Advances in Agricultural Technology & Plant Sciences
ISSN: 2640-6586

Academic Strive
Researcher's perception is our reality

Research Article *Volume 3 Issue 1*

Study on the Effect of Sequential Application of Herbicides on Weed Growth and Yield of Greengram (*Vigna Radiata* (L) Wilczek) after Wet Season Rice in Lower Gangetic Alluvial Soils of West Bengal

Rambilash M*, Mukherjee S, Das D and Buddhadev S

Department of Agronomy, Institute of Agricultural Science, University of Calcutta, India

***Corresponding author:** Rambilash Mallick, Department of Agronomy, Institute of Agricultural Science, University of Calcutta, 51/2 Hazra Road Kolkata-700019, India, Email: rbmmallick@gmail.com

Received Date: February 28, 2020; **Published Date:** March 12, 2020

Abstract

A field experiment was carried out at the Agricultural Experimental Farm of Calcutta University, Baruipur, South 24 Parganas situated in the lower Gangetic Delta region of West Bengal during spring season of 2016 and 2017 to find out the efficacy of sequential application of herbicides on weed growth and yield of greengram Wilczek . The experimental site was silty clay loam in texture, medium in organic carbon (0.66%), available N (174.3 kg/ha), available phosphorus (29.5 kg/ha) and available potassium (257.2 kg/ha) with PH 7.1. There were altogether 8 treatments of pre-emergence and post-emergence herbicides namely butachlor 1.5 kg /ha, pretilachlor 1kg /ha and pendimethalin 1kg /ha as a pre-emergence application, butacholor 1kg /ha followed by imazethapyr 0.1kg /ha, pretilachlor 0.75kg /ha fb imazethapyr 0.1kg /ha, pendimethalin 0.75kg /ha fb imazethapyr 0.1kg /ha, weed free check, and unweeded control.

The experiment was conducted in randomized block design with three replications. The pre-emergence herbicides were applied one day after sowing of the crop and post-emergence herbicide was applied twenty days after sowing of the crop. The cultivar used for the experiment was "SML-668". The crop was sown on 29th March and 15th March and harvested on1st June, and 20th May, in 2016 and 2017 respectively. Broad leaved weed Melochia corchorifolia was most pre-dominant during both the year of experimentations. As regards the relative density on per cent basis, there were 95% broad leaf, 4% grasses and only 1% sedges. Each and every herbicide formulation was found effective in arresting weed growth and proved to be superior in enhancing the yield of greengram over unweeded control. Among the three pre-emergence herbicides, pendimethalin was found to be best. Sequential application of herbicides i.e. pre-emergence fb post-emergence application is better than only single pre-emergence application of herbicides with regards to weed control efficiency and weed index. Weed free check treatment recorded highest production of greengram seed. But in economic point of view, all the three tested pre-emergence herbicides fb post-emergence application of herbicide imazeythapyr 0.1 kg /ha recorded higher benefit cost of ratio and were found quite superior to weed free check treatment. Pendimethalin 0.75kg/ha as a pre-emergence application fb post-emergence application of imazethapyr 0.1 kg /ha was recorded highest benefit and cost ratio. All the tested herbicides were found to be safe to the greengram crop with

Rambilash M, et al. Study on the Effect of Sequential Application of Herbicides on Weed Growth and Yield of Greengram (*Vigna Radiata* (L) Wilczek) after Wet Season Rice in Lower Gangetic Alluvial Soils of West Bengal. Adv Agri Tech Plant Sciences 2020, 3(1): 180047.

respected to phytotoxicity observed visually during spring season of 2016 and 2017.

Keywords: Seed yield; Herbicide application; Spring greengram; Weed Control efficiency

Introduction

Pulses are inseparable ingredients of vegetarian diet, and one of the cheapest sources for combating the protein malnutrition problem by supplying dietary protein to the people. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture. Greengram is a widely grown grain legume and belongs to the family fabaceae and assumes considerable importance from the point of food and nutritional security in the world. Greengram is favourable short duration pulse crop as it thrives better in all seasons either as sole or as intercrop or fallow crop.

