Research Article

Effect of Herbicides on Weed Control Measures of Cotton Crop

Nidhi Rai[1], S. K. Choudhary[1], Sonal Athnere[2], Aakash[1] and Vijay Jamodkar[1]

[1]Department of Agronomy, RVSKVV, College of Agriculture, Indore
[2]Department of Agronomy, MPUAT, Udaipur

Abstract

An agronomic investigation was carried out at IFSR, Project, College of Agriculture Farm, Indore (M.P.) during *Kharif* 2018. The experiment was laid out in RBD (Randomized block design) with three replications. The experiment consists of eight treatments i.e. T_1- metolachlor 50% EC @800g a.i./ha as pre-emergence, T_2- metolachlor 50% EC @1000 g a.i./ha. as pre-emergence, T_3- metolachlor 50% EC @1200 g a.i./ha. as pre-emergence, T_4- metolachlor 50% EC @2000g a.i./ha. as pre-emergence, T_5- diuron 80% EC @1500g a.i./ha. as pre-emergence, T_6- pendimethalin 30% EC@1250 g a.i./ha. as pre-emergence, T_7- hand weeding at 20&40 DAS, T_8- weedy check. The experimental results revealed that treatment T_7 (hand weeding at 20&40 DAS) recorded maximum number of boll plant^{-1} (34.73), weight boll^{-1} (4.82 g), seed cotton yield (1117.07 kg ha^{-1}), stalk yield (2792.67 kg ha^{-1}), ginning percentage (34 %), gross income (Rs. 58925 ha^{-1}), net income (Rs. 23983 ha^{-1}) and Benefit:cost ratio (1.69). It was followed by with treatment T_2 (metolachlor 50% EC @1000 g a.i./ha. as pre-emergence) i.e. number of boll plant^{-1} (31.50), weight boll^{-1} (4.37 g), seed cotton yield (918.68 kg ha^{-1}) stalk yield (2296.70 kg ha^{-1}), ginning percentage (33.50 %), gross income (Rs. 48460 ha^{-1}), net income (Rs. 19398 ha^{-1}) and Benefit:cost ratio (1.67).

Keywords: Weed control, Cotton, Yield, Economics

***Correspondence**
Author Email:
nidhirai055@gmail.com

Introduction

Cotton (*Gossypium hirsutum L.*) is one of the predominant fiber crop and plays a pivotal role in agriculture, industrial development, employment generation and economic development of lndia. Cotton, the king of fiber, is one of the momentous and an important cash crop exercising profound influence on economics and social affairs of the world. Any other fiber crop cannot compare with cotton for its fiber quality. Due to this significant importance cotton is also known as, "White Gold". Cotton is one of the most popular crops among farmers of the world. It is one of the few crop species that were domesticated in both the old and new World possessing great importance as a multipurpose crop that supplies five basic products: lint, oil, seed meal, hulls and linters. Even today, it occupies an outstanding position in the textile industry despite of the pressure of manmade fiber and blended fiber. In India, cotton is planted in about 122.35 lakh hectares of land and it occupies second position in production with 377 lakh bales among all cotton producing countries in the world i.e. next to China. Average productivity of cotton in India is 524 kg ha^{-1} which is low as compared to world average of 733 kg ha^{-1}. It is cultivated in 5.99 lakh ha area with total production of 20.30 lakh bales with the productivity of 568 kg ha^{-1} in Madhya Pradesh. [1]. Chemical control of weed is an efficient method, but environment concerns and resistance developed in weed against herbicides, its use cannot be promoted. There is also demanded for chemical free cotton worldwide because of increasing skin and other diseases in human. The pre-emergence herbicides like alachlor, fluchloralin, pendimethalin and metolachlor have been recommended for weed control in cotton and are being used by the farmers since long. Hand weeding or hand hoeing is the most efficient mean to control weeds in cotton, but it is time consuming and difficult due to unavailability of labourers during peak period of demand and difficulty in use of mechanical means of weeds management due to rains which causes more problem [2]. The seed cotton production per unit area is affected by a number of factors including weeds. Weed infestation is considered one of major risk factors in cotton production. The weeds compete with main crop for moisture, light, space and all soil and applied nutrients, hence check the crop growth and result in reduced production per unit area. Depending upon the nature, density of weeds and severity of in competition, losses in seed cotton yield ranged from 40 to 70 percent. Pre emergence herbicides are generally applied after planting cotton but prior to weed and cotton emergence for residual weed control. Metolachlor can be sprayed on the soil surface (avoiding contact with cotton foliage and stems) and immediately incorporated with a rolling cultivator. However, keeping in view these points the present study was taken under consideration.

