



## Effect of preceding rice herbicide residue towards control of weeds and urdbean productivity in rice -Bhendi-urdbean sequence under high rainfall area

Narayanasamy Bommayasamy ✉

ICAR-Central Island Agricultural Research Institute, Port Blair, A & N Islands, India.

C. R. Chinnamuthu

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

ARTICLE INFO	ABSTRACT
<p>Received : 22 January 2022                      Revised : 27 March 2022                      Accepted : 29 May 2022</p> <p>Available online: 18 September 2022</p> <p><b>Key Words:</b>                      BLW                      Cropping system                      Grass                      Residual effect                      Sedges                      Seed productivity</p>	<p>Field experiment was conducted at Field Crops Research unit, ICAR- Central Island Research Institute, Bloomsdale, Port Blair during summer season, 2018. To study the preceding rice herbicide residual effect in control of weeds, growth and yield of urdbean in rice-bhendi-urdbean sequence under high rainfall area. At 20 DAS, grassy weeds (48.00 weeds/m<sup>2</sup>) were predominant species of weeds followed by sedges and broad leaf weeds of 29.67 and 22.67 nos./m<sup>2</sup> respectively. Among the irrespective of weed control treatments, at 20 DAS, residual effect of 1.25 kg/ha butachlor at 3 DAP + manual weeding at 40 DAP in rice + two manual weeding on 20 and 40 DAS in both bhendi and urdbean recorded significantly lower grass, sedges, broad leaf weeds population and weed biomass of 11.67, 8.67, 6.67 weeds/m<sup>2</sup> and 2.93, 2.02, 1.84 g/m<sup>2</sup> respectively. Residual effect of 1.25 kg/ha butachlor applied at 3 DAP along with manual weeding at 40 DAP in rice + two manual weeding on 20 and 40 DAS in both bhendi and urdbean obtained 299 kg/ha higher seed yield as compared to weedy control.</p>

### Introduction

Urdbean is an essential short duration food leguminous crop which is more suitable and extensively grown under intensive cropping system. Urdbean contains higher content of protein, vitamins, minerals and fibre for direct human being consumption. Integration of urdbean, in different cropping system such as rice fallow, mixed cropping, catch crops and sequential cropping in India, because of it fixes atmospheric nitrogen and also enriches soil nutrient status for succeeding crops. In India, urdbean is grown in an area 4.48 m.ha with the average productivity of 641 kg/ha (Indiastat, 2018). In Andaman and Nicobar Islands, productivity of urdbean was 49.7% lower than national average productivity. There are many reasons for reduction of urdbean productivity. Among them, weeds compete with crops for natural resources and reduced productivity of urdbean. Productivity of urdbean is reduction was noticed upto 43.2 to 90.0% owing to weed infestation

during critical stages of crop growth. Hence, weeding should be done at appropriate time by using suitable weed control method is more essential to obtain higher yield of urdbean (Singh *et al.*, 2010). Manual weeding is laborious, tedious; time consuming as well as costly, even availability of manpower is also scarce during peak stage of crop growth. Hence, farmers are not shown much interest to spend more cost because of its grown in residual crop or fallow situation. Now days, scarcity of agricultural labor increasing day by day which leads to farmers for adoption of chemical weed control methods that is more effective in minimizing weed infestations for prolong period and also reduced soil weed seed bank. For this reason, farmers should be given more emphasis during selection of herbicide because, it causes more persist in soil for prolong period which affect succeeding crops in the cropping sequence. In the above facts, present investigation was conducted to

Corresponding author E-mail: [samygs81@yahoo.co.in](mailto:samygs81@yahoo.co.in)

Doi: <https://doi.org/10.36953/ECJ.10552250>

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find out the preceding rice herbicide residue in control of weeds and urdbean productivity under rice-bhendi-urdbean cropping sequence.

## Material and Methods

### Experimental details

Field experiment was conducted at Field crops Research unit of ICAR – Central Inland Agricultural Research Institute, Bloomsdale, Port Blair during Summer season 2018. To study the preceding rice herbicide residual effect in control of weeds and yield of urdbean in rice-bhendi-urdbean sequence under high rainfall area. The experimental soil type was “Clay loam” soil with 0.38% organic carbon and pH of 6.9, EC (0.3 dS/m) besides, soil available nitrogen (92.0 kg/ha), phosphorus (18.3 kg/ha) and potassium (55.4 kg/ha) content.

