International Journal of Plant & Soil Science

34(23): 671-679, 2022; Article no.IJPSS.92135
ISSN: 2320-7035

Effect of Herbicide Application on Weed Dynamics in Pigeon Pea Based Cropping System under Rainfed Situations of Madhya Pradesh

Balkrishna Namdeo [a], H. S. Kushwaha [b], Dig Vijay Dubey [a], Shriman Kumar Patel [c*] and Neelash Patel [d]

[a] Department of Agronomy, Rabindranath Tagore University, Bhopal, M.P., India.
[b] Department of Natural Resource Management, Mahatma Gandhi Chitrkoot Gramodaya Vishwavidyalaya, Satna (M.P.), India.
[c] Department of Soil Science and Agricultural Chemistry, Rabindranath Tagore University, Bhopal, M.P., India.
[d] Department of Agricultural Statistics, Rabindranath Tagore University, Bhopal, M.P., India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i232474

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/92135

Original Research Article

Received 02 August 2022
Accepted 06 October 2022
Published 17 October 2022

ABSTRACT

A field experiment was conducted to evaluate the role of intercrops in respect of weed suppression and chemical methods for effective weed control in pigeon pea and green gram based intercropping systems.The aim of this stydy to assess the most suitable weed management practices for pigeonpea + green gram intercropping system.Results revealed that the relative density of dicot weeds was lower than the relative weed density of monocot weeds and did not show any significant effect on weed dynamics of pigeon pea and green gram based intercropping systems whereas, the application of Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha significantly minimum weed density, weed dry weight and maximum weed control efficiency recoreded compared to weedy plot at 25, 50 and 75 days after sowing (DAS). This might be due to reduction in weed competition.

Keywords: Herbicide; intercropping; weed dynamics; pigeon pea.

**Corresponding author: E-mail: shrimansoil@gmail.com;*

1. INTRODUCTION

Pigeon pea is one of the most important grain legume crops grown in tropical and subtropical areas. It is primarily grown in rainfed environments. Because pigeon peas are long-duration crop, intercropping is used to best utilise available water and land resources, increase risk tolerance, and enhance cost-benefit ratio. The system is now designed to utilise production resources efficiently, increase productivity per unit, and provide stability under challenging climatic conditions. The basic goal of intercropping is to maximise overall productivity per unit of space and time while also making wise and equitable use of available resources, such as labour and land. In addition to these, solepigeonpea suffers from a heavy weed infestation during the first eight weeks after sowing due to wide row and plant-to-plant spacing, the crop's poor early growth, frequent rains, and insufficient sunlight during the kharif season. During the first 60 days of its growth, the pigeonpea is particularly susceptible to weed competition, as it is a poor weed competitor. It is a wide-row crop that, due to the inadequate canopy cover during the initial growth stage, permits weeds to grow quickly and spreaddue to its shorter growing period, low water requirement, and low soil fertility as well as its preferred for eating, green gram may be one of the suitable crops for intercropping with pigeon pea [1]. With this view, present field experiment was undertaken with objectives to assess the role of intercrops in respect of weed suppression and compare non chemical and chemical methods for effective weed control in pigionpea based intercropping system.

2. MATERIALS AND METHODS

The field experiment was conducted at the Rajoula Research Farm, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) during *kharif* and *rabi* season of 2012-13 at GPS location latitude of 25.146889 and longitude 80.854036. The experimental soil was sandy loam having NPK status of 120 kg N, 15 kg P_2O_5 and 291 kg K_2O/ha with electrical conductivity 0.20 ds/m and soil pH 7.46 [2-4]. The treatments comprised two cropping systems (sole pigeonpea and pigeonpea + green gram 2:2 row ratio) the main plots and six weed management practices (weedy check, pendimethalin 1 kg ai/ha PE, oxyflyorfen 0.2 kg ai/ha PE, imazethapyr 0.1 kg ai/ha, postemer, pendimethalin + in azethapyr and oxyfluorfen + imazethapyr) in the sub-plots. The twelve treatment combinations were laid out in split plot design with three replications. Pigeonpea "ICPL 88039" and green gram "Samrat" were sown on 21 July 2012 keeping row to row 60 and 20 cm, and plant to plant 20 and 10 cm., respectively. The fertilizers were applied @ 20:60: 20 kg N: P_2O_5: K_2O/ha for both the crops. The observations on population of major weeds and other associated weeds were recorded at 25, 50 and 75 days after sowing by quadrate count method. The quadrate of $1m^2$ (1mx 1m) was randomly thrown at four places in each plot species wise weed count and total number of weeds m^2 were recorded. The percentage composition of weed flora was estimated from weedy check. The relative density of weeds was worked out as per formula at 25 DAS.

