- RDF+ Zn 50 ppm, T2- RDF+ Zn 100 ppm, T3- RDF+ Fe
50 ppm, T4- RDF+ Fe 100 ppm, T5- RDF+ B 50 ppm, T6- RDF+ B 100 ppm and T7- RDF+ Zn+ Fe+ B (50 ppm each). Two spray of micronutrient were made first at 30 days after germination (DAG) and second at 50 % flowering stage. The variety of lentil VL-126 was raised by following all other recommended cultural practices. Climate of college of forestry is humid and temperate type with chilled winter. The total precipitation during the growing season of the crop was recorded 150.3 mm, whereas mean monthly minimum and maximum temperature varied between 2^{0}C-13.2^{0}C and 12.4^{0}C-24.5^{0}C respectively.
Number of viable seeds was obtained using the tetrazolium test. Under germination test and accelerated ageing test (seeds were kept for 7 days at 45^o C) seeds were kept in between paper (B.P) and then placed

in germination chamber at 20^{0}C. First count (on 4th day), standard germination percentage (final count) were recorded for normal seedlings 10th day and expressed in terms of percentage and also seed vigour index I and vigour index II were also obtained. For cold test seeds were kept at 10^o C for 7 days and under cool germination test seeds were kept at 15^0 C for 7 days. And then seeds of both the test were subjected for germination test and germination percentage was calculated. Speed of germination was calculated by removing the seedlings which have reached the pre-determined length i.e., 6 cm, which was obtained by measuring the seedling length on first count (5th day of germination) in the germination test and was expressed in terms of percentage, growth index was calculated as the measure of increase in the length of the seedling on daily basis from 4th day till 8th day of the germination test.

RESULTS AND DISCUSSION

Standard germination and accelerated ageing test

Almost all the lentil seeds were viable in all the treatments except RDF+ B 100 ppm. The effect of micronutrient sprays on the viability of seed was statistically non significant.

RDF+ Fe 50 ppm recorded significantly higher first count, germination % (95.5%), vigour index I and vigour index II in both standard germination and accelerated ageing test, which might be due to the earliness in germination caused by enhanced metabolites and their activity, which helps in resumption of embryonic growth during germination. Foliar application of iron increased concentration of N, P, K, Ca, Mg, Fe, Mn and Zn in the seeds of the mother plant. The present investigation which is in conformity with earlier findings [2-3] in case of priming of dill seeds with $FeSO_4$.

Accelerated ageing test recoded higher germination percentage in comparison to the standard germination, even though all the seeds were viable. The reason might be the reduction of dormant seeds. The harvested seeds might had immature embryos thereby reducing the germination percentage in the standard germination test, as the seeds were artificially aged in the accelerated ageing test the number of immature seeds reduced and the germination percentage increased in the accelerated ageing test, also reported the similar findings in case of *Annona coriacea* [4].

Table 1: Effect of foliar spray of iron, boron and zinc on seed quality of lentil under rainfed condition

S. No.	Treatments	Viable seeds (%)	Standard germination				Accelerated Ageing Test				Cold test	Cool germination test
			First count(%)	Final count(%)	Vigour index 1	Vigour index 2	First count(%)	Final count(%)	Vigour index 1	Vigour index 2	Germination (%)	Germination (%)
T0	**RDF**	100	84.8	87.0	2412	1575	83.5	91.5	2379	1616	88.50	93.50
T1	**RDF+ Zn 50 ppm**	100	88.5	92.0	2770	1807	91.5	93.0	2549	1741	97.00	97.00
T2	**RDF+ Zn 100 ppm**	100	89.0	91.5	2834	1728	91.5	92.0	2418	1698	96.50	95.50
T3	**RDF+ Fe 50 ppm**	100	94.5	95.5	3176	1976	92.0	96.5	2845	1930	98.00	98.00
T4	**RDF+ Fe 100 ppm**	100	92.0	92.5	2794	1751	90.0	92.0	2472	1630	96.00	94.50
T5	**RDF+ B 50 ppm**	100	91.0	91.5	2551	1715	92.0	93.0	2644	1760	96.00	96.50
T6	**RDF+ B 100 ppm**	99	83.5	89.0	2317	1681	90.0	92.0	2524	1768	96.00	96.25
T7	**RDF+ Zn+ Fe+ B (50 ppm each)**	100	85.5	89.5	2666	1680	85.5	93.0	2543	1685	92.00	93.50
	CD 1%	NS	7.65	5.34	359.26	245.81	6.71	3.33	289.43	190.67	6.43	2.61
	SEm±	0.09	1.93	1.35	90.83	62.14	1.70	0.84	73.17	48.20	1.63	0.66

