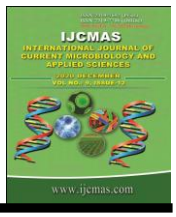
Int.J.Curr.Microbiol.App.Sci (2020) *9*(12): 894-898

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 12 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.912.107

Effect of Chlorimuron Herbicides on Physiology of Growth, Productivity and Quality of Soybean [*Glycine max* (L.) Merrill]

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Keywords

Soybean, Chlorimuron, Handweeding, Growth parameter, etc.

Article Info

Accepted:
10 November 2020
Available Online:
10 December 2020

A B S T R A C T

Soybean is rapidly emerging as the most important oil seed crop in India. A field experiment was conducted during *kharif* 2018 to study the effect of chlorimuron herbicides on physiology of growth, productivity and quality of soybean (*Glycine max* L.). Data exhibited that hand weeding had shown better result compared to all other herbicide treatments. Hand weeding is traditional and effective method of weed control, but untimely and continuous rains as well as unavailability of labour during peak period of demand are the main limitations of manual weeding. Therefore, there is a need for alternative methods of reducing the weed load during early crop growth period of soybean *i.e.* first 30-45 DAS. The various herbicide treatments also increased vital physiological parameters *Viz*., LAI, CGR, RGR, SLA, SLW and BMD.

Introduction

Soybean [*Glycine max* (L.) Merrill] is rapidly emerging as the most important oil seed crop in India. It is legume crop belonging to family leguminasae or fabaceae and sub family papilionaceae (Liu, 1997). Chemical composition of soybean is 35-40% protein, 19% oil, 35% carbohydrate (17% of which is a dietary fiber), 5% minerals and several other components including vitamins (Liu, 1997). Weed is a plant considered undesirable, unattractive or troublesome, especially are growing where it is not wanted. The most favourable agro-climatic condition in the region encourages growth of weeds causing serious decline in its yield, Competition of weeds for moisture, nutrient, space on sunlight greatly affects the growth and yield attributes and ultimately reduce the yield of crop (Muniappa *et al.*, 1975). Among the causes of low productivity, weeds are the major problems causing about 37% yield reduction (Arya *et al.*, 1998).

Weed management through use of herbicides is gaining popularity due to several reasons, and one important of which is non-availability of agriculture labourers. Hand weeding is traditional and effective method of weed control, but untimely and continuous rains as well as unavailability of labors during peak period of demand are the main limitations of manual weeding. Therefore, there is a need for alternative methods of reducing the weed load during early crop growth period of soybean i.e. first 30-45 DAS (Chhokar *et al.*, 1995). The post emergence herbicide displays consequence on physiological parameters, growth and yield components of soybean and weeds growth. The use of herbicides, even in tolerant cultivars, can generate stress conditions, evidenced by the increase in phytoxicity, which affects growth, development and productivity. The herbicides selectivity can be visually assessed by means of the phytoxicity symptoms in plants, and also by the change in photosynthetic pigments, growth and yield parameters.

Materials and Methods

A field experiment was conducted at the research farm (23.90^0 North latitude, 79.58^0 East longitudes and located at 411.78 m above mean sea level) of Department of Agronomy, JNKVV, Jabalpur (M.P).The revealed experiment was laid out in randomized block design with three replications. The climate condition of the study area is hot dry summer and cool dry winters. Average annual precipitation is nearly 1,386 mm (54.6 in) with intermittent dry spell. May is the hottest month, with the average temperature exceeding 45^0 C and in June while the minimum temperature goes down up to 40 in the December and January months followed by occasional frost. The relative humidity is 15-30% during summer, 60-75% during winter and 80-90% in rainy season.

