Original Research Article

INFLUENCE OF CHEMICAL WEED MANAGEMENT PRACTICES ON YIELD, NUTRIENT UPTAKE AND BALANCE IN SOIL OF HIGH DENSITY PLANTING COTTON IN DEEP *VERTISOLS*

ABSTRACT

Field experiment was conducted in 2017 and 2018 with an objective to evaluate efficiency of Clomazone 50 EC on seed cotton yield, nutrient uptake and balance in high density planting (HDP) cotton in deep *Vertisols* of Northern Karnataka. Treatment consists of pre-emergence application of Clomazone 50 EC at 250, 500 and 750 g *a.i.*ha^{-1} compared with pendimethalin 37.5 CS@680 g *a.i.*ha^{-1}, post-emergence herbicides pyrithiobac sodium 10 EC and quizalofop ethyl hand weeding at 25 DAS and intercultivation at 50 and 75 days, weed free and unweeded control. Experiment was laid out in randomized block design with replicated thrice. Results showed that application of Clomazone 50 EC @ 250 g *a.i.* ha^{-1} was found effective to control weeds and increased the seed cotton yield (38.5%). It was resulted in effective control weeds, least nutrient uptake by weeds and greater by the crop. Further it also results in least nutrient losses in the form of uptake and losses. Results suggested application of Clomazone 50 EC @ 250 g *a.i.*ha^{-1} pyrithiobac sodium 10 EC 75 g ai/ha + Quizalofop ethyl 5 EC @ 75 g ai/ha at 25 DAS was found effective to manage weeds in cotton.

Keywords: Cotton, Herbicide, Nutrient balance, Nutrient uptake by weeds

Competing Interest: We declared that there was no competing interest exists.

INTRODUCTION

Karnataka stands eighth in cotton area (5.46 lakh ha) and seventh in production with (18.0 lakh bales) with an average productivity of 560 kg lint ha^{-1} (Anon., 2018). Among different agronomic manipulations that would influence the productivity of cotton,

management of weeds is considered to be critical for achieving higher productivity (Manalil *et al.,* 2017). Weeds primarily compete for nutrients, moisture and sunlight during the early crop growth period than at later stage. Weeds consume 5-6 times of N, 5-12 times of P and 2 to 5 times of K more than cotton crop at the early crop growth (Mahar *et al.,* 2007) and could be very destructive for cotton production systems. The critical period of weed competition in cotton was found to be 15 to 60 days (Sharma, 2008). Thus, if proper weed control measures are followed, there would be greater availability of nutrients and moisture for the benefit of crop. Weeds in cotton field can be effectively affecting its growth at the early germination stage itself by the use of suitable herbicide. They are capable of giving the crop a relatively better weed free situation in the early stage of crop. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to an extent 50-85 per cent (Venugopalan *et al.,* 2009). Thus, if proper weed control measures are followed, there would be greater availability of nutrients and moisture for the benefit of crop (Jalis and Shah, 1982). Cotton with minimal weed competition during the initial phase *i.e.*, three to five weeks would yield better. Thus, there is need for selection of new molecules of pre-emergence to control weeds during initial crop period. This study was conducted to evaluate the effect of weed control practices on nutrient uptake in HDPS cotton.

MATERIAL AND METHODS

Experiment was conducted for two consecutive years 2017-18 and 2018-19 at Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Raichur. The experiment was laid out in Randomized Completely Block Design with three replications. The soil of the experimental site was medium black with clay loam texture. The treatments were allotted at random in each replication. The weed management practices evaluated in the present study consisted of chemical weed control by application of pre-emergence on the day of sowing and post-emergence herbicides were applied 20 days after sowing), Hand weeding was done at 25 DAS and intercultivation at 50 and 75 DAS and unweeded control.

