Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8497

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2021) *9*(1), 336-343

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

To Study the Effect of Growth and Metabolic Parameters of French Bean (*Phaseolus vulgaris* L.) as Influence by Sulphur and Iron Application

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Received: 14.11.2020 | Revised: 23.12.2020 | Accepted: 30.12.2020

ABSTRACT

The objective of investigation way to study the effect of basal application of sulphur and iron application with various levels (four level of sulphur S_0, S_{20}, S_{35}, S_{50} kg ha^{-1} and three level of iron Fe0, $Fe_{3.0}$, $Fe_{6.0}$ kg ha^{-1}) with 12 treatments. The field experiments were conducted in Randomized Block Design (RBD) with three replications at Student Instructional Farm, Department of Agronomy CSAUAT Kanpur, during Rabi seasons in the year 2017-18 and 2018-19. Results revealed that in case of sulphur application of 35 kg ha^{-1} recorded higher value of growth in terms of i.e. plant height, total dry matter accumulation, leaf area, total chlorophyll content, in case of iron application 6.0 kg ha^{-1} maximum value observed growth characters and metabolism as compared to all other tested treatments and lower value was observed in control condition during both year of experimentation.

Keyword: *Condition, Experiments, Leaf area, Metabolism, Total chlorophyll content.*

INTRODUCTION

French bean is one of the most important leguminous vegetable crops of north eastern region. It is cultivated for the tender vegetable, shelled green beans and dry beans (rajmash). It is one of the most important legume vegetables grown for its tender pods in a commercial scale in all types of soils ranging from sandy loam to clay soils but it cannot with stand water logging. It has many synonyms like: common bean, snap bean, dwarf bean, kidney bean, haricot bean, wax bean, field bean, garden bean, string bean pole bean or runner bean etc.

There are four cultivated species in *Phaseolus vulgaris* – The common bean, French bean, haricot bean, snap bean; *P. coccineus*: The runner or scarlet runner bean; *P. lunatus*: The lima (large seeded), sieve (small seeded) butter or Madagascar bean and *P. acutifolius* var *Latifolius*: The tapary bean. All the species are diploid with chromosome number 2n = 22.

Cite this article: Kumar, A., Singh, S. N., Tripathi, D. K., Rawat, D. K., & Maurya, N. (2021). To Study the Effect of Growth and Metabolic Parameters of French Bean (*Phaseolus vulgaris* L.) as Influence by Sulphur and Iron Application, *Ind. J. Pure App. Biosci.* *9*(1), 336-343. doi: http://dx.doi.org/10.18782/2582-2845.8497

French bean is an annual herbaceous, erect, bushy (20-65 cm tall) or twinning or climbing or pole type (2-3.2 m long) with alternate triplicate leaves are stipulate, petiolate with good tendrils. Based on the growth habit, the French bean varieties are grouped as bush type with short internodes, semi-pole type with longer internodes, and the pole type having internodes longer than that of semi-pole type. In the regions of high rainfall, especially during rainy season, generally, the pole type varieties are preferred for cultivation.

Experimental Site and Location:

The field experiment was conducted at the student instructional Farm, C.S. Azad University of Agriculture & Technology, Kanpur- Uttar Pradesh. Experimental field was well levelled and had assured irrigation facilities. At investigations were undertaken in the Department of Crop Physiology, C.S. Azad University of Agriculture & Technology, Kanpur.

Climatic and Weather Conditions

Geographically, Kanpur is one of the principle city of Uttar Pradesh (India), is located in sub-tropical climate situated at 27^0 28' N (latitude) and $80.15^{0'}$ E (longitude) in the Gangetic alluvial tract of central U.P. about 127 meters above sea level. The climate is sub-tropical, semi-arid with hot dry summers and severs cold winters. During experimentation, temperature was cool during vegetative growth while it was hot during pod maturing stage in both years of experimentation.