Results and Discussion

A plant with optimum LAI and NAR may must higher biological yield as well as seed yield (Mondal *et al.*, 2007). Chandraker *et al.*, (2016) revealed that the leaf weight per plant decreases while the leaf area index (LAI) increases with plant population density. Amaregouda *et al.*, (2013) observed that herbicides also increased important physiological characters like leaf area, LAD, RGR, CGR and NAR. Whereas weed competition reduced all these parameters. Thus, present investigation indicated that LAI in treatments exhibited an increasing trend from early growth phase onwards up to 75 DAS, thereafter it declined. The decline of LAI in the late growth phase was attributed to the decrease in quantum of assimilatory surface area as a result of senescence and drying of leaf foliage. The result recorded that the treatment T_6 (Hand weeding) continued to produce significantly highest LAI (1.427) at 30 days, (2.791) at 45 days, (4.465) at 60 days and (3.605) at 75 days. Whereas, hand weeding took the highest LAI due to whole weed free environment during the critical period, resulting in profuse growth and development of foliage and accordingly had maximum LAI. The application of post emergence herbicides imazethapyr 200 g a.i.ha^{-1}, Chlorimuron 9.37 g a.i.ha^{-1} can directly or indirectly influence the physiological activities in plant growth and development such as two hand weeding at 20 and 40 DAS, have been reported to modulate the growth, production and quality of soybean seed (Boras *et al.*, 2011). In the present experiment significantly maximum LAD values of 9586.97, 16490.18 and 18315.53 in treatment T_6 (hand weeding twice) significantly followed by treatment of Chlorimuron + Quizalofop at 9+50 g ha^{-1}, (LAD 9357.89, 16226.04, 17415.90) during 30-45 DAS, 45-60 DAS and 60-75 DAS, respectively (Table 1 and 2).

Table.1 Effect of herbicidal treatments on LAI, LAD and CGR at various crop growth stages of soybean

Treatment	LAI				LAD			CGR		
	30 DAS	45 DAS	60 DAS	75 DAS	30-45 DAS	45-60 DAS	60-75 DAS	30-45 DAS	45-60 DAS	60-75 DAS
T1	1.177	2.447	4.317	3.310	8234.44	15372.17	17335.31	0.00105	0.00131	0.00269
T2	1.032	2.434	4.303	3.605	7879.07	15312.65	17656.98	0.00107	0.00131	0.00265
T3	1.287	2.581	4.222	3.354	8791.89	15463.24	17219.60	0.00108	0.00149	0.00264
T4	1.128	2.520	4.102	3.372	8290.38	15049.09	16985.54	0.00099	0.00149	0.00304
T5	1.329	2.789	4.350	3.313	9357.89	16226.04	17415.90	0.00097	0.00153	0.00288
T6	1.427	2.791	4.465	3.594	9586.97	16490.18	18315.53	0.00096	0.00167	0.00313
T7	0.962	2.260	4.064	3.070	7321.64	14373.74	16214.05	0.00083	0.00087	0.00218
Mean	**1.192**	**2.546**	**4.260**	**3.374**	**8494.61**	**15469.59**	**17306.13**	**0.00100**	**0.00191**	**0.00274**

Table.2 Effect of herbicidal treatments on RGR, SLA, SLW and BMD at various crop growth stages of soybean crop

Treatment	RGR			SLA			SLW			BMD		
	30-45 DAS	45-60 DAS	60-75 DAS	30-45 DAS	45-60 DAS	60-75 DAS	30-45 DAS	45-60 DAS	60-75 DAS	30-45 DAS	45-60 DAS	60-75 DAS
T1	0.0441	0.0382	0.0315	238.62	376.59	290.41	0.00268	0.00301	0.00412	107.88	188.47	319.29
T2	0.0432	0.0371	0.0307	254.01	339.73	288.24	0.00273	0.00300	0.00334	112.70	194.52	324.82
T3	0.0425	0.0352	0.0334	275.65	324.22	252.32	0.00283	0.00313	0.00469	115.89	203.47	340.71
T4	0.0451	0.0343	0.0323	242.55	327.64	255.19	0.00286	0.00308	0.00457	125.82	209.36	357.92
T5	0.0447	0.0364	0.0324	240.79	335.91	280.91	0.00280	0.00303	0.00406	130.12	213.92	359.31
T6	0.0462	0.0374	0.0343	242.62	317.55	249.93	0.00287	0.00319	0.00464	134.23	221.52	379.97
T7	0.0401	0.0352	0.0300	232.13	327.82	253.09	0.00250	0.00243	0.00332	93.54	165.21	281.79
Mean	**0.04369**	**0.0362**	**0.0320**	**246.63**	**355.64**	**267.16**	**0.00275**	**0.00298**	**0.00410**	**117.17**	**199.49**	**337.69**