The weed management practices including Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE followed by (*fb*) HW at 25 DAS and IC at 50 and 75 DAS, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50, 75 DAS, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} at 25 DAS as POE, Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as POE, Pendimethalin

38.7 CS @ 680 g *a.i.* ha^{-1} as PE fb pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as POE, One HW at 25 DAS and IC at 50 and 75 DAS, weed free check and unweeded control. Cotton variety Suraj was selected for the study during both the seasons. seeds were sown at 90 cm x 30 cm spacing in a high density planting. Clomazone 50 EC @ 250, 500 and 750 g *a.i.* ha^{-1} as PE, Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE were sprayed on the day of sowing, pyrithiobac sodium 10% EC 62.5 g ha^{-1}+ quizalofop-p-ethyl 5% EC 50 g ha^{-1} were sprayed at 25 DAS as POE. Weed free check and an unweeded check. The weed samples collected for estimation of dry matter production at maturity used for nutrient analysis. The crop samples were ground using Willey mill and used for estimation of N, P and K to work out t uptake of major nutrients.

Nutrient uptake (kg ha^{-1})

Nitrogen content (%) in the plant and weed samples was estimated by the micro Kjeldahl method using Kelplus N analyser after digesting the samples with H_2SO_4 and H_2O_2 (Piper,1966). For phosphorus estimation the tri-acid (HNO_3, $HCLO_4$ and H_2SO_4) in the ratio of (9:3:1) respectively digested plant and weed samples were analyzed by Vanado-molybdo phosphoric acid. The intensity of yellow colour developed was measured by using spectrophotometer at 420 nm (Piper, 1966). Potassium content in the tri-acid was determined with flame photometer (Piper, 1966).

Nutrient uptake = Nitrogen / phosphorus / potassium of plant parts / weeds x weight of seed cotton yield (kg ha^{-1}) / weeds weight

Data analysis

Analysis of variance (ANOVA) for the randomized complete block design was performed to determine the effect of time and rate of application of herbicides on weed species, lit yield and nutrient uptake by weeds and crop. If the ANOVA for the multi-year combined data showed a significant effect between treatments and years, a separate ANOVA was conducted for each individual year by using SAS 9.3 (SAS Inst., Cary, NC, USA 2008) was used for all analyses.

RESULTS AND DISCUSSION

Weed Flora at experimental site

The weed flora observed in both the soils was recorded. In the red soil, among the

grasses *Cynodon dactylon*, *Rottboellia exaltata*, *Dactyloctenium aegyptium* and *Dinebraretro flexa* were noticed. *Cyperus rotundus* was the only sedge present in the field. Among the broad leaved weeds, *Parthenium hysterophorus*, *Euphorbia geniculata*, *Trianthema portulaca strum*, *Trichodesma indica*, *Commelina benghalensis*, *Digera arvensis*, *Tridax procumbens*, and *Phyllanthus niruri* were observed in the field. In the black soil, among the grasses *Cynodon dactylon*, *Rottboellia exaltata* and *Echinochloa colonum*, *Dactyloctenium aegyptium* were noticed. *Cyperus rotundus* was the only sedge present in the field. Among the broad leaved weeds, *Parthenium hysterophorus*, *Euphorbia geniculata*, *Trianthema portulacastrum*, *Trichodesma indica*, *Cyanotis cristata*, *Digera arvensis* and *Celosia argentea* were observed in the field. Weeds compete with the crops for moisture, nutrients, light and CO_2 and there by affect the yield. Thus the nutrient uptake by crop is an important factor to be determined to know the effect of the control practices.

NPK uptake by weeds

A result on nutrient uptake by weeds was significantly lower in weed free check over unweeded control (42.4, 5.95, 43.3 kg NPK ha^{-1}) over rest of the treatments. Pre emergence application of pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} (9.0 kg ha^{-1}) and Clomazone 50 EC @ 250 g *a.i.* ha^{-1} (7.8 kg ha^{-1}) with one HW at 25 DAS and IC at 50 and 75 DAS or post emergence application of pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} or combined with post emergence application of pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} did not showed significant difference and were on par with each other. It was consistent during both the years. It might be due to higher weed intensity and biomass in unweeded control and its dominance in utilizing natural resources like sunlight, moisture and CO_2 and applied inputs over plants resulting in accumulation of more dry matter in weeds. Further absorption of nutrients from soil and reduced nutrient uptake by weeds was due to less weed dry matter in the respective treatments. These results were in close conformity with these findings of Hiremath *et al.*(2013) and Shivashankar (2016). At every stage of the crop growth, unweeded control has resulted in significantly lower N uptake (Table 1).