Relative density (%) = (Number of individuals of the same species / Number of individuals of all species) X 100

2.1 Weed Dry Matter

Dry weight was worked out by placing a quadrate of $1m^2$ at four places randomly in each plot weed species were removed outside of the net area of each plot at 75 DAS. The weeds were kept in paper bags species wise and dried in oven at oven drying (70 ± 1^0C) and weighted after 48-54 hours till the constant weight was achieved. Dry weight was recorded on electronic balance in g/m^2.

2.2 Weed Control Efficiency

The total weed biomass obtained before harvest was utilized to determine the weed control efficiency of various treatment using the following formula.

$$\text{Weed Control Efficiency (WCE)} = \frac{W_0 - W_1 \text{ X } 100}{W_0}$$

Where:-

W_0 = Weeds dry weight in control weedy plots (g)
W_1 = Weed dry weight in treated plots (g)

3. RESULTS AND DISCUSSION

3.1 Associated Weed Flora

The weed flora associated with the crops are found in experimental field is shown in Table-1

according to their botanical names, family and nature of cotyledons. *Amongst monocots, Cyperusrotundus* L (perenial Sedge)*; Cynodondactylon* (grassy weed) were observed in the experimental area. The associated annual dicot weeds were *Convolvulus arvensis* (perenial) also observed. Such associated weed problems might be because of the experimental field was fallow during past season and this favours the growing of kharif and rabisedgse and other propagules growing weeds (eg. *Cyprus routundus, cynodondactylen* etc.). Similar weeds were also found by [5,6].

3.2 Weed Population and Relative Weed Density

Pigeon pea and green gram faced the problem of both types of weeds viz. monocot (grassy) as well as dicot weeds during crop season. Total weed population and relative density of weedy control plots at 25, 50 and 75 DAS are presented in Table 2. Perusal of the data revealed that monocot and dicot both weeds dominating during early crop season. The population of grassy weeds was 105.24/m^2 while dicot weeds were to the magnitude of 79.67/m^2 at 25 DAS. The relative density of dicot weeds was lower than the relative weed density of monocot weeds. Among the monocot weeds, the highest relative density was noted in *Echinocloa spp.* (31.41 %), *Cyprus rotundus* L (12.18 %) and lowest in *Sorghum halepense* (3.00 %). Among the dicot Weeds, *Digeraarvensis* (22.65 %) had the highest relative density followed by *Convolvulus arvensis* L. (8.84 %) and it was lowest was in case of *Amaranthusvirdis*(4.75 %)*.*The primary stage of slow growing nature, long and short height of pigeon pea and green gram may be responsible for the weed infestation. Similar observation was also noted by [7,8].

3.3 Total Weed Population

Weed control measure significantly affected to the weed density/m^2 of pigeon pea and green gram field (Appendix II). A perusal of data Table-3 revealed that higher number of weeds/m^2 was recorded during early stage of crop and it decreases with advancement in age of crop growth. At 25 DAS, weed density/m^2 was lowest in those treatments which had applied W_5: Pendimethalin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha gradually lower at 50 and 75 days' stages of crop while, the weed density of control plot was higher till 90 days' crop stages, while, Maximum values were observed in control. This might be due to persistence nature of pre-emergence herbicides. Due to slow initial growth of pigeon pea is unable to compete with weeds and fully utilize sunlight and available soil moisture at early growth stage provides an ample scope for emergence and growth of many annual weeds, which compete with crops [9]. The significantly lowest weed population in pigeon pea were recorded in the application of pendimethalin @ 0.75 kg a.i./ha PE + 1 HW after 50 DAS followed by oxyfluorfen @ 100g a.i./ha PE + 1 HW 50 DAS [10]. The significantly reduced weed density in pigeon pea when pendimethalin was applied@ 0.75 kg a.i./ha (PE) over control [11].

