Efficacy and phytotoxicity of Triafamone 18.52% SC in direct sown Rice and their residual effect on succeeding Blackgram

Abstract

Rice (*Oryza sativa*), the staple food of more than half of the population of the world, is an important target to provide food security and livelihoods for millions. Direct seeding of rice (DSR) refers to the process of establishing the crop from seeds sown in the field rather than by transplanting seedling from the nursery. Therefore, field experiment was conducted on clay loam soils at Agricultural Research Station, Jangamaheswarapuram, Guntur Dist. Andhra Pradesh, India, during 2017-18 and 2018-19 in directsown rice (DSR) to test the efficacy of Triafamone 18.52 SC herbicide on production and to evaluate the lasting impact of herbicides on succeeding blackgram. Among the herbicides tested only Triafamone 18.52 SC @ 100 g *a.i.* ha^{-1} had a slight phytotoxic effect on direct sown rice. Phytotoxicity of Triafamone 18.52 SC @ 100 g *a.i.* ha^{-1}applied at 2-3 leaf stage of weedeffect the rice crop, exhibiting slightly stunted growthand the leaves failed to fully expand and became yellow at 7 days after application. However, those symptoms disappeared, and the Rice plants recovered within a week. Further, it was observed that none of the herbicides applied at tested rates had adverse effect on succeeding blackgram. In among the herbicides Triafamone 18.52 SC @ 100 g *a.i.* ha^{-1}(T_5) and Triafamone18.52 SC @ 50 g *a.i.* ha^{-1}(T_4)applied at 2-3 leaf stage of weedwere at par recorded significantly higher grain yield over weedy check (T_1).

Keywords: Rice, phytotoxicity, Blackgram, DSR

Introduction

The primary crop grown in the tropics, particularly in India, is rice. The phrase "Rice is Life" perfectly captures the significance of rice in the food and nutritional security of Asian nations. India is the second-largest producer of rice in the world, with a production of 118.4 million tonnes and a productivity of 2.7 t ha^{-1} on an area of 43.8 million hectares (GOI 2021). With a yield of 8.23 million tonnes and a productivity of 3.73 t ha^{-1}, it is grown on 2.21 million hectares in Andhra Pradesh (Reserve Bank of India 2020).Before the advent of Green revolution and adoption of irrigation, rainfed rice was often broadcasted into moist soil and yields were low, variable and highly prone to weed competition. Weed spectrum and degree of infestation in rice field are often determined by rice ecosystems and establishment methods. Research evidences at different places has shown around 20-100% losses due to weeds such as *Echinochloa spp*., *Leptochloa spp*., *Cyanotis spp*., *Commelina sp.*, *Digitaria spp.* and *Alternanthera sp* in DSR. Integrated weed management approach based on the

critical period of crop weed competition, involving different direct and indirect control measures, has been developed and widely adopted by farmers to overcome weed problem in DSR in a sustainable way. Weed infestation is the major biotic constraint for higher productivity especially in dry direct sown rice (DSR) (Jyothi Basu *et al.*, 2020[a], 2020[b], 2021). Herbicides are frequently employed in high-input crop production systems to suppress weeds. Yet, the majority of the unused fractions of herbicides may stay within soils. Weed competition reduced multiple rice yield components, and weed biomass in wet-seeded rice was six-fold greater that in rice transplanted into puddled soil and twice as much again in dry-seeded rice sown either after dry tillage or without tillage (Singh *et al.*, 2012). Hence, information regarding persistence and residual effect of herbicides in soil is essential to use them safely and effectively. Because of this, bioassay continues to be a crucial technique for both qualitative and quantitative analysis of herbicide residue in soil (Jyothi Basu *et al.*, 2020[c]). In light of the aforementioned facts, an effort has been made to assess the Triafamone 18.52% SC efficacy and phytotoxicity in direct sown Rice and their residual effect on succeeding Blackgram.