NPK uptake by cotton

Average data over two years showed that significantly higher uptake of N, P and K was recorded in weed free check (97.2, 13.1 and 95.0 kg NPK ha^{-1}, respectively) over rest of the treatments (Table 2). It was lowest in unweeded control (65.5, 8.10 and 64.7 kg ha^{-1}NPK, respectively). All weed management practices had increased the NPK concentration in plant and their uptake over unweeded control. Moreover, weed free check was effective in

enhancing nutrient uptake except in unweeded control and integrated weed control treatments. Among chemical method of weed management, pre-emergence application of Clomazone 50 EC @ 250 g *a.i.*/ha as PE fb Pyrithiobac Sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE recorded higher N uptake (85.8 kg ha^{-1}), Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE fb pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE recorded higher P (11.3 kg ha^{-1}) and K uptake (85.5 $kgha^{-1}$). The uptake of major nutrients by the crop was a function of crop dry matter production, nutrient availability and nutrient concentration of plants. This might be due to minimum weed competition in these plots throughout the crop period that facilitated higher dry matter production and nutrient uptake by the crop (Nalayini *et al.*, 2001).

Seed cotton yield

Higher concentration of Clomazone from 250 g *a.i.* ha^{-1} to 500 g *a.i.* ha^{-1} or 750 g *a.i.* ha^{-1} did not increased the seed cotton yield, it indicated that application of Clomazone @ 250 g *a.i.* ha^{-1} was found optimum (Table 3). These treatments were on par with weed free check (1517 kg ha^{-1}) but significantly superior over unweeded control (862 kg ha^{-1}) and HW at 25 DAS and IC at 50 and 75 DAS (1148 kg ha^{-1}). These treatments were increased yield with the tune of 43.2%, 35.9% and 35.8% over unweeded control. The variation in seed cotton yield may be attributed to be positive association between yield and nutrient uptake by weed and cotton crop. Better growth of cotton plants in these treatments might be due least competition with weeds for nutrients. Shahzad *et al.*, (2012) showed hand weeding and herbicidal treatments reduced the weed infestation, resulted in higher seed cotton yield over weedy plots. This was due to heavy infestation of weeds and poor yield components such as lower number of bolls $plant^{-1}$, less number of sympodial branches, lower seed index under unweeded control.

Soil nitrogen balance

Soil nitrogen balance differed considerably with various weed management practices during both the years (Table 4).The nutrient balance sheet was worked out by considering the soil N status at harvest and quantity of nitrogen applied to the soil through inorganic fertilizer. The data showed that higher total N was recorded in clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (256 kg ha^{-1}) followed by clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as POE (253 kg ha^{-1}), clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g

a.i. ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as POE (252.4 kg ha^{-1}) and weed free check (252 kg ha^{-1}). Lower total nitrogen was recorded in unweeded control (224 kg ha^{-1}). The higher N balance was recorded in clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (162.3 kg ha^{-1}) followed by clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb*pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as POE (161.2 kg ha^{-1}), clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (160.0 kg ha^{-1}) and weed free check (158 kg ha^{-1}). The lowest N balance was recorded in unweeded control (108.5 kg ha^{-1}). The net gain or loss varied with different treatments. The application of clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (13.25 kg ha^{-1}) showed higher net gain followed by pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (6.12 kg ha^{-1}), weed free check (3.71 kg ha^{-1}), clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (2.62 kg ha^{-1}). The other treatments recorded greater negative values indicate more losses by various means.