Treatment combination and symbols

In all, there were 12 treatments with four levels of sulphur and three levels of iron as given below:

	Sulphur Level	
S_0 (Zero Kg S/ha)		S_0
S_{20} (20 Kg S/ha)		S_1
S_{35} (35 Kg S/ha)		S_2
S_{50} (50 Kg S/ha)		S_3

:	**Iron Level**	
:	Fe 0 (Zero kg Fe/ha)	f_0
:	Fe 3.0 (3.0 kg Fe/ha)	f_1
:	Fe 6.0 (6.0 kg Fe/ha)	f_2

Method of seed sowing:

Sowing was done at 45 cm row spacing by Kera method behind the Deshi plough in furrow at 5 - 6 cm depth from the surface in the row spaced 45 cm and plant to plant distance of 10 cm as for as possible. The sowing of seeds was done on 4th November, 2017 and 2nd November". 2018 during both the years, respectively.

Application of Fertilizer:

A total dose of fertilizer basal requirements 120 kg/ha Nitrogen, 60 kg/ha (P_20_5) Phosphorus and 60 kg/ha (K_20) Potash were applied through Urea, Di-ammonium phosphate (DAP) and murate of potash (MOP) were used in the experiment respectively.

Application of Treatments:

Elemental Sulphurs were applied through Sachovet (wp) and Irons were applied through Etiolytic iron powder after demarcating individual plots in accordance with layout plan.

Plant Sampling Schedule:

Plant samples were taken at 30 days intervals from sowing i.e. 30 DAS, 60 DAS, 90 DAS and harvest for recording growth observations. After recording growth data plant was separated into different organs for recording dry matter content.

RESULTS AND DISCUSSION

Leaf area

The significant effect of leaf area observed in treatment S_{35} with 153.89 and 155.90 (30 DAS), 760.44 and 766.05 (60 DAS), 1112.80 and 1122.17 (90 DAS) and at maturity its value 466.48 and 474.46 followed by S_{50} with 143.48 and 145.36 (30 DAS), 708.98 and 724.31 (60 DAS), 1003.67 and 1012.40 (90 DAS) and at maturity recorded leaf area in 434.92 and 442.36. The lowest value was observed in treatment S_0 with 131.30 and 132.98 (30 DAS), 648.99 and 653.87 (60 DAS), 876.43 and 884.43 (90 DAS) and finally its value observed in maturity with

respect in 398.12 and 404.93 during both the year of experimentation.

The mean value of iron recorded significantly higher leaf area for all stages i.e., 30, 60, 90 DAS and at maturity with treatment $Fe_{6.0}$ 145.95 and 147.86 (30 DAS), 721.21 and 726.63 (60 DAS), 1029.61 and 1038.49 (90 DAS) and maturity 442.42, 449.99 followed by $Fe_{3.0}$ kg Fe ha^{-1} with 144.11 and 145.98 (30 DAS), 712.13 and 717.40 (60 DAS), 1010.35 and 1019.12 (90 DAS) and maturity 436.85, 444.32. Lowest leaf area recorded in Fe_0 with 138.18 and 139.95 (30 DAS), 682.96 and 688.09 (60 DAS), 948.47 and 956.89 (90 DAS) and maturity 418.95, 426.12 during both cropping seasons, respectively.

Interaction (S x Fe) leaf area was found non-significant during both years experimentation. Numerically the interactive treatments, maximum leaf area was observed in all the treatments over control. During both years of experimentation.

Table 1: Leaf area per plant (cm^2) of French bean at 30 DAS and 60 DAS as influenced by different levels of sulphur and iron application

Treatment	Leaf area/plant 30 DAS		Leaf area/plant 60 DAS	
	2017 – 2018	2018 - 2019	2017 – 2018	2018 – 2019
Levels of Sulphur				
S_0	131.30	132.98	648.99	653.87
S_{20}	142.33	144.16	703.33	708.61
S_{35}	153.89	155.90	760.44	766.05
S_{50}	143.48	145.36	708.98	714.31
S.E. (d)	**2.722**	**3.401**	**7.622**	**8.296**
C. D. (p=0.05)	**5.646**	**7.056**	**15.812**	**17.210**
Levels of Iron (Fe)				
Fe_0	138.18	139.95	682.96	688.09
Fe_3	144.11	145.98	712.13	717.40
Fe_6	145.95	147.86	721.21	726.63
S.E. (d)	**2.397**	**2.946**	**6.601**	**7.185**
C. D. (p=0.05)	**4.890**	**6.111**	**13.694**	**14.904**
S x Fe interaction				
S.E. (d)	**4.715**	**5.892**	**13.202**	**14.370**
C. D. (p=0.05)	**N. S.**	**N. S.**	**N. S.**	**N. S.**