The experiment was laid out in previous rice crop experiment without any disturbance in layout for subsequent okra and urdbean. The details of eight weed control treatments imposed to previous rice were “T<sub>1</sub>- Oxadiargyl loading with biochar applied on 3 days after planting (DAP), T<sub>2</sub>- Oxadiargyl loading with zeolites applied on 3 DAP, T<sub>3</sub>- Oxadiargyl entrapped in starch applied on 3 DAP, T<sub>4</sub>- Oxadiargyl entrapped in water-soluble polymers applied on 3 DAP, T<sub>5</sub>- Application of 100g ha<sup>-1</sup> of oxadiargyl on 3 DAP, whereas, slight modification was done in Treatment T<sub>6</sub> to T<sub>8</sub> viz., T<sub>6</sub>- Application of 1.25 kg/ha of butachlor on 3 DAP along with manual weeding at 40 DAP+ two manual weeding on 20 and 40 days after sowing (DAS) in bhendi and urdbean, T<sub>7</sub>- Weed free control and T<sub>8</sub>- Weedy Control (entire crop sequence). After harvest of rice crop, bhendi seeds sown in rice stubbles. After harvest of bhendi residues were removed from the field and applied glyphosate at 1.0 kg/ha.

After 7 days of glyphosate application, urdbean variety of VBN (Bg)-8 dibbled with recommended spacing of 30cm and 10cm apart rows and lines. The crop was nourished with 25 kg of Nitrogen, 50 kg of Phosphorus and 25 kg of Potassium/ha was applied as basal though urea, Diammonium, Phosphate (DAP) and muriate of potash respectively. Agronomic practices were adopted as per standard packages. Crop growth and yield attributes registered as per standard procedure.

### Calculating relative density of weeds

Relative density (RD) of predominant species of weeds registered separately in category wise recorded and calculated with standard protocol suggested by Kim and Moody (1983).

$$RD(\%) = \frac{\text{No. of weeds of individual species}}{\text{Total no. of weeds}} \times 100$$

### Statistical analysis

Data on weeds showed high variation; hence they were subjected to transformation of  $\sqrt{x+2}$  and analyzed statistically as described by Gomaz and Gomez (2010). Wherever, statistical significant was observed, critical difference at 0.05 level of probability was worked out for comparison. Non-significant effects are indicated as NS.

## Results and Discussion

### Absolute density and relative density of weed

The predominant weeds were noticed in experimental field viz., four species of grassy weeds such as *Echinochloa colonum*, *Leptochloa chinensis*, *Acrachne racemose*, *Setaria glauca* and sedges such as *Cyperus haspan*, *C. iria*, *C. eragrostis*, *F.aestivalis* and six weed species of broad leaved weeds such as *Wedelia chinensis*, *Ammannia baccifera*, *Phyllanthus maderaspatensis*, *P. niruri*, *Boerhavia diffusa*, *Cleome viscosa* were observed in urdbean. The absolute density and relative density of individual weeds presented in Table 1.

At 20 DAS, grassy weeds of 48.00 weed/m<sup>2</sup> were predominant species of weeds followed by sedges and broad leaf weeds of 29.67 and 22.67 weeds/m<sup>2</sup> respectively. Among the grassy weeds *Echinochloa colonum* was predominant weed species with higher absolute density of 15.67 weeds/m<sup>2</sup> with relative density of 15.62%. However, at 60 DAS sedges were predominant weeds species followed by broad leaf weeds and grasses respectively. *Cyperus haspan* was dominant weeds species among sedges with 10.67 weeds/m<sup>2</sup> and 10.63% of absolute density and relative density respectively which was followed by *F. aestivalis*. It might be due to weeds were adapted to wide range of environmental condition and also deplete natural resources for their growth. Similar species of weeds were also reported by Bommayasamy *et al.* (2018).