Soil phosphorus balance

Soil P balance was differed considerably with various weed management practices during both the seasons of 2017 and 2018 (Table 4). Balance sheet after second year crop harvest soil P status at harvest and the quantity applied through chemical fertilizers. The higher P was received in weed free check (118.3 kg ha^{-1}) followed by One HW at 25 DAS and IC at 50 and 75 DAS (116.5 kg ha^{-1}), Clomazone 50 EC @ 750 g *a.i.* ha^{-1}. as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (115.7 kg ha^{-1}) and Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* Pyrithiobac sodium 10 EC 75 g *a.i.* ha^{-1} at 25 DAS as POE (114.2 kg ha^{-1}). The lowest quantity of Phosphorus was received in unweeded control (82.20 kg ha^{-1}).

The expected P balance based on the soil status at the end of the second year cycle was maximum in weed free check (96 kg ha^{-1}) followed by HW at 25 DAS and IC at 50 and 75 DAS (90.50 kg ha^{-1}) and Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (88.97 kg ha^{-1}). The lowest P was recorded in unweeded control (76.50 kg ha^{-1}). The net gain or loss was varied with different treatments. The available soil P showed a net gain in unweeded control (7.46) and was followed by weed free check with net loss (-9.12 kg ha^{-1}), whereas the rest of the treatments were recorded negative values.

Soil potassium balance

Soil K was differed considerably with various weed management practices during both the years (Table 4). The data revealed that regardless of the weed management practices, there

was net gain of K in all the practices at the end of the experimentation. The results indicated that lower net gain was higher in unweeded control (9.5 kg ha^{-1}), while in weed free check (64.5 kg ha^{-1}) higher gain compared to unweeded control and other treatments. In 2018-19, nutrient balance was worked out based on the soil status at harvest and quantity applied through fertilizers. Greater potassium content was recorded in weed free check (562.0 kg ha^{-1}) followed by Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (548.5 kg ha^{-1}) and Clomazone 50 EC @ 500 g *a.i*. ha^{-1} as PE fb pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE (544.8 kg ha^{-1}) and least in unweeded control (468.2 kg ha^{-1}). The two year balance sheet recorded positive expected and estimated balance of K in the soil. The net gain or loss varied with different treatments. The unweeded control showed the higher net K gain (43.1 kg ha^{-1}) followed by weed free (53.5 kg ha^{-1}) and clomazone 50 ec @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE (38.6 kg ha^{-1}. The lower potassium gain was recorded in Clomazone 50 EC @ 250 g *a.i* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS (6.3 kg ha^{-1}) and clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE (9.1 kg ha^{-1}).

Significantly higher soil available NPK estimated in weed free check and application of clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE due to lower weed population and weed dry weight, which led to lower uptake of nutrients by the weeds. It could have resulted in more available nutrients in soil after harvest of the crop. The unweeded check recorded lower soil available NPK due to non-control of weeds as evidenced by higher weed population and weed dry weight. It is a well-established fact that weeds are aggressive in utilizing the nutrients than crop plants. Similar observations were also reported by Madavi (2016).

CONCLUSION

Results of the study showed that macronutrient contents in cotton crop was higher in weed free check and it was comparable to pre emergence application of Clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE fb Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE. The nutrient removal by weeds also was minimal in pre emergence application of pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} and Clomazone 50 EC @ 250 g *a.i.* ha^{-1} with HW at 25 DAS and IC at 50 and 75 DAS or post emergence application of Pyrithiobac sodium 10 EC @ 75 g *a.i.*ha^{-1} or combined with post emergence application of

Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} over unweeded control. Nutrient balance after crop harvest also showed greater losses in application of Clomazone 50E followed by HW at 25 DAS and IC at 50, 75 DAS as ecofriendly weed management practice in cotton.