Materials and Methods

The experiment was laid out at IFSR Project, College of Agriculture Farm, Indore (M.P.) during the *kharif* season of 2018, which is situated in between 22.43^{0}N latitude and 75.56^{0}E longitudes with an altitude of 555.5 meters above from the mean sea level. This region enjoys sub tropical semi arid type climate with an average rainfall of 941 mm most of which is received during mid June to middle of September. Weekly mean value of maximum temperature varied from 25.36^{0}C to 38.21^{0}C during crop growing period. At the time of sowing and germination and also towards maturity of crop it was relatively high. The experiment was laid out in RBD (Randomized block design) with three replications. The experiment consists of eight treatments i.e. T_1- metolachlor 50% EC @800g a.i./ha as pre-emergence, T_2- metolachlor 50% EC @1000 g a.i./ha. as pre-emergence, T_3- metolachlor 50% EC @1200 g a.i./ha. as pre-emergence, T_4- metolachlor 50% EC @2000g a.i./ha. as pre-emergence, T_5- diuron 80% EC @1500g a.i./ha. as pre-emergence, T_6- pendimethalin 30% EC@1250 g a.i./ha. as pre-emergence, T_7- hand weeding at 20&40 DAS, T_8- weedy check.

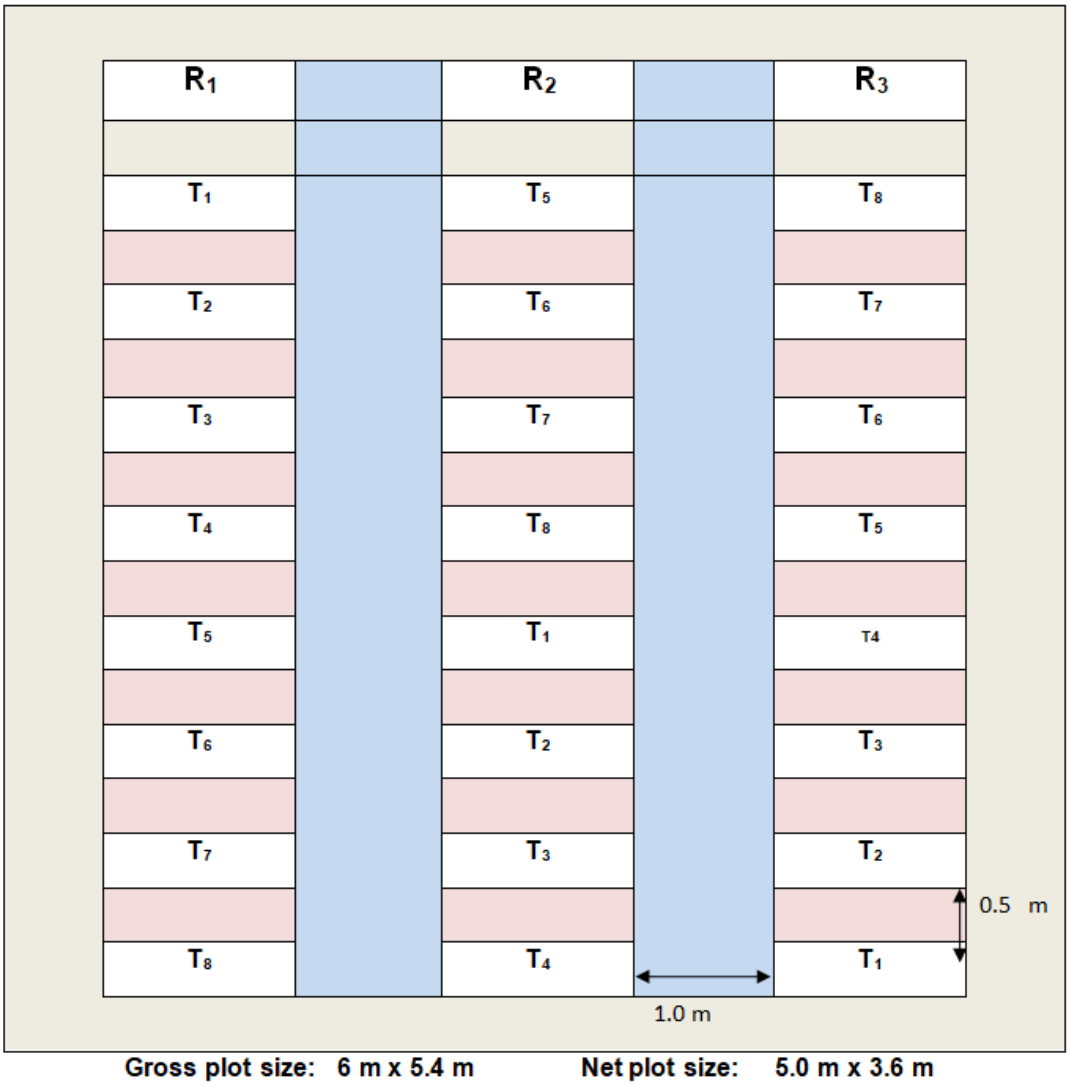

Figure 1 Layout of experiment [3]

For sowing of cotton, variety " Rasi RCH 2 (BG-II)" was sown at spacing of 90×60(cm). The fertilizer dose of nitrogen, phosphorus and potash were applied through urea, single super phosphate and muriate of potash, respectively. Number of bolls and boll weight per plant was recorded from 5 tagged plants of each plot at the time of picking. Seed cotton yield was recorded from the plots at the time of picking by weighing the seed cotton received from each plot. The stalk yield per plot was obtained from cut or uprooted cotton plants after completion of all pickings. This was later on convert into kg per hectare. Treatment wise composite samples were taken to assess the ginning percentage (GP). This is the ratio of lint to seed cotton expressed as percentage and can be calculated by the following formula:

