Indian Journal of Agricultural Sciences **91** (4): 573–6, April 2021/Article
https://doi.org/10.56093/ijas.v91i4.112678

Effect of sowing and micronutrients foliar spray on lentil (*Lens culinaris*) in West Bengal

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Received: 24 August 2020; Accepted: 08 December 2020

ABSTRACT

A field experiment was conducted consecutively during 2018–19 and 2019–20 cropping seasons at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. The study was carried out in split-plot design having two sowing dates (November first week and December first week) in main plot, and foliar spray (no spray, spray of tap water, Zn @ 0.5% ($ZnSO_4.7H_2O$), Fe @ 0.5% ($FeSO_4.7H_2O$), B @ 0.2% (Borax 10.5%), Zn @ 0.5% + B @ 0.2%, Zn @ 0.5% + Fe @ 0.5%, B @ 0.2% + Fe @ 0.5% and Zn @ 0.5% + Fe @ 0.5% + B @ 0.2%) in sub-plots with three replications. Pooled results of two years experiment clearly indicated that November sown crop produced significantly (P>0.05) higher growth attributes, yield attributes and yield. November sown crop recorded 52.9%, 58.3%, 11.3% and 3.0% higher number of pods, seed yield, stover yield and test weight compared to the crop sown in December. Foliar spraying of micronutrients, viz. B @ 0.2% + Fe @ 0.5% produced significantly higher seed and stover yield of 1438 kg/ha and 3981 kg/ha respectively, which were 58.3% and 27.0% more than that obtained from the control treatment (772 and 3134 kg/ha). Delay in sowing of crop from November to December reduced the crop duration by 11.4 days (113.4 days vs 101.7 days) which affected the yield of the crop. Overall, it can be concluded that lentil sown during November along with foliar spray B @ 0.2% + Fe @ 0.5% can improve the yield in new alluvial zone of West Bengal, India.

Keywords: Date of sowing, Growth, Lentil , Phenology, Seed quality, Yield

In West Bengal, lentil (*Lens culinaris* Medikus) is an important winter (cool season) food legume. It covers an area of 1.51 million ha with a production of 1.56 million tonnes and productivity of 1032 kg/ha (DES 2020). Lentil is a highly nutritious legume with adequate quantity of carbohydrates, right amount of proteins and good amount of micronutrients. The mineral content of lentils is composed of relatively high levels of Mg, P, Ca and S (Faris *et al.* 2013). As lentil is grown after the harvest of rainy season (*kharif*) crop, often the sowing of the crop gets delayed either due to delayed harvest of long duration *kharif* crop or delay in the preparation of the field due to higher moisture in the field due to unexpected rain (Visha *et al.* 2019). Delay in sowing may encounter heat and moisture stress in the later stage hampering its development. Delay in sowing gets comparatively less time to complete life cycle of lentil and ends up in forced maturity (Ramakrishna *et al.* 2000). Foliar application of micronutrients helps in the rapid translocation and may mitigate the heat stress apart from meeting the nutritional requirement of the crop. Micronutrients especially Zn, Fe and B have shown their multidimensional role in plant production system. Zn is known for its metabolic and regulatory functions (Broadly *et al.* 2007) besides playing a pivotal role in reproductive phase of the crop. Iron (Fe) is important for various biochemical pathways of the plants (Rout and Sahoo 2015). The role of boron for pistil development and pollination to fertilization has also been reported by many researchers.

Proper date of sowing and foliar spray is an important agronomic strategy to mitigate stress and will help in improving the growth and yield of lentil under climate variability. In view of this, the present study was thus carried out to investigate the effect of sowing dates and foliar spray of zinc, boron and iron on growth, phenology, and yield of lentil.

MATERIALS AND METHODS

A field experiment was conducted consecutively during *rabi* seasons of 2018–19 and 2019–20 at the District Seed Farm, Kalyani under Bidhan Chandra Krishi Viswavidyalaya (Latitude 22º 58´ N and Longitude 88º 32´ E), West Bengal, India. The experimental site is located at an altitude of 9.75 m AMSL. The soil of experimental site was well-drained alluvial soil (order: Inceptisol), clay loam in texture with

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medium fertility and almost neutral in reaction (*p*H 7.2). The crop received precipitation of 149.5 mm and 105.8 mm, maximum and minimum temperature ranged from 22.2°C to 35.5°C and 7.8°C and 25.5°C, respectively during *rabi* 2018–19 and 2019–20. The estimated values of experimental soil for available organic carbon (wet-digestion method), nitrogen (alkaline permanganate-oxidizable), P_2O_5 (Brays' P), and K_2O (NH_4OAc-extractable), zinc (DTPA-extractable), boron (Azomethine H) and iron (DTPA extractable), were 0.52 %, 138 kg/ha, 30 kg/ha, 160 kg/ha 0.40 ppm, 0.49 ppm and 0.45 ppm, respectively.