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Table 1. Nitrogen, Phosphorus and potassium uptake by weeds as influenced by different chemical weed management practices in HDPS cotton

Treatment	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Pendimethalin 38.7 CS @ 680 g *a.i*ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	9.09	8.90	9.0	1.29	1.26	1.28	9.55	9.37	9.46
Clomazone 50 EC @ 250 g *a.i* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	7.76	7.76	7.8	1.02	1.02	1.02	7.57	7.57	7.57
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	7.64	7.64	7.6	1.05	1.05	1.05	7.78	7.78	7.78
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	9.19	8.39	8.8	1.32	1.19	1.26	8.76	8.00	8.38
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	9.46	7.14	8.3	1.34	1.00	1.17	9.39	7.10	8.25
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb*pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	7.72	7.91	7.8	1.12	1.14	1.13	8.55	8.72	8.64
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb*pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	8.68	7.01	7.8	1.25	1.00	1.12	8.91	7.16	8.04
Clomazone 50 EC @ 250 g *a.i.*/ha as PE *fb*pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.*ha^{-1} at 25 DAS as PoE.	10.8	8.17	9.5	1.65	1.24	1.44	11.1	8.39	9.75
Clomazone 50 EC @ 500 g *a.i.*ha^{-1} as PE *fb*pyrithiobac sodium 10 EC @ 75 g *a.i.*ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE.	11.5	10.5	11.0	1.61	1.46	1.54	10.6	9.69	10.2
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE.	10.7	6.88	8.8	1.63	1.02	1.32	11.2	7.22	9.23
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25DAS as PoE	12.3	8.22	10.3	1.80	1.20	1.50	12.5	8.37	10.4
HW at 25 DAS and IC at 50 and 75 DAS	9.67	7.07	8.4	1.42	1.04	1.23	9.37	6.84	8.10
Weed free check	-	-	-	-	-	-	-	-	-
Unweeded control	47.9	37.0	42.4	6.77	5.14	5.95	48.9	37.7	43.3
S.Em±	1.50	1.30	1.00	0.37	0.16	0.24	1.54	1.04	0.92
C.D. at 5%	4.30	3.60	3.00	1.07	0.47	0.70	4.46	3.03	2.69

Table 2.Nitrogen, phosphorus and potassium uptake by high density planting cotton as Influenced by different chemical weed management practices

Treatment	N uptake(kg ha^{-1})			P uptake(kg ha^{-1})			K uptake(kg ha^{-1})		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Pendimethalin 38.7 CS @ 680 g *a.i*ha^{-1} as PE *fb* HW at 25 DAS and IC at 50,75DAS	84.6	78.7	81.6	11.6	11.1	11.4	82.5	82.5	82.5
Clomazone 50 EC @ 250 g *a.i* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50, 75 DAS	73.1	65.8	69.5	9.4	8.9	9.2	64.4	65.4	64.9
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50,75 DAS	74.8	77.5	76.1	9.9	10.1	10.0	70.5	85.4	77.9
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50, 75 DAS	74.1	78.6	76.3	10.1	10.5	10.3	65.8	76.6	71.2
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	71.4	62.5	66.9	9.2	8.5	8.9	62.4	59.3	60.8
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	77.6	67.8	72.7	10.1	9.5	9.8	71.8	71.2	71.5
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	76.6	75.2	75.9	10.0	9.9	10.0	68.8	81.2	75.0
Clomazone 50 EC @ 250 g *a.i.*/ha as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.*ha^{-1} at 25 DAS as PoE.	88.3	83.3	85.8	10.8	10.5	10.7	76.4	83.3	79.8
Clomazone 50 EC @ 500 g *a.i.*ha^{-1} as PE *fb*pyrithiobac sodium 10 EC @ 75 g *a.i.*ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE.	81.8	82.0	81.9	10.7	10.7	10.7	71.1	74.1	72.6
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE.	80.0	70.2	75.1	11.7	10.9	11.3	89.1	81.9	85.5
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25DAS as PoE	91.6	77.8	84.7	11.1	10.3	10.7	86.4	77.8	82.1
HW at 25 DAS and IC at 50,75 DAS	80.0	77.3	78.6	10.2	10.1	10.2	78.7	80.7	79.7
Weed free check	96.6	97.7	97.2	13.0	13.1	13.1	92.3	97.7	95.0
Unweeded control	65.6	65.3	65.5	8.1	8.0	8.1	64.0	65.3	64.7
S.Em±	2.8	5.4	3.0	0.6	0.8	0.6	2.9	5.0	0.9
C.D. at 5%	8.1	15.8	8.7	1.8	2.3	1.7	8.5	14.6	2.7