Cold and cool germination test

RDF+ Fe 50 ppm recorded significantly higher germination percentage in both cold test and cool germination test compared to the RDF and statistically on par with RDF+ Zn 50 ppm, RDF+ B 50 ppm, RDF+ Zn 100 ppm and RDF+ B 100 ppm. And also there was increase in the germination percentage in both the test in comparison to the standard germination test. The phenomenon behind may be due to the decrease in the number of un-germinated seeds as a result of cold temperature treatment for seven days both in cold test and cool germination test which has reduced the seed dormancy considerably. Since lentil is a cold season crop which may require a low temperature before the germination for higher field stand of the crop. As temperature affects the germination and the state of dormancy of the seeds and the seasonal changes of the dormancy state of the seeds of some species is directly related to the seasonal temperature changes [5].

Speed of germination and Growth index

RDF+ Fe 50 ppm recorded significantly higher speed of germination with respect to RDF. On 8th day there was 12.3% higher speed of germination in RDF+ Fe 50 ppm than RDF, while 6.4% higher speed of germination was recorded in RDF+ Fe 50 ppm than RDF+ B 50ppm, since there was higher seed vigour index I and II which represents higher speed of germination because they are positively correlated to each other, that was also reported in corn with application of Fe_3O_4 [6].

Statistically superior growth index was recorded in RDF+ Fe 50 ppm compared to the RDF.RDF+ Fe 50 ppm recorded the maximum growth index on all the days from 4th to 8th day which was followed by RDF+ B 50ppm and the lowest growth index was recorded for RDF on all the days, which might be due to increased performance in terms of seedling growth, higher enzymatic activity, production of higher plant growth promoting substances like gibberellins, and auxins and higher concentration of some macro and micro nutrients in the seeds as a result of foliar application of iron.

Table 2:Effect of foliar spray of iron, boron and zinc on speed of germination and growth index of lentil under rainfed condition.

S. No.	Treatments	Speed of Germination (%)					Growth Index (cm)				
		4th day	5th day	6th day	7th day	8th day	4th day	5th day	6th day	7th day	8th day
T0	**RDF**	8.0	50.5	74.5	81.0	85.0	7.77	9.95	13.30	16.59	19.21
T1	**RDF+ Zn 50 ppm**	18.5	54.0	79.5	87.0	92.5	7.94	10.95	14.31	18.48	21.52
T2	**RDF+ Zn 100 ppm**	20.0	56.0	81.0	89.0	90.3	7.77	11.10	14.78	17.98	21.18
T3	**RDF + Fe 50 ppm**	12.5	61.5	83.5	91.5	95.5	8.41	11.38	16.33	19.15	22.53
T4	**RDF + Fe 100 ppm**	17.5	60.5	79.0	91.0	93.3	8.02	10.91	15.16	18.30	20.22
T5	**RDF + B50 ppm**	16.5	58.0	78.5	88.0	89.8	8.27	10.66	13.89	17.61	20.87
T6	**RDF + B100 ppm**	11.0	49.5	73.5	83.5	88.0	7.63	10.38	14.67	18.03	19.34
T7	**RDF + Zn+ Fe+ B (50 ppm each)**	19.5	56.5	75.5	86.0	89.5	7.85	10.62	13.90	17.50	19.83
	CD 1%	1.34	7.30	7.06	6.83	6.72	0.57	0.94	1.70	1.44	2.26
	SEm±	0.34	1.85	1.79	1.73	1.70	0.14	0.24	0.43	0.36	0.57

CONCLUSION

The recommended dose of fertilizer (N:P:K- 20:40:20 kg ha^{-1}) along with foliar spry of Fe 50 ppm increase viability and germination percentage. It also enhances speed of germination, growth index, and germination under cold and cool condition. Therefore we can use foliar application of iron 50 ppm along with recommended dose of fertilizer to improve the quality of lentil seed.

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