Table 2: Leaf area per plant (cm^2) of French bean at 90 DAS and maturity stage as influenced by different levels of sulphur and iron application

Treatment	Leaf area/plant 90 DAS		Leaf area/plant Maturity Stage	
	2017 – 2018	2018 - 2019	2017 – 2018	2018 – 2019
Levels of Sulphur				
S_0	876.43	884.43	398.12	404.93
S_{20}	991.68	1000.34	431.45	438.83
S_{35}	1112.80	1122.17	466.48	474.46
S_{50}	1003.67	1012.40	434.92	442.36
S.E. (d)	**13.600**	**18.97**	**5.442**	**6.802**
C. D. (p=0.05)	**28.213**	**37.541**	**11.289**	**14.111**
Levels of Iron (Fe)				
Fe_0	948.47	956.89	418.95	426.12
Fe_3	1010.35	1019.12	436.85	444.32
Fe_6	1029.61	1038.49	442.42	449.99
S.E. (d)	**11.778**	**15.673**	**4.713**	**5.891**
C. D. (p=0.05)	**24.433**	**32.512**	**9.777**	**12.220**
S x Fe interaction				
S.E. (d)	**23.557**	**31.346**	**9.426**	**11.782**
C. D. (p=0.05)	**N. S.**	**N. S.**	**N. S.**	**N. S.**

Total chlorophyll content

The significantly higher mean value of total chlorophyll content in mg g^{-1} fresh tissue with treatment S_{35} (0.648, 0.665) at pre-flowering and (0.540, 0.554) at post-flowering stage followed by S_{50} (0.606, 0.621) in pre-flowering and in post-flowering its content value (0.506, 0.518) while, least chlorophyll content value was found in treatment S_0 (0.546, 0.560) at pre-flowering and at after flowering its content value (0.456, 0.472) with both years of experimentation, respectively.

The data of iron application show significant effect on total chlorophyll content however, maximum value of total chlorophyll content was found in $Fe_{6.0}$ (0.635, 0.650) in pre-flowering and at post-flowering (0.529, 0.543) and minimum in Fe_0 (0.566, 0.580) in before flowering and at after flowering its value (0.472, 0.487) both concerning experimental years.

The interaction effect of (S × Fe) sulphur and iron treatments its visualized that the value of total chlorophyll content in mg g^{-1} fresh tissue of both experimental years was non-significant effect but numerically, maximum value showed in combination $S_{35}Fe_{6.0}$ followed by $S_{35}Fe_{3.0}$ and $S_{50}Fe_{6.0}$ while minimum in S_0Fe_0 in both stages and in both corresponding years of experimentation, respectively.

Table 3: Total chlorophyll content of French bean Pre-Flowering and Post-Flowering stage as influenced by different levels of sulphur and iron application

Treatment	Pre-Flowering stage		Post-Flowering stage	
	2017 – 2018	**2018 - 2019**	**2017 – 2018**	**2018 – 2019**
Levels of Sulphur				
S_0	0.546	0.560	0.456	0.472
S_{20}	0.600	0.615	0.500	0.513
S_{35}	0.648	0.665	0.540	0.554
S_{50}	0.606	0.621	0.506	0.518
S.E. (d)	**0.027**	**0.031**	**0.022**	**0.024**
C. D. (p=0.05)	**0.057**	**0.063**	**0.046**	**0.051**
Levels of Iron (Fe)				
Fe_0	0.566	0.580	0.472	0.487
Fe_3	0.600	0.616	0.501	0.513
Fe_6	0.635	0.650	0.529	0.543
S.E. (d)	**0.024**	**0.026**	**0.019**	**0.021**
C. D. (p=0.05)	**0.049**	**0.055**	**0.040**	**0.044**
S x Fe interaction				
S.E. (d)	**0.047**	**0.053**	**0.039**	**0.042**
C. D. (p=0.05)	**N. S.**	**N. S.**	**N. S.**	**N. S.**

Relative water content in (%)

At pre flowering stage significantly higher mean value of RWC content with application of 35 kg S ha^{-1} (73.67, 75.42 and 51.63, 52.43) followed by 50 kg S kg ha^{-1} (72.75, 74.48 and 50.90, 51.97) and 20 kg S kg ha^{-1} (72.00, 73.72 and 53.53, 51.68), and minimum value of RWC was recorded treatment S_0 (70.42, 72.12 and 49.51, 51.70) during in the year 2017-18 and 2018-19, respectively.