The minimum value were observed in control (weedy check) 7321.64, 14373.74 and 16214.0 at respective stages. Shiraiwa *et al.,* (2004) revealed that the yield significantly and positively correlated with crop growth rate (CGR) during the 20 days' period after the beginning of seed filling (R_5), i.e. initial seed filling stage in soybean. The CGR describes the dry matter accumulated per unit land area per unit time (g m^{-2} day^{-1}). The result of present investigation displayed that the significant highest CGR (0.00313) under treatment of hand weeding (twice) surveyed by treatment of Chlorimuron at 12 g ha^{-1} CGR(0.00304) while lowest CGR (0.00218) was detected in control treatment (weedy check) during 60-75 DAS. Later slower rate of CGR during 45-60 DAS then again increase in rate of CGR during 60-75 DAS was registered.

Radford (1967) noted that the relative growth rate (RGR) is increase in plant dry matter per unit plant material per unit time. Tandale and Ubale (2007) described in 8 soybean cultivars, the highest relative growth rate (RGR) during 30-60 DAS and decreased during 60-90 DAS. The data on RGR showed that it decreased as growth advanced and maximum RGR was noticed at 30-45 DAS. The result of present investigation displayed that the non-significant highest RGR (0.0462) under treatment of hand weeding (twice) followed by treatment of Chlorimuron at 12 g ha^{-1}RGR (0.0451) while lowest CGR (0.0401) was detected in control treatment (weedy check) during 30-45 DAS. Specific Leaf Area can be used as an indirect measure of several basic leaf processes, such as leaf-water relations, photosynthetic capacity and growth potential (Dong *et al.,* 2011). Amaregouda *et al.,* (2013) experiential similar result that all herbicides increased leaf dry matter, stem dry matter and total dry matter. The herbicides also increased important physiological characters like leaf area, LAD, RGR, CGR and NAR. Where, weed competition reduced all these parameters. The results pertaining to total dry matter (TDM) indicated significant difference among the treatments at all the stages. The total dry matter increased from 20 DAS to harvest in all the treatments.

The SLW specified the leaf thickness which is due to compactness and stacking of mesophyll cells. Pearce *et al.,* (1968), Poorter and Vander Werf (1998), Cambridge and Lambers (1998) revealed that the plants with a higher SLW are usually greener SLW have been correlated with the photosynthetic rate growth relative rate, production and leaf structure. In the present experiment significantly maximum SLW values of treatment T_6 (Hand weeding at 20 and 40 DAS) (0.00287), T_6 (Hand weeding) (0.00319) and T_3 (Chlorimuron at 9 g ha^{-1}) (0.00469) during 30-45 DAS, 45-60 DAS and 60-75 DAS, respectively. The minimum value was observed in control (weedy check) 0.00250, 0.00243 and 0.00332 at respective stages. The results exhibited that the maximum biomass duration T_6 (379.97) had the maximum biomass duration at par with T_5 (359.31), T_4 (357.92) and T_3 (340.71), while the minimum biomass duration was valued in T_7 (281.79).

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How to cite this article:

Mrunal Ghogare, S.K. Dwivedi, Supriya Debnath, A.K. Jha, Anubha Upadhyay, Preeti Sagar Nayak and Ompal Singh. 2020. Effect of Chlorimuron Herbicides on Physiology of Growth, Productivity and Quality of Soybean [*Glycine max* (L.) Merrill]. *Int.J.Curr.Microbiol.App.Sci.* 9(12): 894-898. doi: https://doi.org/10.20546/ijcmas.2020.912.107