Materials and Methods

A field experiment was conducted on clay loam soils of at Agricultural Research Station, Jangamaheswarapuram, Guntur Dist. Andhra Pradesh, India for two consecutive years (2017 -18 and 2018-19). The soils of the experimental locations were medium to deep black texture with PH 7.6, organic carbon 0.57, available Nitrogen 228 kg/ha, available Phosphorus 47.8 kg/ha, and available Potassium 310.4 kg/ha. The experiment was laid out in randomized block design with nine treatments.

Table 1. Treatments, dose and time of application.

Treatment	**Dose (g ha^{-1})**	**Time of Application**
T_1:Untreated control	-	-
T_2:Triafamone 18.52 SC	30	2 to 3 leaf stage of weed
T_3:Triafamone 18.52 SC	40	2 to 3 leaf stage of weed
T_4:Triafamone18.52 SC	50	2 to 3 leaf stage of weed
T_5:Triafamone18.52 SC	100	2 to 3 leaf stage of weed
T_6:Pyrazosulfuron ethyl 10% WP	15	2 to 3 leaf stage of weed
T_7:Cyhalofop Butyl 10% EC	80	2 to 3 leaf stage of weed
T_8:Farmer practice (two hand weedings)	-	20 DAS and 40 DAS

T_9:Weed free	-	-

Triafamone belongs to the keto sulfonanilide herbicides. In plants, Triafamone is taken up by leaves and roots and is very quickly converted into an intermediate form by reduction of the keto group. Contrary to rice, in weeds a 2nd metabolite is formed by N-demethylation, and this metabolite strongly inhibits acetolactate synthase (ALS). Phytotoxic effect of herbicides on Rice crop, if any, was assessed at 7, 14, 21, 28 and 35 days after spraying by using simple rating scale of 0-10 (equal to 0 to 100%) (Rao, 2000) as given in Table 2

Table 2. Phytotoxicity Rating Scale (PRS)

Effect	**Rating**	**Description on crop**	**Crop response/ Crop injury**
None	0	No injury, normal	0-00
Slight	1	Slight stunting injury or discolouration	1-10%
	2	Some stand loss, stunting discolouration	11-20%
	3	Injury more pronounced but not persistent	21-30%
Moderate	4	Moderate injury, recovery possible	31-40%
	5	Injury more persistent, recovery doubtful	41-50%
	6	Near severe injury, no recovery possible	51-60%
Severe	7	Severe injury, stand loss	61-70%
	8	Almost destroyed, a few plants surviving	71-80%
	9	Very few plants alive	81-90%
Complete	10	Complete destruction	91-100%

After harvest and threshing of crop, grain yield was recorded in net plot wise and converted to grain yield per hectare. The data of each year was analyzed separately. Weed index indicates percent reduction in grain yield due to weed competition. The weed index was calculated by using the formula as suggested by Gill and Vijay Kumar (1969).

$$WI\ (\%) = \frac{X - Y}{X} x100$$

Where,

X = Grain yield from weed free plot
Y= Grain yield from plots for which WI is to be calculated.

The observations on growth attributes were taken at different intervals and yield attributing characters like no of panicles m^{-2}, panicle length, no of grains per panicle and test weight were recorded at harvest. The data was analyzed using ANOVA and the least significant difference (LSD) values at 5% level of significance were calculated and used the RBD test significant difference between treatment means.

Results and Discussion

Crop Injury Score

Among the herbicides tested only T_5 (Triafamone 18.52 SC @ 100 g *a.i*. ha^{-1}at 2-3 leaf stage of weed)had a slight phytotoxic effect on Rice. Phytotoxicity of Triafamone 200 SC @ 100 g *a.i.* $ha^{-1}$was characterized by slightly stunted plant growth and leaves fail to expand fully and became yellowish as observed at 7 days after application. However, those symptoms disappeared, and the Rice plants recovered within a week.Similar trend was close conformity of Mohapatra*et al.* (2021) and Murali Arthanari(2023).

Grain Yield (kg ha^{-1})

Grain yield of Rice was significantly influenced by different weed management practices in both the years of study (Table 4).