Similarly, RWC % increased significantly with increasing levels of Fe @ 6.0 kg ha^{-1} (72.56, 74.29 and 50.89, 52.17) and it was decreased slightly with application of Fe @ 3.0 kg ha^{-1} (72.25, 73.97 and 50.68, 52.01), and minimum value of RWC observed Fe_0

control (71.81, 73.54 and 50.35, 51.65) respectively, both stage of plant growth during both year of cropping seasons.

The interaction of sulphur and iron (S × Fe) did not show any significant role of relative water content at both stages and during both the year of experimentation.

Table 4: Relative water content of French bean Pre-Flowering and Post-Flowering stage as influenced by different levels of sulphur and iron application

Treatment	Pre-Flowering stage		Post-Flowering stage	
	2017 – 2018	**2018 - 2019**	**2017 – 2018**	**2018 – 2019**
Levels of Sulphur				
S_0	70.42	72.12	49.51	51.70
S_{20}	72.00	73.72	50.53	51.68
S_{35}	73.67	75.42	51.63	52.43
S_{50}	72.75	74.48	50.90	51.97
S.E. (d)	**0.069**	**0.095**	**0.170**	**0.177**
C. D. (p=0.05)	**0.143**	**0.197**	**0.352**	**0.367**
Levels of Iron (Fe)				
Fe_0	71.81	73.54	50.35	51.65
Fe_3	72.25	73.97	50.68	52.01
Fe_6	72.56	74.29	50.89	52.17
S.E. (d)	**0.060**	**0.082**	**0.147**	**0.153**
C. D. (p=0.05)	**0.124**	**0.170**	**0.305**	**0.318**
				S x Fe interaction
S.E. (d)	**0.119**	**0.164**	**0.294**	**0.306**
C. D. (p=0.05)	**N. S.**	**N. S.**	**N. S.**	**N. S.**