The experiment was laid out in a split-plot design with two sowing dates (November first week and December first week) in main plots and nine combinations of foliar sprays (no spray, spray of tap water, Zn @ 0.5% ($ZnSO_4.7H_2O$), Fe @ 0.5% ($FeSO_4.7H_2O$), B @ 0.2% (Borax 10.5%), Zn @ 0.5% + B @ 0.2%, Zn @ 0.5% + Fe @ 0.5%, B @ 0.2% + Fe @ 0.5% and Zn @ 0.5% + Fe @ 0.5% + B @ 0.2%) in sub-plots. The foliar sprays were given at flower initiation and pod initiation stage. The seeds of popular variety Moitree (WBL 77) were sown at 30 × 10 cm row spacing in experimental plot of (5 m × 4 m) as per sowing time of main plot treatments. The standard crop management practices like uniform application of fertilizers (20:40:40 kg/ha of N: P_2O_5 and K_2O) and one hand weeding at 25-30 days after sowing (DAS) were followed to raise the experimental crop of lentil. No irrigation was provided and lentil was grown on residual soil moisture with little precipitation (149.5 and 105.8 mm) during *rabi*. The crop sown on November first week was harvest in March first week each year. However, December first week sown crop was harvest in March second week in both the years. Treatment means separation was done by using Fishers LSD at 5% significance level when F tests indicated that significant differences existed ($P<0.05$) (Payne RW 2009).

RESULTS AND DISCUSSION

Growth parameters: The pooled data of two years indicated the date of sowing significantly influenced the growth attributes such as plant height, number of nodules and dry matter production (Table 1). November sown crop recorded taller plants (51.9 cm) compared to December sown crop (47.4 cm). Likewise, number of nodules were found higher in November sown crop (31.3) than December sown one (26.9). Singh *et al.* (2005) also reported a decreasing trend in number of nodules with delay in sowing from November to December in West Bengal. Similarly, dry matter production was also observed higher in November sown crop (119.9 g/m^2) compared to December sown crop (104.3 g/m^2). The results are in accordance with the findings of Gill (2012). Though number of branches were also higher in November sown crop, the difference was not significant.

In addition, foliar spraying treatments also influenced plant height, dry matter production and number of nodules except number of primary branches (Table 1). Foliar spray of B @ 0.5% resulted highest plant height (52.2 cm), and was significantly superior over other treatments. The significant differences in dry matter accumulation among different treatments may be due to the role of micronutrients which played an important role in crop growth and development. Foliar spraying of B @ 0.2% + Fe @ 0.5% recorded significantly higher dry matter production (113.3 g/m) which was 8.8% higher than control (no spray). The effect of foliar spray also differed significantly for root nodulation.

Table 1 Growth and yield parameters of lentil as influenced by dates of sowing and foliar spraying of micronutrients (pooled data of 2 years)

Treatment	Plant height (cm)	Dry matter (g/m^2)	No. of nodules	No. of branches/ plant	No. of pods	Seed yield (kg/ ha)	Stover yield (kg/ ha)	Test weight (g)	Harvest index (%)
November sowing	51.9	119.9	31.3	3.2	127.2	1328	3723	20.5	0.36
December Sowing	47.4	104.3	26.9	3.1	83.2	839	3346	19.9	0.25
SEm±	0.36	1.04	1.73	0.13	1.55	5.46	5.56	0.02	0.00
CD(P=0.05)	1.40	6.33	10.52	NS	6.08	21.44	21.82	0.09	NS
No spray	45.8	104.1	24.6	2.8	81.4	772	3134	19.7	0.25
Tap water	47.5	104.9	24.4	2.5	89.1	829	3257	19.8	0.25
Zn @ 0.5%	48.8	107.8	24.0	3.0	100.6	1020	3490	20.2	0.29
Fe @ 0.5%	49.7	110.6	26.3	2.8	105.4	970	3357	20.3	0.29
B @ 0.2%	52.2	109.9	28.0	3.2	107.5	1099	3535	20.3	0.31
Zn @ 0.5% +B @ 0.2%	51.3	111.8	28.4	3.3	113.2	1180	3583	20.3	0.33
Zn @ 0.5% +Fe @ 0.5%	49.3	111.8	28.0	3.4	115.6	1144	3625	20.4	0.32
B @ 0.2% + Fe @ 0.5%	50.0	113.3	30.6	3.5	121.4	1438	3981	20.4	0.36
Zn @ 0.5% + Fe @ 0.5% +B @ 0.2%	51.9	109.5	32.4	3.5	112.6	1300	3847	20.3	0.33
SEm±	0.57	1.04	1.05	0.15	1.79	12.06	20.69	0.05	0.00
CD(P=0.05)	1.62	2.93	2.96	NS	5.05	34.08	58.45	0.15	NS

Table 2 Phenology of lentil as influenced by dates of sowing and foliar spraying of micronutrients (pooled data of 2 years)