3.4 Total Dry Matter of Weeds

Weed dry matter (g/m^2) of pigeon pea + green gram field was significantly affected due to various weed control measures at all the stages of crop. Weed dry matter increased with advancement in age of the crop growth i.e. up to 50 days stage. Thereafter, it reduced with the crop age Table - 4. At 75 days stage, the weed dry weight reduced probably due to lower weed density and crop shedding effect on weed growth. The results showed that maximum weed dry matter in control plot (177.83, 243.83 and 186.67 g) and minimum weed dry matter in W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha (2.34, 15.04 and 11.63 g) at all the stage crop. Weed dry matter (gram/m^2) was significantly affected by different weed management practices at 25, 50 and 75 DAS. Here, significantly lower weed dry weight was recorded in the application of pendimethalin plot mainly due to the lowest weed counts and because of batter weed control in pre emergence application of this herbicide. These herbicides control the annual and broad leaf weeds. [12] reported that significantly lower dry weed weight in pigeon pea field were recorded in PRE application of pendimethalin @ 1.0 kg a.i./ha over weedy check found that [13]. Lowest weed dry weight of weed in pegion pea were secured under treatment of weed free followed by treatment of pendimethalin @ 0.75 kg /ha with one hand weeding at 45 days after sowing [14,15].

3.5 Weed Control Efficiency

Weed control efficiencies under different treatments was worked out and the analyzed data are presented in Table-5. The data showed that the weed control efficiency under different

intercropping treatment was statistically non-significant, but it was significantly affected by various weed management practices. Among the weed management practices, the weed control efficiency of (91.93, 87.4 and 80 per cent) were recorded highest under W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha at 25, 50 and 75 DAS, respectively followed by W_4: Imazethapyr @ 0.1 kg ai/ha at 25 and 50 DAS, while it was recorded maximum with W_6: Oxyfluorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha at 75 DAS.

Such higher weed control efficiencies might be due to use of integration of pre and post emergence weedicides for weed control. Similar findings were also reported by [16,17].

3.6 Seed Yield (Kg/ha)

Seed yield of pigeon pea sole (11.36.68 kg/ha) was recorded higher than I_1: sole pigeon pea (1119.67 kg/ha. In weed management, W_5: Pendimethelin @ 1.0 kg ai+ Imazethapyr @0.1 kg ai/ha (1126.77 kg/ha) gave significantly higher seed yield than rest of weed management treatments and is at par with W_6: Oxyflorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha post emergence (1311.80 kg/ha). Minimum seed yield was recorded in weedy check treatment. This could be ascribed due to greater value of growth parameter i.e. plant height, plant dry weight, nodules/plant and their dry weight and yield attributes, pods/plant. Such trend might be due to better spatial arrangement of pigeon pea under sole as well as inter cropping system with 2:2 row ratios. The row ratio of pigeon pea + green gram could be associated with least completion of main crop pigeon pea with intercrop green gram [18]. In weed management, these seed yields of pigeon pea were obtained significantly greater under the treatment W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha followed by W_6: Oxyfluorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha post emergence. The higher seed yield might be due to significantly greater yield attributes and better growth environments. Such enhancement might be due to least completion between crop plant and weeds which resulted better interception and utilization of radiant energy leading to higher photosynthesis and finally improvement yield of pigeon pea. The results confined to the findings of [19].This might be due herbicide treated plot have comparatively higher weed control over untreated control plots. This may also facilitate the better availability of moisture, nutrients and solar energy reflecting in higher vegetative growth. Similar finding was also established by [20] in pigeon pea. The significantly higher grain yield of pigeon pea in pendimethalin 0.75 kg a.i./ha as pre emergence followed by 0.45 kg a.i./ha. Similar result was recorded by [21] reported that significantly highest yield and yield attributes of pigeon pea were recorded in PRE application of pendimethalin @ 1000 g a.i./ha followed by imazethapyr @ 75 g a.i./ha at 45 DAS, imazethapyr @ 100 g a.i./ha at 45 DAS. These findings are in agreement with the present investigation.