The highest grain yield (5076 and 5651 kg ha^{-1} during 2017-18 and 2018-19, respectively) was recorded under weed free treatment (T_9), which was significantly superior to rest of the treatments except treatments T_8 (Two hand weedings), which was however, comparable to the treatments T_5 (Triafamone 18.52 SC @ 100 g *a.i.* ha^{-1}at 2-3 leaf stage of weed) andT_4 (Triafamone 18.52 SC @ 50 g *a.i.* ha^{-1}at 2-3 leaf stage of weed). The lowest grain yield (1922 and 2552 kg ha^{-1}) was obtained in untreated (T_1) plot, which was significantly lower than any herbicidal treatment.The results are conformity with the findings of Kumar *et al.*, (2013), Mohapatra *et al.* (2021) and Murali Arthanari(2023) .

Phyto-toxicity effect on succeeding crop

The data on succeeding crop (Blackgram) did not show any crop injury as well as there was no adverse effect on its germination, plant height, branches and yield of crop.

Seed yield of blackgram (kg ha^{-1})

The seed yield of succeeding blackgram crop after rice was non significant among the treatments during both the years of study [Table-6]. This indicates that there was no marked difference among the treatments and the impact of herbicides applied to rice. The applied herbicides left no lingering effects on the germination, plant height, number of branches per

plant or seed yields of blackgram after they had adequately broken down in the soil. This extraordinary manifestation suggests that the various weed management techniques used on rice had no discernible impact on the development and productivity of the next blackgram crop. Jyothi Basu *et al.*, 2020[c] found similar findings, stating that herbicides applied to rice crops had no lasting effects on subsequent crops' growth and production.These findings were in agreement with the views expressed by Deivasigamani(2016[a]), Deivasigamani(2016[b]), Murali Arthanari(2023).

Conclusions

On the basis of foregone studies, it is concluded that, Triafamone 18.52 SC was not shown any phytotoxicity on Rice crop and Triafamone 18.52 SC applied in Rice doesn't have any residual effect either positive or negative on growth and yield of succeeding Blackgram crop. Further, Triafamone 18.52 SC @ 100 g *a.i.* ha^{-1}at 2-3 leaf stage of weed (T_5) followed by T_4 (Triafamone 18.52 SC @ 50 g *a.i.* ha^{-1}at 2-3 leaf stage of weed) may be used for attaining effective weed management, maximum rice grain yield with no residual effect on succeeding blackgram.

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Table .3 Phytotoxic effect of Triafamone 18.52 SC on direct seeded Rice as influenced by weed management practices during*Rabi*, 2017-18 and *Kharif*, 2018-19

Treatments	**Dose (g *a.i.* ha^{-1})**	**Phyto-toxicity Days after herbicide application**									
		2017-18					**2018-19**				
		7	14	21	28	35	**7**	14	21	28	35
$T_{1.}$Untreated (control)	-	-	-	-	-	-	-	-	-	-	-
$T_{2.}$ Council Prime (Triafamone 18.52 SC)	30	0	0	0	0	0	0	0	0	0	0
$T_{3.}$ Council Prime (Triafamone 18.52 SC)	40	0	0	0	0	0	0	0	0	0	0
$T_{4.}$ Council Prime (Triafamone 18.52 SC)	50	0	0	0	0	0	0	0	0	0	0
$T_{5.}$Council Prime (Triafamone 18.52 SC)	100	1	0	0	0	0	1	0	0	0	0
$T_{6.}$Pyrazosulfuron ethyl 10% WP	15	0	0	0	0	0	0	0	0	0	0
$T_{7.}$Cyhalofop Butyl 10% EC	80	0	0	0	0	0	0	0	0	0	0
$T_{8.}$Farmer practice (two hand weedings)	-	-	-	-	-	-	-	-	-	-	-
$T_{9.}$Weed free	-	-	-	-	-	-	-	-	-	-	-

Table 4. Grain yield and weed index of direct seeded Rice as influenced by weed management practices during *Rabi*, 2017-18 and *Kharif*, 2018-19

