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Growth and Productivity of Black Gram (*Vigna mungo* L.) as Influenced by Residual Effect of Triafamone Herbicide Applied for Transplanted Rice (*Oryza sativa* L.)

P. Murali Arthanari[1]

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ABSTRACT

Background: The major area under black gram are cultivated as rice fallow crop to harness the available soil moisture and other resources without application of any inputs as that of other input intensive crops. Weeds are one of the important biotic factors which affect the growth and yield of black gram. The weeds can be effectively managed in black gram by the herbicide applied in the previous crop *viz*., transplanted rice. Since, the black gram has quick ground cover, hence initial weed management is very much important. In order to manage the weeds in rice fallow black gram crop evaluation of Triafamone herbicide applied to the transplanted rice crop was carried out in succeeding black gram crop in terms of the growth and yield of black gram.

Methods: Field experiments were conducted during *Kharif*, 2019 (July to August) and *Rabi* 2019-20 (November to January) at Wetland farm of Tamil Nadu Agricultural University, Coimbatore to study the residual effect of herbicides applied in transplanted rice on succeeding black gram growth and productivity. The experiment was laid out in a randomized complete block design with three replications. The treatments consisted of four doses (30, 40, 50 and 100 g/ha) of new rice herbicide Triafamone 20% SC each as pre emergence and early post emergence, along with check herbicides Pretilachlor 50% EC 750 ml/ha and Pyrazosulfuron ethyl 10% WP 15 ml/ha as early post-emergence along with farmers practice (two hand weedings), weed free and weedy checks.

Result: The weed flora of the experimental field consisted of weed complex including grasses, sedges and broad leaved weeds. Among the different dose of herbicides applied, Triafamone 20% SC at 100 g/ha markedly suppressed the weeds growth. There were no phytotoxic effects of herbicides on succeeding black gram. Different doses and time herbicides applied in transplanted rice did not affect the germination of succeeding black gram. Higher weed control efficiency, growth and yield component and yield of black gram were recorded with the Triafamone at 40 g/ha as pre emergence and early post emergence application.

Key words: Black gram, Residual effect, Triafamone.

INTRODUCTION

Today, the global agriculture facing acute labour shortage and high wages for labourers forced the farmers to use herbicidal weed management for rice grown in different establishment methods. Many rice herbicides can be accumulated in soil (Naveen *et al.,* 2012) and some herbicides may be accumulated but their residues might be present in the soil. These herbicide residues are much beneficial to contain the non-targeted plant species and the growth and productivity of the succeeding crop will be enhanced (Balyan, 2016). However, most of the rice farmers in Tamil Nadu practicing herbicidal weed management with different time of application with new generation herbicide molecules. But, the farmers are applying herbicides without knowing the residual effect of herbicides on the succeeding crops especially pulse crops. Because, in most of the rice growing areas, the farmers are usually cultivate pulse crops *viz*., black gram as rice fallow crop in order to get additional income and enrich the soil fertility. Black gram (*Vigna mungo* L.) is one of the important pulse crops in Tamil Nadu, grown under irrigated, rainfed and rice fallow conditions. Rice fallow black gram is grown during the month of January to March in Cauvery Delta Zone, Tamil Nadu in an area of 2.0 lakh hectares (Anonymous, 2017). It grows in the residual soil moisture, which is broadcasted 7-10 days before the harvest of paddy crop in waxy soil condition. Since black gram is grown under paddy stubbles, it has to survive in the residual nutrients and moisture present in the soil, residual herbicides present in the soil, besides frost and mist available during the period and complete the lifecycle within 65-70 days of sowing.

Sometimes, this practice will leads to poor germination and productivity of the pulse crop due to high accumulation of herbicides applied in the previous rice crop. The Triafamone is a new herbicide recommended for transplanted rice either as pre emergence or early post emergence

[1]Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.

Corresponding Author: P. Murali Arthanari, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: agronmurali@tnau.ac.in

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of weeds. The label claim showed that, it has very good residual control of weeds to succeeding crop after transplanted rice. To keep these points in view, experiments were carried out to study the residual effect of Triafamone herbicide on black gram after harvest of the transplanted rice.