Table 1. Associated weed flora at 25 DAS

S. No.	English Name	Botanical Name	Family
	Monocot Weeds		
1.	Johnson Grass	*Sorghum halepense*	Poaceae
2.	Doob Grass	*Cynodondactylon*	Graminae
3.	Nutgrass/ purple nut sedge	*Cyprus rotundus* L.	Cypraceae
4.	Sanwa grass	*Echinocloa spp.*	Poaceae
5.	Swollen finger grass	*Chloris barbata*	Poaceae
	Dicot weeds		
1.	Field bind weed	*Convolvulus arvensis* L.	Convolvulaceae
2.	JangliGobhi	*LauneaAsplenpfolia*	Compositae
3.	Pig weed	*Amaranthusvirdis*	Amaranthaceae
4.	Chaff plant	*Digeraarvensis*	Amaranthaceae

Table 2. Composition of weed flora (weedy control plot) expressed in terms of relative density (%) at 25, 50 and 75 DAS

S. No.	Weed species	25 DAS		50 DAS		75 DAS	
		Weed population/ m^2	Relative density (%)	Weed population/ m^2	Relative density (%)	Weed population/ m^2	Relative density (%)
	Monocot Weeds						
1.	*Sorghum halepense*	5.54	3.00	7.55	4.48	20.98	13.15
2.	*Cynodondactylon*	11.52	6.23	10.35	6.14	19.85	12.45
3.	*Cyprus rotundus* L.	22.53	12.18	21.52	12.77	21.54	13.51
4.	*Echinocloa spp.*	58.11	31.43	41.2	24.45	21.54	13.51
5.	*Chloris barbata*	7.54	4.08	10.65	6.32	20.44	12.82
	Dicot weeds						
1.	*Convolvulus arvensis* L.	16.34	8.84	20.98	12.45	11.12	6.97
2.	*Commelinabengalensis*	12.65	6.84	10.98	6.52	13.54	8.49
3.	*Amaranthusvirdis*	8.79	4.75	9.56	5.67	17.34	10.87
4.	*Digeraarvensis*	41.89	22.65	35.69	21.18	13.14	8.24
	Total	**184.91**	**100.00**	**168.48**	**100.00**	**159.49**	**100.00**

Table 3. Effect of intercropping and weed management practices on weed density

Treatment	Weed density (no. of weeds/m^2)		
	25 DAS	**50 DAS**	**75 DAS**
Cropping system			
I_1: sole pigeon pea	57.56	64.61	99.33
I_2: pigeon pea + green gram (2:2)	53.39	57.78	99.28
SEm ±	**0.77**	**1.43**	**9.63**
CD (P=0.05)	**NS**	**NS**	**NS**
Weed management			
W_1: Weedy check	189.33	180.83	163.50
W_2: Pendimethalin @ 1kg ai/ha	36.17	53.67	146.50
W_3: Oxyfluorfen @ 0.2 kg ai/ha PE	43.67	53.00	112.17
W_4: Imazethapyr @ 0.1 kg ai/ha	24.33	29.50	87.17
W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha	15.83	13.83	39.67
W_6: Oxyfluorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha	23.50	36.33	46.83
SEm ±	**1.93**	**9.70**	**18.01**
CD (P=0.05)	**5.68**	**28.60**	**53.13**

Table 4. Effect of weed management and intercropping practices on weed dry matter

Treatment	Weed dry matter (g)		
	25 DAS	50 DAS	75 DAS
Cropping system			
I_1: sole pigeon pea	58.61	127.56	94.39
I_2: pigeon pea + green gram (2:2)	51.33	101.06	103.61
SEm ±	**1.68**	**11.14**	**5.44**
CD (P=0.05)	**NS**	**NS**	**NS**
Weed management			
W_1: Weedy check	177.83	243.83	186.67
W_2: Pendimethalin @ 1kg ai/ha	37.67	107.67	148.00
W_3: Oxyfluorfen @ 0.2 kg ai/ha PE	48.00	156.00	105.17
W_4: Imazethapyr @ 0.1 kg ai/ha	24.33	64.33	77.67
W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha	14.50	28.00	34.50
W_6: Oxyfluorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha post emergence	27.50	86.00	42.00
SEm ±	**2.34**	**15.04**	**11.63**
CD (P=0.05)	**6.91**	**44.38**	**34.32**