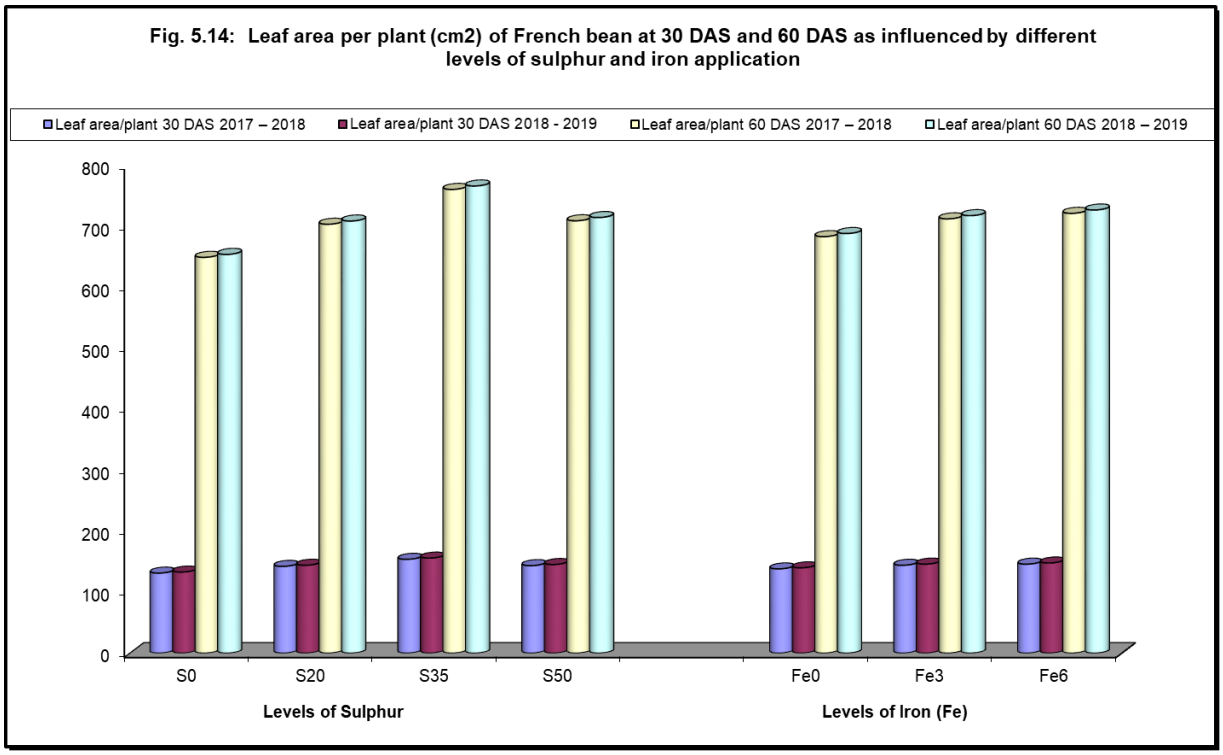


Fig. 5.15: Leaf area per plant (cm2) of French bean at 90 DAS and maturity stage as influenced by different levels of sulphur and iron application

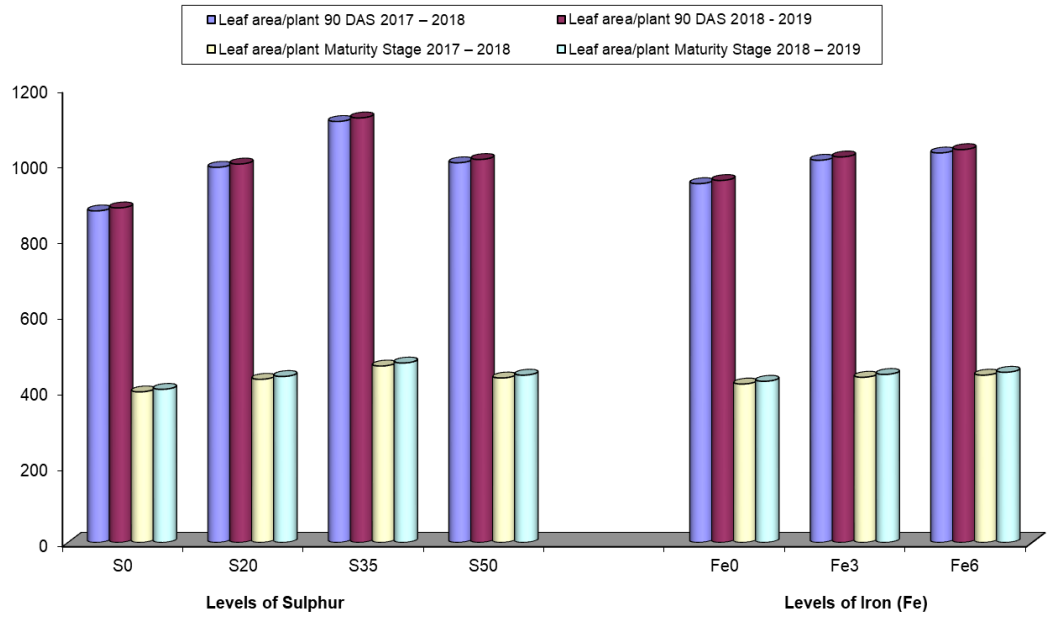


Fig. 5.22: Total chlorophyll content of French bean Pre-Flowering and Post-Flowering stage as influenced by different levels of sulphur and iron application