MATERIALS AND METHODS

To study the residual effect of herbicides applied to rice crop, the succeeding crop of black gram (VBN 8) field experiments were conducted at Wetland Farm of Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India during *Kharif* 2019 and *Rabi*, Coimbatore, 2019-20. After the harvest of rice crop, the follow up black gram crop was dibbled in rice stubbles. A seed rate of 20 kg/ha as adopted with a spacing of 30 cm × 10 cm. The other crop management practices *viz*, irrigation, and plant protection measures were adopted as recommended in Crop Production Guide (2019).

The farm is situated at 11°N latitude and 77°E longitude and at an altitude of 426.7 m above MSL. The experiment was laid out in randomized block design comprised of thirteen treatments. The treatments were replicated thrice.

The soil texture of the experimental field was clay loam with low in available nitrogen (219 kg ha^{-1}), medium in phosphorus (15 kg ha^{-1}) and high in potassium contents (449.8 kg ha^{-1}). Black gram VBN- 8 and CO 6 varieties having duration of 75 -80 days released by Tamil Nadu Agricultural University (TNAU) was used as the test crops. The seeds were sown in plots of size 9 m × 2 m at spacing of 30 cm × 10 cm with a seed rate of 20 kg ha^{-1}. Fertilizer nutrients at 25: 50: 25 kg NPK ha^{-1} were applied in the form of urea, single super phosphate and muriate of potash, respectively. Entire dose of fertilizers were applied basally. Treatments includes spraying of 30, 40, 50 and 100 g/ha new formulation of rice herbicide Triafamone 200 SC as pre emergence on 3 days after sowing and early post emergence herbicide (2-3 leaf stage of weeds) using knapsack sprayer fitted with deflector type nozzle pre emergence herbicide Pretilachlor 50% EC 750 g/ha on 3 days after sowing and early post emergence herbicide Pyrazosulfuron ethyl 10% WP 15 ml/ha along with farmers practice (two hand weedings) and weed free and check.

Weed control efficiency (WCE)

The weed control efficiency was computed based upon the weed dry weight in the field at 21 DAS using the formula suggested by Mani *et al.* (1973):

$$WCE\ (\%) = \frac{WDW_c - WDW_t}{WDW_c} \times 100$$

Where,

WCE- Weed control efficiency in percentage.

WDW_c- Total dry weight of weeds in unweeded plot.

WDW_t- Total dry weight of weeds in herbicide treated plot.

The germination percentage was worked out by counting the number of black gram seeds germinated 20 days after germination. Yield attributes of black gram was recorded at harvest from already tagged five plants. The height of the green gram was recorded at 20 and 40 DAS on five tagged plants and means was worked out and expressed in cm. Grains from net plot cleaned, sun dried and weighed at 12 per cent moisture content and grain yield calculated and expressed in kg/ha.

The pods harvested from net plot area (8.1 m × 1.4 m) of each treatment plot were sun dried, threshed, cleaned and grain yield was recorded at a moisture level of 14%. The yield data of net plot was converted in to per hectare. The observed data were statistically analyzed based on the procedure given by Gomez and Gomez (2008) to find out the treatment differences. All statistical analyses were performed using the software AGRES developed by TNAU. Critical differences were worked out at five per cent probability level wherever the treatment differences were significant. The non-significant results were indicated as NS.

RESULTS AND DISCUSSION

The residual effect of Triafamone herbicide application on weed control efficiency, growth and productivity of black gram were presented in the Table 1, 2 and 3. The detailed results and discussion were made in the respective parameters.

Effect of triafamone on weed flora in black gram

The observation made on the common weeds of the experimental field consisted of grasses, sedges and broad leaved weeds from unweeded check plot at 28 and 42 Days After herbicide Application (DAA). Weed flora of the experimental field predominantly consisted of three species of grasses, two species of sedges and five species of broad leaved weeds. The weed flora composition was influenced by the herbicide Triafamone in the black gram. This result is corroborated with the findings of Mansoori *et al.* (2015). The major grasses were *Echinochloa crus-galli* (L.) and *E. colonum* (L.) while the sedge weed included *Cyperus nutans* (L.). Among the broad leaved weeds *Eclipta alba* (L.) and *Bergia ammanioides* were the dominant species. The grassy weeds dominated with relative density of 87 per cent and broad leaved weeds were dominated with the relative density of 71 per cent observed in the control plot. Whereas, drastic reduction of 37 per cent of grassy weeds and 21 per cent of broad leaved weeds were observed in the Triafamone applied plots. This might be due to effective control of Triafamone herbicide on different group of weeds in the rice crop (Punia *et al.,* 2011; Gupta *et al.*, 2014).