Treatments	**Dose (g *a.i.* ha^{-1})**	**Grain yield (kg ha^{-1})**		***Weed index (%)**	
		2017-18	**2018-19**	**2017-18**	**2018-19**
$T_{1.}$ Untreated (control)	-	1922	2552	52.07 (62.1)	48.27 (55.6)
$T_{2.}$ Council Prime (Triafamone 18.52 SC)	30	3440	3667	34.48 (32.1)	36.37 (35.5)
$T_{3.}$ Council Prime (Triafamone 18.52 SC)	40	3751	4143	30.70 (26.7)	31.01 (26.8)
$T_{4.}$ Council Prime (Triafamone 18.52 SC)	50	3993	4460	27.68 (22.0)	27.07 (21.3)
$T_{5.}$ Council Prime (Triafamone 18.52 SC)	100	4376	4730	21.80 (14.4)	22.83 (16.4)
$T_{6.}$ Pyrazosulfuron ethyl 10% WP	15	3226	3537	37.09 (36.5)	37.64 (37.4)
$T_{7.}$ Cyhalofop Butyl 10% EC	80	3492	3713	33.83 (31.4)	35.93 (34.6)
$T_{8.}$ Farmer practice (two hand weedings)	-	4649	5185	16.82 (8.8)	13.90 (7.7)
$T_{9.}$ Weed free	-	5076	5651	0.00 (0.0)	0.00 (0.0)
SEm+	-	168.27	177.16	2.06	2.68
CD (P = 0.05)	-	491.13	517.09	6.03	7.82

*Note: Data transformed to arc sine transformations. Figures in parenthesis are original values

Table 5. Phytotoxic symptoms and germination of succeeding Blackgram as influenced byTriafamone18.52 SCduring *Rabi*, 2017-18 and *Kharif*, 2018-19

Tr. No	Treatment	Dose (g *a.i.*ha^{-1})	Phyto-toxicity (Days after sowing)				Plant germination per 3 row at 20 DAS	
			2017-18		2018-19		2017-18	2018-19
			20	Harvest	20	Harvest		
$T_{1.}$	Untreated control	-	0	0	0	0	47.5	48.1
$T_{4.}$	Council Prime (Triafamone 18.52 SC)	50	0	0	0	0	47.3	47.1
$T_{5.}$	Council Prime (Triafamone 18.52 SC)	100	0	0	0	0	46.1	46.3

Table 6. Plant height (cm), braches (No. plant^{-1}) and seed yield (kg ha^{-1}) of Blackgramas influenced by weed management practices in Rice-Blackgram sequence during *Rabi*, 2017-18 and *Kharif*, 2018-19

Treatments	Dose (g *a.i.* ha^{-1})	Plant height		No of branches plant^{-1}		Seed yield (kgha^{-1})	
		2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
$T_{1.}$Untreated control	-	31.98	34.83	7.17	7.73	506	549
$T_{2.}$ Council Prime (Triafamone 200 SC)	30	33.41	34.76	7.18	7.95	520	547
$T_{3.}$ Council Prime (Triafamone 200 SC)	40	34.90	35.33	7.06	7.39	525	547
$T_{4.}$ Council Prime (Triafamone 200 SC)	50	34.86	35.89	7.26	8.00	557	561
$T_{5.}$Council Prime (Triafamone 200 SC)	100	36.12	36.59	8.02	8.17	566	574
$T_{6.}$Pyrazosulfuron ethyl 10% WP	15	34.33	36.35	6.97	7.80	545	560
$T_{7.}$Cyhalofop Butyl 10% EC	80	32.87	34.95	7.44	8.44	534	558
$T_{8.}$Farmer practice (two hand weedings)	-	34.96	34.99	8.27	8.81	560	569
$T_{9.}$Weed free	-	36.33	35.88	7.78	8.06	555	580
SEm+	-	0.95	0.52	0.35	0.33	14.07	8.24
CD (P = 0.05)	-	NS	NS	NS	NS	NS	NS