Table 5. Weed control efficiency under different cropping system and weed management practices

Treatment	Weed control efficiency		
	25 DAS	50 DAS	75DAS
Cropping system			
I_1: sole pigeon pea	68.36	42.24	39.24
I_2: pigeon pea + green gram (2:2)	69.79	61.38	49.70
SEm ±	**0.70**	**7.01**	**4.40**
CD (P=0.05)	**NS**	**NS**	**NS**
Weed management			
W_1: Weedy check	0.00	0.00	0.00
W_2: Pendimethalin @ 1kg ai/ha	78.75	52.79	18.23
W_3: Oxyfluorfen @ 0.2 kg ai/ha PE	72.82	34.22	38.45
W_4: Imazethapyr @ 0.1 kg ai/ha	86.36	73.33	55.71
W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha	91.93	87.40	80.00
W_6: Oxyfluorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha post emergence	84.60	63.12	74.44
SEm ±	**0.88**	**5.97**	**4.71**
CD (P=0.05)	**2.61**	**17.61**	**13.88**

Table 6. Effect of weed management and intercropping practices on seed yields of pigeon pea and green gram

Treatment	Seed yield of pigeon pea (kg/ha)	Seed yield of green gram (kg/ha)
Cropping system		
I_1: sole pigeon pea	1136.68	0.00
I_2: pigeon pea + green gram (2:2)	1119.67	738.09
SEm ±	**9.65**	**15.59**
CD (P=0.05)	**NS**	**17.92**
Weed management		
W_1: Weedy check	917.70	535.18
W_2: Pendimethalin @ 1kg ai/ha	1151.38	796.29
W_3: Oxyflorfen @ 0.2 kg ai/ha PE	1027.08	544.29
W_4: Imazethapyr @ 0.1 kg ai/ha	1034.37	698.14
W_5: Pendimethelin @ 1.0 kg ai + Imazethapyr @0.1 kg ai/ha	1326.73	979.62
W_6: Oxyflorfen @ 0.2 kg ai/ha PE + Imazethapyr @0.1 kg ai/ha post emergence	1311.80	874.99
SEm ±	**20.10**	**19.20**
CD (P=0.05)	**59.28**	**56.65**