$$GP = \frac{\text{Lint weight}}{\text{Seed cotton weight}} \text{ x100}$$

Result and Discussion

Yield and yield attributes

Number of bolls plant^{-1} and Weight of bolls plant^{-1} (g)

The result revealed that the number of bolls was recorded minimum of 22.83 under weedy check plots. The maximum number of bolls (34.73) was recorded with the hand weeding followed by application of metolachlor at the different dose (1000 and 800g a.i./ha) i.e. 31.50 and 29.03 respectively. However, application of metolachlor (800g a.i./ha) were at par with application of metolachlor at (1200 g a.i./ha) and pendimethalin (1250g a.i./ ha). Similarly, application of metolachlor at dose (2000g a.i./ha) was at par to application of diuron (1500g a.i./ha). The maximum number of bolls was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton. The weight of bolls was recorded minimum of 3.17 (g) under weedy check plots. The maximum weight of bolls (4.82 g) was recorded with the hand weeding followed by application of metolachlor at the different dose (1000 and 800g a.i./ha) i.e. 4.37 g and 4.03 g respectively. However, application of metolachlor (800g a.i./ha) were at par with application of metolachlor at (1200 g a.i./ha) and pendimethalin (1250g a.i./ ha). Similarly, application of metolachlor at dose (2000g a.i./ha) was at par with application of diuron (1500g a.i./ha) (**Table 1**). Hand weeding treatments shown maximum number of boll plant^{-1} and boll weight followed by application of metolachlor at the different dose (1000 and 800g a.i./ha). However, application of metolachlor (800g a.i./ha) were at par with application of metolachlor at (1200 g a.i./ha) and pendimethalin (1250g a.i./ ha), while rest of the treatment shown significantly less number of bolls plant^{-1} and boll weight. Among the weed control treatments the higher number of bolls plant^{-1} and boll weight beard by application of metolachlor (1000g a.i./ha) treatment which might be more congenial conditions prevailed by the plant throughout growing season as compared to all rest treatments [4-9].