Weeds continue to have major impact on crop production in spite of efforts to eliminate them. Weed roblems vary according to crops, region and soil type. When improved agricultural technologies are adopted, efficient weed management becomes even more important, otherwise the weeds rather than the crop benefit from the costly inputs. Yield losses in greengram due to weeds have been estimated to range 30 to 85% [1-4]. In greengram, weed management is an important factor for contributed maximum followed by fertilizer use and insect pest and disease control. The crop needs a weed free period of first 30 days, as the crop is short stature and suffers badly if weeds are not controlled at early stages [4]. If weeds allowed growing throughout the crop season caused 63.8% reduction in summer blackgram/ greengram yield [5]. Emergence of weeds and crops are generally simultaneous in the field. But weeds on account of their better adaptation and survival mechanism and fast growing habit even under adverse conditions offer severe competition and sometimes smother the crop plant and cause substantial yield loss. Among several factors, proper weed management plays an important role in improving the production. Weeds being the major problem which provide opportunities for harbouring insects, pests and diseases and result in yield reduction. They reduce the crop yield and deteriorate the quality of produce and hence, reduce the market value of the turnout. The conventional methods of weed control (hoeing or hand weeding) are labour intensive and uneconomical and may cause damage to the crop.

Chemical weed control may be preferred because of its better efficiency along with less cost and time involvement. Also, it causes no mechanical damage to the crop that happens during manual weeding. Moreover, the control is more effective as the weeds even within the rows are not killed during mechanical control. Pre-emergence herbicides can control first flush weed emergence effectively but when field get moistened either by receiving rainfall or by irrigation second flush weed emergence happens profusely. Pre-emergence herbicides cannot control this. With the availability of post-emergence herbicides this could be managed effectively. Thus the use of post-emergence herbicides alone or in combination may broaden the window of weed management by broad spectrum weed control. Keeping the above points in mind the present field investigation was carried out to evaluate the efficacy of sequential application of herbicides on weed growth and yield of greengram in spring season.

Materials and Methods

The experiment was conducted at the Agricultural Experimental Farm of Institute of Agricultural Science of Calcutta University(88^0 28' east longitude, $22^0$22' north latitude and 9.75m altitude), situated in South 24-Parganas district, West Bengal during spring season of 2016 and 2017. The soil of the experimental site was silty clay loam in texture, medium in organic carbon (0.66%), available N (174.3 kg/ha), available phosphorus (29.5 kg/ha) and available potassium (257.2 kg/ha) with pH 7.1. The experiment was laid out in randomised block design with eight treatments. There were altogether 8 treatments of pre-emergence and post-emergence herbicides namely butachlor 1.5 kg /ha as a pre-emergence application, pretilachior 1kg /ha as a pre-emergence application, pendimethalin 1kg / ha as a pre-emergence application, butacholor 1kg /ha followed by imazethapyr 0.1kg /ha, pretilacholr 0.75kg / ha *fb* imazethapyr 0.1kg /ha, pendimethalin 0.75kg /ha *fb* imazethapyr 0.1kg /ha, weed free check, and unweeded control. The pre-emergence herbicides were applied on the same day of sowing with knap sack sprayer fitted with flat fan nozzle using 500 litre water/ha whereas post-emergence herbicides were sprayed using 750 litre of water at 20 DAS when weeds were at 3-4 leaf stage. All other recommended package of practices for crop cultivation was followed.

Weed population count was taken with a quadrate of 0.5m × 0.5 m area at four location of each plot for studying the total weed population. Weed species after taking the weed count data were dried plot wise and the data converted to dry matter of weeds in g/m^2 at 45 and 60 DAS. Weed control efficiency and Weed Index were calculated by using standard formula. The crop was sown on 29th March and 15th March and harvested on 1st June, and 20th May, in 2016 and 2017 respectively. The crop was sown with hand drill with seed rate

of 20 kg/ha keeping 30 cm row to row spacing using cultivar SML 668 during both years. Observations on phytotoxicity effect of herbicides were studied visually. At maturity, data on pods per plant from randomly selected10 plants from each plot and the average number of pods per plant was recorded. 20 pods from each plot were randomly selected from previously stripped pods. Seeds were separated from pods and counted. The average number of seeds per pod was recorded. 1000 mature seeds were sun dried and weighted separately for each plot to have test weight and ultimately yield of seed was calculated. Seed yield and haulm yield were recorded on the basis of whole plot area and converted into kg/ha.