Table 3: Balance sheet of available NPK in soil after second year of high density planting cotton as influenced by different chemical weed management practices

Treatment	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Soil supply and applied	Total uptake	Net gain/ loss	Soil supply and applied	Total uptake	Net gain/ loss	Soil supply and applied	Total uptake	Net gain/ loss
Pendimethalin 38.7 CS @ 680 g *a.i*ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	228.0	87.6	6.1	112.6	12.0	-18.0	592.0	86.2	28.7
Clomazone 50 EC @ 250 g *a.i* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50, 75 DAS	256.0	73.5	-30.5	109.0	9.5	-22.5	581.2	66.1	6.3
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50,75 DAS	242.5	85.1	2.6	110.3	11.3	-20.7	592.2	81.0	25.5
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* HW at 25 DAS and IC at 50 and 75 DAS	236.0	87.0	13.3	115.7	12.0	-14.7	602.8	77.8	23.5
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	238.5	69.6	-7.7	112.2	8.8	-15.8	582.5	61.0	21.1
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	253.0	75.7	-28.3	114.2	9.9	-17.8	592.8	71.7	23.7
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb*pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS as PoE	249.5	82.2	-12.3	113.6	10.8	-17.3	600.1	75.0	9.1
Clomazone 50 EC @ 250 g *a.i.*/ha as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.*ha^{-1} at 25 DAS as PoE	250.0	91.5	-3.6	107.4	11.5	-11.5	576.4	80.3	20.2
Clomazone 50 EC @ 500 g *a.i.*ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.*ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE	252.4	92.5	-8.9	112.4	12.2	-13.8	568.2	81.0	31.0
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS as PoE	251.2	77.1	-10.8	105.5	11.2	-13.8	567.6	85.5	38.6
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} as PE *fb* pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25DAS as PoE	252.2	86.1	-20.2	106.4	10.6	-11.4	569.4	81.7	30.1
HW at 25 DAS and IC at 50, 75 DAS	247.0	84.4	-19.6	116.5	10.9	-15.1	596.5	83.0	23.7
Weed free check	252.0	97.7	3.7	118.3	13.2	-9.1	602.0	93.5	53.5
Unweeded control	223.5	102.3	-12.7	82.2	13.2	7.5	426.4	101.3	143.1

Table 4: Seed cotton yield as influenced by eco-friendly weed management through chemical approaches in High density planting cotton

Treatment	2017	2018	Pooled
Pendimethalin 38.7 CS @ 680 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 &75 DAS	1367	1326	1346
Clomazone* 50 EC @ 250 g *a.i* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	1387	1304	1345
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	1477	1410	1444
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* HW at 25 DAS and IC at 50 and 75 DAS	1370	1183	1277
Clomazone 50 EC @ 250 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25DAS	1407	1246	1326
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	1417	1267	1342
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10EC 75 g *a.i.* ha^{-1} at 25 DAS	1361	1243	1302
Clomazone 50 EC @ 250 g *a.i.*/ha *fb* Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS ¥	1296	1219	1258
Clomazone 50 EC @ 500 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	1407	1267	1337
Clomazone 50 EC @ 750 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10 EC @75 g *a.i.* ha^{-1} + Quizolofop ethyl 5EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	1283	1173	1228
Pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} *fb* Pyrithiobac sodium 10 EC @ 75 g *a.i.* ha^{-1} + Quizolofop ethyl 5 EC @ 37.5 g *a.i.* ha^{-1} at 25 DAS	1300	1230	1265
HW at 25 DAS and IC at 50 and 75 DAS	1159	1137	1148
Weed free check	1603	1431	1517
Unweeded control	859	865	862
S.Em.±	124	84	85
CD at 5%	360	243	246

*as pre-emergence; ¥ as post emergent