Table 1 Effect of different weed control measures on yield attribute and yield of cotton

Treatments	Number of boll plant^{-1}	Weight boll^{-1} (g)	Seed cotton yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Ginning (%)
T_1 Metolachlor 50% EC @ 800 g a.i/ha.Pre-emergence	29.03	4.03	780.39	1950.96	33.30
T_2 Metolachlor 50% EC @ 1000 g a.i/ha.Pre-emergence	31.50	4.37	918.68	2296.70	33.50
T_3 Metolachlor 50% EC @ 1200g a.i/ha.Pre-emergence	28.27	3.93	740.87	1852.18	33.00
T_4 Metolachlor 50% EC @ 2000 g a.i/ha.Pre-emergence	26.23	3.64	637.34	1593.36	32.40
T_5 Diuron 80 % EC @ 1500 g a.i./ha.as Pre-emergence	26.79	3.72	665.72	1664.29	32.50
T_6 Pendimethalin 30% EC @ 1250 g a.i./ha.as pre-emergence	27.49	3.82	701.69	1754.23	32.77
T_7 Hand weeding at 20 &40 DAS	34.73	4.82	1117.07	2792.67	34.00
T_8 Weed check	22.83	3.17	499.90	1207.26	32.00
SEm±	0.51	0.07	26.05	65.12	0.41
CD at (0.05)	1.54	0.21	78.84	197.09	NS

Seed cotton yield (kg ha^{-1})

The seed cotton yield was recorded minimum of 499.90 kg ha^{-1} under weedy check plots. The maximum seed cotton yield (1117.07 kg ha^{-1}) was recorded with the hand weeding followed by application of metolachlor at the different dose (1000 and 800g a.i./ha) i.e. 918.68 kg ha^{-1} and 780.39 kg ha^{-1} respectively. However, application of metolachlor (800g a.i./ha) were at par with application of metolachlor at (1200 g a.i./ha) and pendimethalin (1250g a.i./ ha). Similarly, application of metolachlor at dose (2000g a.i./ha) was at par to application of diuron (1500g a.i./ha). The maximum seed cotton yield was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton (Table 1). It means performance of hand weeding with application of metolachlor (1000, 800 and 1200g a.i./ha) was better as compared to remaining herbicidal weed control treatments. The increased seed cotton yield in this treatment could be attributed to the higher accumulation of dry matter in bolls via efficient utilization of

growth resources and other environmental factors. This was consequence of reduced crop-weed competition due to good control of weeds. On the other hand, weedy check recorded lower seed cotton yield per hectare. This could be due to reduced dry matter accumulation due to inadequate translocation of metabolites to bolls due to severe competition for moisture, nutrients, light and space by weeds [10, 11].

Stalk yield (kg ha^{-1})

The stalk yield was recorded minimum of 1207.26 kg ha^{-1} under weedy check plots. The maximum stalk yield (2792.67 kg ha^{-1}) was recorded with the hand weeding followed by application of metolachlor at the different dose (1000 and 800g a.i./ha) i.e. 2296.70 kg ha^{-1} and 1950.96 kg ha^{-1}, respectivley. However, application of metolachlor (800g a.i./ha) were at par with application of metolachlor at (1200 g a.i./ha) and pendimethalin (1250g a.i./ ha). Similarly, application of metolachlor at dose (2000g a.i./ha) was at par to application of diuron (1500g a.i./ha). The maximum stalk yield was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton.

Ginning (%)

The ginning percent was recorded minimum of 32 % under weedy check plots. The maximum ginning (34 %) was recorded with the hand weeding followed by application of metolachlor at the different dose (1000 and 800g a.i./ha) 33.50 and 33.30%. A critical examination of the data revealed that the ginning percentage is concerned the various weed control treatments did not have hardly any effect. As all integrated weed control treatments were recorded almost similar ginning percentage [12-15].

Economics

Cost of cultivation (Rs ha^{-1})

The cost cultivation was recorded minimum of Rs. 26142 ha^{-1} under weedy check plots. The maximum cost cultivation Rs. 34942 ha^{-1} was recorded with the hand weeding followed by application of metolachlor at the different dose (2000 and 1200g a.i./ha) Rs. 30182 ha^{-1} and Rs. 29166 ha^{-1}. However, application of metolachlor (1200g a.i./ha) were at par with application of metolachlor at (1000 g a.i./ha), application of metolachlor (800g a.i./ha), diuron 80 % EC @ 1500 g a.i./ha and pendimethalin (1250g a.i./ ha). Similarly, application of metolachlor at dose (2000g a.i./ha) was at par to application of diuron (1500g a.i./ha). The higher cost of cultivation was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton. The higher cost of cultivation under treatment metolachlor 50% EC @ 1200 and 2000 g a.i/ha may be due to the cost of weedicides is just more in weed treatment [16, 17].