Effect on Weeds

Weeds of the experimental field were collected, identified and classified and categorized into broad leaf and grasses at different growth stages of crop *i.e.* 45 and 60 days after sowing (DAS) during both years of experimentation. The weed species found in the experimental field were *Melochia corchorifolia, Setaria glauca, Eleusine indica, Echinochola colona, Cyperus rotundus. Though Melochia corchorifolia* (most dominant weed flora) *was only* one broad leave weed species but it alone created mat like situation in unweeded control plots. Observation from unweeded control (weedy check) plots revealed that the broad leaf category of weeds was highest at both the growth stages of crop i.e. 45 and 60 days after sowing(DAS) of the crop followed by grasses while the population of sedges was almost nil. As regards the relative density on per cent basis, there were 95% broad leaf, 4% grasses and only 1% sedges. Most of the weeds of the experimental field emerged along with the crop plants.

Total Weed Population

It is clearly evident that all the weeds control treatments whether cultural or chemical reduced the weed population significantly over the unweeded control (weedy check) at 45DAS and 60 DAS (Table 1). Weed emergence in greengram begins almost with the crop emergence leading to crop-weed competition from initial stages. The high weed pressure under aerobic soil conditions as observed in this study is long established as reported by many researchers. All the pre-emergence herbicides (butacholor, pritilacholor, pendimethalin) were found to be highly effective as compared to unweeded control. But pendimethalin1.0 kg /ha recorded lowest weed population as compared to butacholor 1.5 kg / ha and pretilacholor 1.0 kg /ha application. Pre-emergence *fb* post-emergence herbicide application kept the plots almost weed free situation. But at 60 DAS it was observed that some weeds with lanky growth occurred in those plots which were not in position to uproot. During both the year of experiment, pendimethalin fb imazethapyr provided effective control of all categories of weeds and created weed free conditions till first 45 days of sowing [6-8].

Treatment	Total weed population (No./ m2)		Weed dry weight (g/m2)		Weed control efficiency (%)		Weed Index (%)
	45DAS	60 DAS	45DAS	60 DAS	45 DAS	60 DAS	
T_1-Butachlor 1.5kg /ha	9.29(76.35)	9.78 (95.33)	9.54 (90.08)	14.38 (206.76)	21.29	41.27	20.96
T_2-Pretilachlor 1.0 kg /ha	8.38(70.65)	9.55 (86.19)	8.76 (73.90)	12.38 (152.23)	31.26	55.57	18.62
T_3-Pendimethalin 1.0 kg /ha	8.71 (65.0)	9.69 (82.0)	8.26 (62.25)	8.64 (72.28)	42.33	77.55	15.82
T_4-Butachlor 1.0 kg /ha fb Imazethapyr 0.1 kg /ha	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	100	100	9.43
T_5-Pretilachlor 0.75kg /ha fb Imazethapyr 0.1 kg /ha	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	100	100	8.64
T_6-Pendimethalin 0.75kg /ha fb Imazethapyr 0.1 kg /ha	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	100	100	5.36
T_7-Weed Free Check	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	100	100	-
T_8-Unweeded Control	21.51(445.67)	21.85(506.57)	10.81 (115.0)	18.79 (350.44)	-	-	47.16
CD	0.56	1	0.25	0.06			

Table 1: Effect of treatments on weed population, dry weight of weed, weed control efficiency and weed index (Pooled data). Figures in parentheses are original values. Data were subjected to square root transformations.

Dry mater accumulation of weeds decreased significantly due to the adoption of weed control method either cultural or chemical compared to untreated check. Weed dry matter is a better parameter to measure the competition than the weed number. Unweeded control recorded significantly highest weed dry weight at 45 DAS and 60 DAS. Among the pre-

emergence herbicides, pendimethalin recorded the lowest weed dry matter accumulation (62.25g/m^2) as compared to butachlor 1.5 kg/ha and pretilachlor 1.0 kg/ha. Performance of pendimethalin and pretilachlor was almost identical with regards to reduction of dry matter production of weed. Dry mater accumulation of weeds at 45 DAS and 60 DAS, pre-emergence followed by post-emergence herbicide recorded no weed dry matter in those plots.

Weed Control Efficiency

It was observed that higher weed control efficiency (%) was found in sequential application of pre-emergence herbicides *fb* post-emergence herbicide application. Those treatments were showed highest weed control efficiency as compared to sole application pre-emergence herbicide like butacholor, pretilachlor, pendimethalin at their used rates. But application of pendimethalin 1.0 kg/ha was showed better weed control efficiency other than other two pre-emergence herbicides. The pre-emergence herbicide butachlor1.5kg/ha showed the lower weed control efficiency in greengram throughout the growing season.