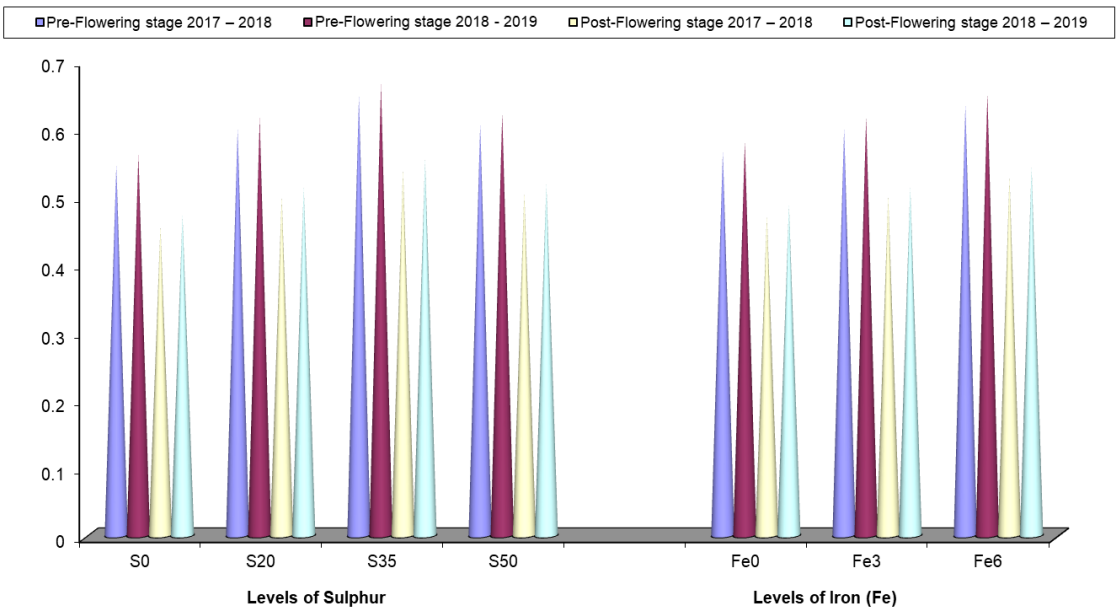
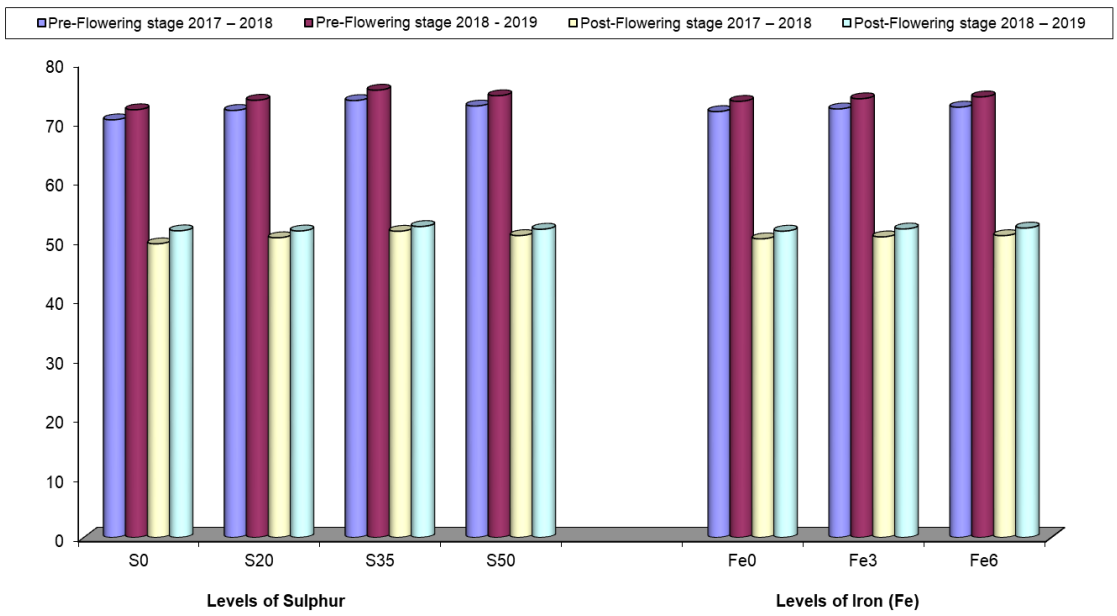


Fig. 5.19: Relative water content of French bean Pre-Flowering and Post-Flowering stage as influenced by different levels of sulphur and iron application



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