Gross return (Rs ha^{-1}), Net return (Rs ha^{-1}) and B:C ratio

The gross return was recorded minimum of Rs. 26349 ha^{-1} under weedy check plots. The maximum gross return Rs. 58925 ha^{-1} was recorded with the hand weeding followed by application of metolachlor at the different dose (1000, 800, 1200g a.i./ha) i.e. Rs. 48460 ha^{-1}, Rs. 41165 ha^{-1} and Rs. 39081 ha^{-1} respectively. The higher gross return was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton. The net return was recorded minimum of Rs. 207 ha^{-1} under weedy check plots. The maximum net return Rs. 23983 ha^{-1} was recorded with the hand weeding followed by application of metolachlor at the different dose (1000, 800, 1200g a.i./ha) i.e. Rs. 19398 ha^{-1}, Rs. 13007 ha^{-1} and Rs. 9915 ha^{-1},respectively. The higher net return was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton. The B:C ratio was recorded minimum of 1.01 under weedy check plots. The maximum B:C ratio 1.69 was recorded with the hand weeding followed by and at par to application of metolachlor at the different dose (1000g a.i./ha) i.e. 1.67. However, application of application of metolachlor (800g a.i./ha) 1.46 was at par with application of metolachlor (1200g a.i./ha) 1.34 and pendimethalin (1250g a.i./ ha) 1.31. Similarly, application of metolachlor (2000g a.i./ha) did not differed significantly to diuron 80 % EC @ 1500 g a.i./ha. The higher B:C ratio was recorded under hand weeding treatments, which proved superior over herbicidal treatments of cotton**.(Table 2)** [18-20]. In case of herbicidal weed control treatments, maximum B:C ratio was realized in Metolachlor 50% EC @ 1000, 800 and 1200g a.i/ha. Higher profitability in case of Metolachlor 50% EC @ 2000 g a.i/ha) was due to lower cost of cultivation and higher seed cotton yield [21].

Table 2 Effect of different weed control measures on economics of cotton.

Treatments		Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1	Metolachlor 50% EC @ 800 g a.i/ha Pre-emergence	28158	41165	13007	1.46
T_2	Metolachlor 50% EC @ 1000 g a.i/ha Pre-emergence	29062	48460	19398	1.67
T_3	Metolachlor 50% EC @ 1200g a.i/ha Pre-emergence	29166	39081	9915	1.34
T_4	Metolachlor 50% EC @ 2000 g a.i/ha Pre-emergence	30182	33620	3438	1.11
T_5	Diuron 80 % EC @ 1500 g a.i./ha as Pre-emergence	28823	35117	6293	1.22
T_6	Pendimethalin 30% EC @ 1250 g a.i./ha as pre-emergence	28308	37014	8705	1.31
T_7	Hand weeding at 20 &40 DAS	34942	58925	23983	1.69
T_8	Weed check	26142	26349	207	1.01
SEm±		204.12	267.26	20.41	0.06
CD at (0.05)		617.76	808.84	61.78	0.19

Conclusion

On the basis of one year experiment, it could be concluded that, Application of pre-emergence metolachlor 50% EC @ 1000 g a.i/ha. was found more remunerative in terms of yield, yield attributes, gross return, net return and B:C ratio than other weed control treatments.

References

[1] Annual report of AICCIP, CICR, Coimbatore. 2018 pp: 1-4

[2] A.H. Galal. 2003. Effect of weed control treatments and hill spacing on soybean and associated weeds, Assiut Journal of Agricultural Science, 34, 1, 15-32.

[3] N. Rai. 2019. To study the bio efficacy of metolachlor herbicide against the weed flora in cotton. M. Sc. (Agri.) Thesis, College of Agriculture, Indore, RVSKVV, Gwalior, Madhya Pradesh (India).

[4] K. S. Detroja, U. M. Damor, J. C. Patel, B. S. Patel and D. D. Malavia. 1992. Effect of chemical and cultural methods of weed control on yield and nutrient uptake in upland cotton, Indian J. Agron. 37, 876-878.