Weed Index

Weed index indicate the reduction in yield due to crop-weed competition, among the herbicide treatments, pre-emergence application of pendimethalin 0.75kg */ha fb* post-emergence application of imazethapyr 0.1 kg/ha resulted in lowest weed index (5.36%) and it was evident than unweeded control plot resulted in highest weed index (47.16%).

Effect on Crop

The impact of different weed management practices were clearly reflected their positive impact on crop growth, yield attributes and yield of greengram (Table 2). Plant stands were unaffected due to different weed management practices.

Treatment	Yield components			Seed yield (kg/ha)	Haulm yield (kg/ha)	Net return (Rs./ha)	Benefit : cost ratio
	No. of pods/ plant	No. of seeds/ pod	Test weight(g)				
T_1-Butachlor 1.5kg /ha	12.29	11.73	28.3	745	4876	40729	2.16
T_2-Pretilachlor 1.0 kg /ha	15.23	10.58	30.53	771	5027	43109	2.32
T_3-Pendimethalin 1.0 kg /ha	17.84	11.4	30.46	800	5117	44673	2.31
T_4-Butachlor 1.0 kg/ha fb Imazethapyr 0.1 kg /ha	20.67	11.16	31.69	856	5204	47729	2.3
T_5-Pretilachlor 0.75kg/ha fb Imazethapyr 0.1 kg /ha	22.39	11.57	31.99	864	5321	48489	2.35
T_6-Pendimethalin 0.75kg/ha fb Imazethapyr 0.1 kg /ha	24.56	11.37	32.3	893	5270	50229	2.36
T_7-Weed Free Check	31.14	12.3	36.42	946	5443	52219	2.2
T_8-Unweeded Control	5.11	6.17	26.29	500	3998	23289	1.39

Table 2: Effect of treatments on yield components and yield of greengram (Pooled data).

Yield Attributes and Seed Yield

Yield components like number of pods/plant, number of seeds/pod and test weight at the time of harvest varied significantly with the variation in weed management practices. Maximum number of pods/plants, number of seeds/pod and test weight were found in weed free check and the lowest was recorded under unweeded check. Sequential applications of pre-emergence herbicide *fb* post-emergence herbicides application recorded significantly higher number of pods/plant, number of seeds/pod and test weight over only sole application of pre-emergence herbicides. Among the soil application of three pre-emergence herbicides, pendimethalin 1.0 kg /ha recorded higher number of yield attributes. The increase in yield attributes under weed free treatment was due to weed management from beginning of crop growth which resulted in higher dry matter accumulation which helped in greater translocation of food materials to the reproductive parts and reflected in superiority of yield attributing characters and ultimately to higher yield. The lower weed density and higher weed control efficiency also resulted in higher seed yield. Yield attributes like pods/plant (31.14), seeds/pod (12.3) and 1000 seed weight (36.42) was found highest under weed free treatment. Weed infestation caused stress to the crop plant with respect to nutrient, light, moisture, space and other various aspects related to physiological processes of crop plant and thus enforced the crop to have less number of seeds/pod and this was highly evident in weedy check treatment.

All the weed control treatments significantly enhanced

the seed yield of greengram as compared to untreated control which was as low as 500kg/ha. Highest seed yield was recorded in weed free check (946 kg/ha) which was significantly higher over all the other weed management treatments. The significantly lowest seed yield (500 kg/ha) was observed in weedy check treatment. Sequential applications of pre-emergence herbicide followed by post-emergence herbicides application recorded significantly higher grain yield over sole application of pre-emergence herbicides. Among the three pre-emergence herbicides, pendimethalin 1.0 kg /ha recorded higher yield over butachlor 1.5kg /ha and pretilachlor 1.0 kg /ha. From the results, it may be expressed that higher weed infestation was responsible for reducing seed yield, as the treatments with higher weed intensity were with lower seed yield of the crop during spring season [9-11].

This was quite clear from seed yield produced in weedy check treatment, which faced the tremendous competition with vigorous weed infestation. Weed free check reduced weed infestation most efficiently throughout the growing period of the crop and as a consequence it produced the highest seed yield of spring greengram. Similar results were also reported by greengram [12,13]. Weed free treatment recorded the highest seed yield. Decrease in productivity of greengram due to very high weed competition was up to the extent of 47.15%. These results corroborate the findings of Pandey J, et al. [2] who observed decrease in mungbean productivity due to weed competition to the extent of 45.6%. These results are in agreements with [14].