Weed control efficiency

Among the different Triafamone dose applied, the weed control efficiency ranged from 43.5% to 100% at 42 DAA. Among the different dose of application of Triafamone, application of 40 g/ha as pre emergence and early post emergence application recorded highest weed control efficiency of 100, 97.7 and 99.6, 97.8 per cent at 42 days after herbicide application during both seasons of

experimentation. This might be due to better control of grassy and broad leaved weeds which led to less dry matter accumulation by weeds (Choudhary *et al.,* 2012; Punia, 2014). Further, triafamone herbicide addressed very effectively as pre emergence and early post emergence. The mode of action of this herbicide was played role to prevent the weed seed germination during pre-emergence application and at the time early post emergence application, it was killed the weeds within the shorter period of time. This might be due to the quick translocation to the site of action (Verma *et al.,* 2020). Lowest weed control efficiency was registered by the treatment consisting of EPOE Pyrazosulfuron ethyl at 15 g/ha with values of 43.4 and 40.8 % at 25, 50 and 75 DAT, respectively.

Table 1: Effect of Triafamone on succeeding crop black gram growth and yield during *Kharif* 2019.

Treatments	*Kharif* 2019			
	Germination (%)	Plant height (cm) 40 DAS	Grain yield (kg/ha)	Haulm yield (kg/ha)
T_1: EPOE Triafamone 200SC @ 30 g/ha	76	39.0	503	836
T_2: EPOE Triafamone 200SC @ 40 g/ha	83	39.1	510	1048
T_3: EPOE Triafamone 200SC @ 50 g/ha	72	36.8	451	855
T_4: EPOE Triafamone 200SC @ 100 g/ha	82	41.6	373	696
T_5: EPOE Pyrazosulfuron ethyl 10% WP @ 15 g/ha	72	39.0	433	840
T_6: PE Triafamone 200SC @ 30 g/ha	79	32.1	494	869
T_7: PE Triafamone 200SC @ 40 g/ha	78	54.2	533	987
T_8: PE Triafamone 200SC @ 50 g/ha	83	39.6	482	835
T_9: PE Triafamone 200SC @ 100 g/ha	72	40.8	404	723
T_{10}: PE pretilachlor 50% EC @ 750 g/ha	75	51.7	490	860
T_{11}: Farmers practice (Two hand weeding on 20 and 40 DAT)	78	43.8	427	697
T_{12}: Weed free	84	49.6	522	762
T_{13}: Unweeded control	60	31.4	299	461
SEd	-	1.20	22	34
CD (P= 0.05)	-	NS	49.0	69

EPOE- Early post emergence (2-3 leaf stage of weed), PE- Pre emergence (0-3 days after transplanting), DAA- Days after application.

Table 2: Effect of Triafamone herbicide on succeeding crop black gram growth and yield during *Rabi* 2019-20.

Treatments	*Rabi* 2019-20			
	Germination (%)	Plant height (cm) 40 DAS	Grain yield (kg/ha)	Haulm yield (kg/ha)
T_1: EPOE Triafamone 200SC @ 30 g/ha	84	22.1	449	746
T_2: EPOE Triafamone 200SC @ 40 g/ha	87	21.5	455	936
T_3: EPOE Triafamone 200SC @ 50 g/ha	91	21.9	403	764
T_4: EPOE Triafamone 200SC @ 100 g/ha	83	21.8	386	622
T_5: EPOE Pyrazosulfuron ethyl 10% WP @ 15 g/ha	87	21.6	441	750
T_6: PE Triafamone 200SC @ 30 g/ha	89	21.3	361	776
T_7: PE Triafamone 200SC @ 40 g/ha	88	24.3	476	881
T_8: PE Triafamone 200SC @ 50 g/ha	96	22.2	431	745
T_9: PE Triafamone 200SC @ 100 g/ha	90	19.8	333	645
T_{10}: PE Pretilachlor 50% EC @ 750 g/ha	92	19.2	438	767
T_{11}: Farmers practice (Two hand weeding on 20 and 40 DAT)	81	20.5	381	644
T_{12}: Weed free	87	22.4	466	702
T_{13}: Unweeded control	79	17.1	267	412
SEd	1.10	19	32	
CD (P= 0.05)		NS	42.0	73

EPOE - Early post emergence (2 -3 leaf stage of weed), PE - Pre emergence (0-3 days after transplanting), DAA - Days after application.