Treatment	S-E	G-F	F-PI	PI-M	LC: S-M
November sowing	7.1	45.8	17.2	43.3	113.5
December sowing	8.1	39.1	19.1	35.9	102.1
SEm±	0.04	0.12	0.07	0.07	0.03
CD (P=0.05)	0.17	0.47	0.28	0.29	0.10
No spray	7.8	41.8	18.2	38.6	106.3
Tap water	7.6	42.3	17.7	39.1	106.8
Zn @ 0.5 %	7.4	42.1	18.1	39.4	107.2
Fe@ 0.5 %	7.6	42.4	17.7	39.6	107.3
B @ 0.2 %	7.7	42.5	17.8	40.0	108.0
Zn @ 0.5% + B @ 0.2%	7.7	42.7	18.3	39.6	108.2
Zn @ 0.5% + Fe @ 0.5%,	7.6	42.8	18.4	39.6	108.2
B @ 0.2% +Fe @ 0.5%	7.5	42.9	18.5	40.3	109.3
Zn @ 0.5% + Fe @ 0.5% + B @ 0.2%	7.8	42.8	18.5	40.6	109.4
SEm±	0.11	0.20	0.32	0.20	0.44
CD(P=0.05)	NS	NS	0.91	0.58	NS

*S-E: Sowing to emergence, G-F: germination to flowering, F-PI: Flowering to pod initiation, PI-M: Pod initiation to maturity LC-S-M: Life cycle sowing to maturity.

Foliar spraying of B @ 0.2% + Zn and Fe @ 0.5% recorded significantly higher no. of nodules/plant (32.4) than other spraying treatments, but it was statistically at par with the foliar spray of B @ 0.2% + Fe @ 0.5% (30.6) (Table 1).

Yield attributes and yield: Both sowing time and micronutrients foliar spray had significant influence on number of pods per plant, seed and stover yields of lentil (Table 1). November sown crop produced significantly higher number of pods/plant (127.2) compared to December sown crop (83.2). Higher test weight was also recorded (20.5 g) in November sown crop. December sown crop resulted in a test weight of 19.9 g. Delay in sowing generally hastens the life cycle of the crop, resulting to lower test weight. Similarly, lentil sown in November first week produced significantly highest seed yield (1328 kg/ha), which was 58.3% higher over late sown crop (839 kg/ha) (Table 1). Stover yield also followed the same trend as that of seed yield. The results are in accordance with Roy *et al.* (2009) where the first fortnight of November was considered to be the optimum for sowing of lentil in New Alluvial Zone of West Bengal.

Foliar spraying of B @ 0.2 % + Fe @ 0.5 % and Zn + Fe @ 0.5% was statistically on par with each other and had produced significantly higher test weight (20.4 g). Among the foliar spray treatments, B @ 0.2% +Fe @ 0.5% produced significantly higher seed yield (1438 kg/ha) followed by B @ 0.2% +Zn + Fe @ 0.5% producing 1300 kg/ha (Table 1). Foliar spraying of B @ 0.2% + Fe @ 0.5% produced significantly higher stover yield (3981 kg/ha) over other treatments. The pooled results of harvest index did not differ significantly. The results are in accordance with Visha *et al.* (2019) where they have found that foliar spray of boron and iron are highly beneficial in improving the yield of lentil in alluvial zones of West Bengal. This increase in grain and stover yields of lentil may be attributed to foliar spraying of micronutrients, which regulated their supply to the crop through mineralization with better absorption and may have prevented them from leaching and other losses. The availability of nutrients might have helped in increasing the translocation of photosynthates to sink leading to improvement in yield as reported by Choudhary *et al*. (2015).

Phenology: The duration of lentil crop was significantly reduced with delay in sowing from November to December (Table 2). On an average, lentil sown in November first week took 113.5 days from sowing to maturity compared to 102.1 days with sowing in December first week. Singh *et al.* (2005) reported similar reduction in time during 50% flowering and maturity with delay in sowing of lentil (cv. LG 308) from 10 November to 10 December at Gurdaspur, Punjab. Sen *et al.* (2016) also reported similar trend in a study with four lentil varieties (HUL 57, Moitree, KLS 218 and Ranjan) sown on three different dates in West Bengal. Though the variations among the stages were not uniform, germination –flowering (G-F) and pod initiation to maturity (PI – M) stages probably influenced the life cycle of lentil as a whole. The emergence of seedlings was relatively faster (7.1 days) in normal sown plots compared to late sown crop (8.1 days), due to better residual soil moisture during post-rainy period after sowing.

Foliar spray of B @ 0.2% +Fe @ 0.5% and B @ 0.2% +Zn and Fe @ 0.5% took three days more to mature than the control (no spray) (Table 2).. This may be attributed to the fact that, lentil being an indeterminate crop kept on producing flowers when supplemented with required nutrients and thus have a slighter longer duration.

Based on the above results, it can be concluded that

sowing of lentil in November along with foliar spraying of B @ 0.2% + Fe @ 0.5% is highly effectual for getting better lentil crop growth, establishment and yield. Even under late sowing condition, foliar spraying of B @ 0.2% +Fe @ 0.5% can prove advantageous in reducing the impact of heat and moisture stresses on growth and yield lentil in the new alluvial zone of West Bengal.

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