The availability of plant nutrients depends upon the soil moisture, with the decrease in the availability of soil moisture, the nutrient uptake also get reduced. Hence, keeping the field free from weed at the early stages of the crop growth is most appropriate way for obtaining higher yield [13]. Among different weed management practices, Sequential application of herbicides i.e. pre-emergence *fb* post-emergence application is better than only single pre-emergence application of herbicides with regards to weed control efficiency and weed index and significantly reduced the dominant broad leaved weed population and increased the growth and yield of greengram.

Economics

The results of the economics analysis of the weed management practices revealed that maximum net return (Rs 52219 /ha) was recorded in weed free check followed by pendimethalin 0.75 kg /ha *fb* imazethapyr 0.1 kg /ha (Rs 50229/ha) followed by pretilachlor 0.75 kg /ha *fb* imazethapyr 0.1 kg /ha and (Rs48489 /ha. The highest BC ratio (2.36) was recorded with pendimethalin 0.75 kg /ha *fb* imazethapyr 0.1 kg /ha followed by (T5) i.e. pretilachlor 0.75 kg /ha *fb* imazethapyr 0.1 kg /ha).

Conclusion

It can be concluded on the basis of this study that under acute labour scarcity condition and in economic point of view, sequential application of herbicides like pendimethalin 0.75kg/ha as a pre-emergence *fb* post-emergence application of imazethapyr 0.1 kg /ha or pretilachlor 0.75 kg /ha *fb* imazethapyr 0.1 kg /ha or butachlor 1.0 kg /ha *fb* imazethapyr 0.1 kg /ha will be better option than sole application of herbicides either pre-emergence or post-emergence application for maximising productivity of greengram cultivation.

References

1. Kaur G, Brar HS, Guriqbal Singh (2009) Effect of Weed Management on Weeds, Growth and Yield of summer mungbean (*Vigna radiata* L). Indian J Weed Sci 41(3&4): 228-231.

2. Pandey J, Mishra BN (2003) Effect of weed management practices in a rice mustard-mungbean cropping system on weeds and yield of crops. Annals of Agri Research 24: 737-742.

3. Raman R, Kuppuswamy G, Krishnamoorthy R (2005) Response of weed management practices on the growth and yield of urdbean (*Vigna mungo Hepper*). Legume Res 28(2): 122-124.

4. Mirjha PR, Prasad SK, Singh MK, Paikra HR, Patel S, et al. (2013) Effect of weed control measures on weeds, nodulation, growth and yield of mungbean (*Vigna radiata*). Indian J Agronomy 58(4): 615-617.

5. Mishra JS, Chandrabhanu (2006) Effect of Herbicides on Weeds, Nodulation and Growth of Rhizobium in Summer Blackgram (*Vigna mungo* L.). Indian J weed Sci 38(1 & 2): 150-153.

6. Chhodavadia SK, Mathukiya RK, Dobariya VK (2013) Pre-and post-emergence herbicides for integrated weed management in summer greengram. Indian J Weed Science 45(2): 137-139.

7. Kumar R (2014) Crop technology demonstration: An effective communication approach for dissemination of wheat production technology. Agri Sci Digest 34(2): 131-134.

8. Nandan Brij, Sharma BC, Kumar Anil, Sharma Vikas (2011) Efficacy of pre and post-emergence herbicides on weed flora of black gram under rainfed subtropical foot hills of Jammu & Kashmir. Indian J Weed Sci 43(3&4):

172-174.

9. Punia SS, Hooda VS, Duhan Anil, Yadav Dharambir, Amarjeet (2013) Distribution of weed flora of greengram and blackgram in Haryana. Indian J Weed Sci 45(4): 247-249.

10. Punia SS, Malik RS, Yadav A, Rinwa RS (2004) Effect of varying density of *Cyperus rotundus, Echinochloa colona* and *Trianthema portulacastrum* on mungbean. Indian J Weed Sci 36: 280-281.

11. Reddy SR (2004) Agronomy of Field Crops. Kalyani Publications, New Delhi, pp: 458.

12. Singh V, Gautam RC and Singh VK. 2002. Effect of row spacing and weed management practices on the productivity of late planted *urdbean*. Indian Journal of Pulses Research 15(2): 185.

13. Malik RS, Yadav A, Malik RK, Singh S (2005) Performance of weed control treatments in mungbean under different sowing methods. Indian J Weed Sci 37(3&4): 273-274.

14. Raj VC, Patel DD, Thanki JD, Arvadia MK (2012) Effect of integrated weed management on weed control and productivity of greengram (*Vigna radiata*). Bioinfolet 9(3): 392-396.