Table 3: Effect of Triafamone on weed control efficiency (per cent) in black gram at 42 DAA.

Treatments	Weed control efficiency (%) - Black gram							
	Kharif 2019				*Rabi* 2019-20			
	Grasses	Sedges	BLWs	WCE	Grasses	Sedges	BLWs	WCE
T_1: EPOE Triafamone 200SC @ 30 g/ha	31.6	47.1	52.3	43.7	64.3	46.7	50.4	53.8
T_2: EPOE Triafamone 200SC @ 40 g/ha	96.8	100.0	96.6	97.8	98.4	100.0	94.8	97.7
T_3: EPOE Triafamone 200SC @ 50 g/ha	54.9	66.4	67.7	63.0	69.0	66.7	65.2	67.0
T_4: EPOE Triafamone 200SC @ 100 g/ha	32.7	59.5	83.1	58.4	87.8	60.0	80.1	76.0
T_5: EPOE Pyrazosulfuron ethyl 10% WP @ 15 g/ha	45.4	40.2	36.9	40.8	54.8	40.0	35.6	43.5
T_6: PE Triafamone 200SC @ 30 g/ha	64.3	65.3	46.2	58.6	86.2	66.7	44.5	65.8
T_7: PE Triafamone 200SC @ 40 g/ha	98.9	100.0	100.0	99.6	100.0	100.0	100.0	100.0
T_8: PE Triafamone 200SC @ 50 g/ha	51.7	39.7	45.2	45.5	66.5	40.0	39.7	48.7
T_9: PE Triafamone 200SC @ 100 g/ha	67.5	59.8	80.0	69.1	86.2	60.0	77.1	74.4
T_{10}: PE Pretilachlor 50% EC @ 750 g/ha	61.2	27.0	55.4	47.9	59.6	26.7	53.4	46.6
T_{11}: Farmers practice (Two hand weeding on 20 and 40 DAT)	-	-	-	-	-	-	-	-
T_{12}: Weed free	-	-	-	-	-	-	-	-
T_{13}: Unweeded control	-	-	-	-	-	-	-	-

EPOE- Early post emergence (2-3 leaf stage of weed), PE- Pre emergence (0-3 days after transplanting), DAA- Days after application.

Germination of black gram

The different level of Triafamone herbicide application did not affect the germination percentage of succeeding green gram crop. The germination percentage ranged between 79 to 96 per cent. The left over residue of Triafamone herbicide controlled the weeds and not influenced the germination process of black gram. But, the unweeded control plot registered lower germination percentage than other plots during both seasons. This might be due to heavy infestation of weeds in the main crop (transplanted rice) might have influenced the early competition for the black gram seed germination (Singh *et al.,* 2014).

Growth and productivity of black gram

All the weed management practices imposed on rice significantly altered the plant height of black gram at 20 and 40 DAS. All the weed control treatments behaved similarly in influencing the plant height of succeeding green gram. Significantly higher plant height was observed in all the weed control treatments except Triafamone at higher doses (100 g/ha) at 40 DAS indicating reduction in plant height of black gram at higher doses and which was recovered during the crop growth.

Grain and haulm yield

Weed management practices adopted for rice had significant influence on the grain yield of succeeding black gram. Highest grain yield (455 and 476 kg/ ha) was recorded with council prime at 40 g/ha during *rabi* 2018-19 and (510 and 533 kg/ha) during *Khairf* 2019 this was comparable with PE pretilachlor at 0.75 kg/ha. This might be due to effective weed control (Rathi *et al*., 2004 and Chhodavadiya *et al.,* 2013) as a result, the conducive environment for good crop growth and effective translocation of assimilates happened from source to sink which leads to higher productivity of black gram. Similar environment also helped to obtained higher haulm yield also. Significant difference in haulm yield was observed on the succeeding crop of black gram. Invariably pre and early post emergence application of Triafamone at 40 g/ha) higher doses recorded higher haulm yield than other herbicidal treatments (Chand *et al.,* 2004; Singh, 2011; Shashidhar *et al.,* 2020).

CONCLUSION

Application of Triafamone at the rate of 40 g/ha either as pre emergence or early post emergence application for the transplanted rice as main crop significantly recorded higher weed control efficiency, growth and higher productivity yield of black gram. This shows that, the herbicide and application cost for black gram is reduced in spite of higher weed control efficiency and monetary return.

Conflict of interest

All authors declared that there is no conflict of interest.

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