[5] M. Shivashenkaramurthy. 2000. Sequential application of herbicides for control of Cyperus rotundus and Cynodon dactylon L. Pers. in hybrid cotton. M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka (India). (unpublished)

[6] A. Velayutham, A.M. Ali and V. Veerabadran. 2002. Influence of intercropping systems and weed management practices on the growth and yield of irrigated cotton. Madras Agric. J. 89, 1-3, 59-62.

[7] R.G. Wilson, B.G. Young, J.L. Matthews, S.C. Weller, W.G. Johnson, D.L. Jordan, M.D. Owen, P.M. Dixon and D.R. Shaw. 2011. Benchmark Study on Glyphosate resistant Cropping Systems in the United States. Part 4: Weed Management Practices and Effects on Weed Populations and Soil Seed banks, Pest Management Science. 67, 7, 771–780.

[8] K. Singh and P. Rathore. 2015. Efficacy evaluation of selected herbicides on weed control and productivity evaluation of Bt cotton in Punjab, J Environ Biol. 36, 4, 993-8.

[9] G.S. Hargilas, S.C. Ameta and D.P. Saini. 2015. Evaluation of effective weed management strategy for BT cotton, The bioscan. 10, 3, 1313-1316

[10] Chhokar and Balyan. 1996. Control of weeds in cotton fields through herbicides, Journal of cotton research and development.13, 2, 205-208.

[11] J.E. Mofett and W.B. Mcclosky.1998. Effects of soil moisture and yellow nut sedge (Cyperus esculentus) density on cotton (Gossypium hirsutum L.), Weed Sci. 46, 2, 231-237.

[12] B. Asher, J. Keeling, P. A. Dotray. 2002. Weed Management in Transgenic and Non-Transgenic Cotton (Gossypium hirsutum) in the Texas High Plains, Texas Journal of Agriculture and Natural Resources. 15, 27-36.

[13] S. S. Punia, A. Yadav and S. Singh. 2005. Integrated weed management in American cotton (Gossypium hirsutum L.), Journal of cotton research and development.19, 2, 182-184.
[14] D. Muhammad, N. Muhammad, I. Afzal, R. Muhammad and A. Mian. 2009. Effect of mechanical and chemical weed control on the productivity of cotton, Pak. J. Weed Sci. Res. 15, 2-3, 117-122.
[15] W. J. Everman, S. B. Clewis, A. C. York and J. W. Wilcut. 2009. Weed control and yield with flumioxazin, fomesafen, and S-metolachlor systems for glufosinate resistant cotton residual weed management, Weed Technology. 23, 391-397.
[16] G. Srinivasan. 2005. Bio efficacy of new herbicide molecule on weed control in summer irrigated cotton (Gossypium hirsutum), Journal of cotton research and development. 19, 2, 194-196.
[17] P. L. Rani, M. Yakadri and T. Ramprakash. 2016. Effect of Integrated Weed Management Practices on Growth and Yield of Bt-Cotton in Telangana State, India, Int.J.Curr.Microbiol.App.Sci. 5, 2, 17-25.
[18] K. Das, B. Guha, and A.S.N. Zaman. 2008. Productivity and profitability of tossa jute (corchorus olitorius) under different weed management practices in jute-toria cropping system, Madras Agric. J. 95, 7-12, 353-358.
[19] J. S. Aulakh, A. J. Price and K. S. Balkcom. 2011. Weed management and cotton yield under two row spacings in conventional and conservation tillage systems utilizing conventional, glufosinate resistant and glyphosate based weed management systems, Weed Technology. 25, 4, 542–547.
[20] P. Neve, J.K. Norsworthy, K.L. Smith and I.A. Zelaya. 2011. Modeling glyphosate resistance management strategies for palmer amaranth (Amaranthus palmeri) in cotton, Weed Technology. 3, 25, 335–343.
[21] G. Prabhu, A. S. Halepyati, B. T. Pujari and B. K. Desai. 2012. Weed management in Bt cotton (Gossypium hirsutum L.) under irrigation, Karnataka J. Agric. Sci. 25, 2, 183-186.

Publication History
Received 20.07.2020
Revised 07.12.2020
Accepted 17.12.2020
Online 30.03.2021