4. CONCLUSION

On the basis of results obtained from the experiment, it can be concluded that weed can be managed efficiently by application of the pre-emergence weedicide such as Pendimethelin @ 1.0 kg ai with post emergence weedicide Imazethapyr @0.1 kg ai/ha (W_5) or by pre-emergence weedicide Oxyfluorfen @ 0.2 kg ai/ha with post emergence weedicide Imazethapyr @ 0.1 kg ai/ha ((W_6). These weedicides were found efficient in controlling weeds and in relation to higher yield attributes, seed and straw yield of pigeon pea and green gram and gross return, net return of pigeon pea and green gram.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dhandayuthapani MM, Padmaja B, Rao LJ. Response of rabipigeonpea to irrigation scheduling and weed management in Alfisols. Journal of Food Legumes. 2015; 21 (4): 237-239.
2. Subbaiah BV. A rapid procedure for the estimation of available nitrogen in soils. Curr. Science.1956;25:259-260.
3. Olsens SR, Cole EV, Watanable FS, Dean LA. Estimation of available phosphorus in soil by extraction with $NaHCO_3$. Cri.U.S. Dep. Agric 939.1954.
4. Hanway JJ. Soil analysis method as used in lowa state college. Soil testing laboratory. Lowa Agriculture. 1952;57: 1-31.
5. Tomar JS, Vivek HB,Tripathi SS. Integrated weed management in intercropping of mungbean (Vignaradiata) and cowpea fodder (Vignaunguiculata) with pigeonpea (Cajanuscajan) under western U. P. condition. Indian Journal of Weed Science. 2007; 36(1/2) :133-134.
6. Bhengra S, Jerai MC, Kandeyang S, Pandey AC. Study on Integrated Weed Management of Pigeon Pea (*CajanusCajan* L. Millsp) at Kanke Block, Ranchi–A Case Study. Serial publication. 2010; 28 (1): 1-2.
7. Dangi BL. A study on integrated weed management and pigenpea [*Cajanuscajan* (L) Millsp] + black gram [*Vignaraditata* (L) Millsp] intercropping system in Kymore Plateau of Madhya Pradesh. Thesis (M. Sc. Ag. Agronomy). MGCGVV, Chitrakoot, Satna (M.P.); 2012.
8. Kaur R, Raj R, Das TK, Shekhawat K, Singh R, Choudhary K. Weed management in pigeonpea-based cropping systems. Indian Journal of Weed Science. 2015;47(3):267–276.
9. Kumar A, Dhaka AK, Kumar S, Singh S, Singh A. Influence of imidazolinones alone and in combination on pigeon pea (*Cajanuscajan* L.) Indian Journal of Agricultural Sciences. 2020;90(7):1319-22.
10. Rao PV, Reddy AS, Rao YK. Effect of integrated weed management practices on growth and yield of pigeonpea [*Cajanuscajan* L.] International Journal of Plant, Animal and Environmental Sciences. 2015;5(3):124-127.
11. Singh AK, Singh RS, Singh R, Kumawat N, Singh NK, Singh SP, et al. Effect of weed management on weed interference and production potential of long duration pigeonpea (*Cajanuscajan* L.) under irrigated ecosystem. International Journal of Current Microbiology and Applied Sciences. 2020;9(1):676-689.
12. Chavan AS, Raj VC, Waghmare PK. Residues studies of pendimethalin and other herbicides in pigeon pea field through bioassay technique. International Journal of Current Microbiology and Applied Sciences. 2018; 6:1866-1873.
13. Chandrakar S, Raj VC, Chandrakar M. Effect of weed management on weeds and yield of chickpea varieties under south Gujarat conditions. Trends in Biosciences. 2018;11(3):383-385.
14. Kumar A, Dhaka AK, Kumar S, Singh S, Punia SS. Weed management indices as affected by different weed control treatments in pigeon pea [*Cajanuscajan* L.] Journal of Pharmacognosy and Phytochemistry. 2019;8(3):3490-3494.
15. Padmaja B, Reddy MM, Vishnu VR. Weed control efficiency of pre-and post-emergence herbicides in pigeonpea. Journal of food legumes. 2013;26 (1) 44-45.
16. Nirala H, Choubey NK. Sandeep B. Performance of post-emergence herbicides and hand weedings with respect to their effects on weed dynamics and yields of blackgram (*Vigna mungo L.*). International Journal of Agricultural and Statistical Sciences. 2012;8(2):679-689.

17. Rao PV, Reddy AS, Rao YK. Effect of integrated weed management practices on growth and yield of pigeonpea [*Cajanuscajan* L.] International Journal of Plant, Animal and Environmental Sciences. 2015;5(3):124-127.
18. Hemlata N, Dewangan DK. Effect of weed management on weeds, growth and yield of kharifblackgram (*Vigna mungo* L.). Journal of Interacademicia. 2012; 16 (4): 835-844.
19. Rai CL, Tiwari RK, Sirothia P, Pandey S. Intercropping and weed management effects on weed dynamics, productivity and economics of pigeon pea. Indian Journal of Weed Science. 2016;48(1):44-47.
20. Khanna, Veena Singh, Guriqbal Sharma, Poonam, Kaur Harpreet. Influence of Herbicides on Rhizobium Growth and its Symbiosis with Pig eon pea, Trends in Biosciences. 2012;5(2):133-135.
21. Sekhon AS, Kadam GL, Karande DR, Jogdand PB. Integrated weed management in pigeonpea [*Cajanuscajan (L.) Mills*p.]. International Journal of Agriculture Science. 2013;4(1):363-370.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/92135