**Table 1: Preceding rice herbicide residue on absolute and relative density of weeds at 20 and 60 DAS in urdbean under high rainfall area**

Weed species	20 DAS		60 DAS	
	AD (weeds/m <sup>2</sup> )	RD (%)	AD (weeds/m <sup>2</sup> )	RD (%)
<b>Grasses</b>				
<i>Echinochloa colonum</i>	15.67	15.62	41.67	14.25
<i>Leptochloa chinensis</i>	10.67	10.63	19.33	6.61
<i>Acrachne racemosa</i>	13.33	13.28	16.67	5.70
<i>Setaria glauca</i>	8.33	8.30	16.00	5.47
Total grasses	<b>48.00</b>	<b>47.84</b>	<b>93.67</b>	<b>32.04</b>
<b>Sedge</b>				
<i>Cyperus haspan</i>	10.67	10.63	46.67	15.96
<i>Cyperus iria</i>	5.33	5.31	19.33	6.61
<i>Cyperus eragrostis</i>	4.67	4.65	15.00	5.13
<i>F. aestivalis</i>	9.00	8.97	23.33	7.98
Total sedges	<b>29.67</b>	<b>29.57</b>	<b>104.33</b>	<b>35.69</b>
<b>Broad leaved weeds (BLW)</b>				
<i>Wedelia chinensis</i>	8.67	8.64	36.67	12.54
<i>Ammannia baccifera</i>	6.67	6.65	22.67	7.75
<i>Phyllanthu .maderaspatensis</i>	5.33	5.31	12.00	4.10
<i>Phyllanthus niruri</i>	2.00	1.99	9.33	3.19
<i>Boerhavia diffusa</i>	0.00	0.00	7.33	2.51
<i>Cleome viscosa</i>	0.00	0.00	6.33	2.17
<b>Total BLW</b>	<b>22.67</b>	<b>22.59</b>	<b>94.33</b>	<b>32.27</b>
<b>Total weed density</b>	<b>100.34</b>	<b>100.00</b>	<b>292.33</b>	<b>100.00</b>

AD- Absolute density

RD- Relative density

Data statistically not analysed

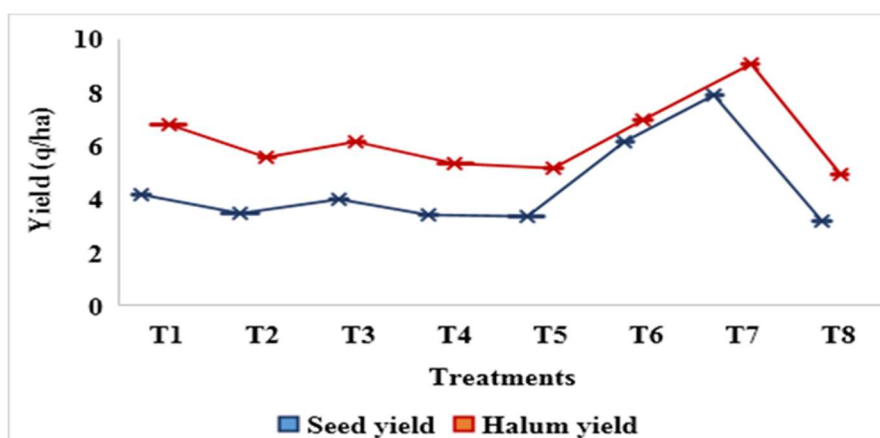
**Table 2: Preceding rice herbicide residue on grass, sedges, BLW weed population (weeds/ im<sup>2</sup>) and dry biomass production (g/m<sup>2</sup>) at 20 DAS in urdbean under high rainfall area**

Treatments	Weed population (weeds/m <sup>2</sup> )			Weed dry biomass (g/m <sup>2</sup> )		
	Grass	Sedges	BLW	Grass	Sedges	BLW
T <sub>1</sub> - Oxadiargyl loading with biochar applied on 3 DAP	4.65 (19.67)	3.36 (9.33)	2.94 (6.67)	2.66 (5.06)	2.12 (2.49)	1.97 (1.87)
T <sub>2</sub> - Oxadiargyl loading with zeolites applied on 3 DAP	5.20 (25.00)	4.20 (15.67)	3.56 (10.67)	2.81 (5.90)	2.40 (3.75)	2.28 (3.22)
T <sub>3</sub> -Oxadiargyl entrapped in starch applied on 3 DAP	4.72 (20.33)	3.56 (10.67)	3.11 (7.67)	2.73 (5.45)	2.13 (2.52)	2.07 (2.28)
T <sub>4</sub> -Oxadiargyl entrapped in water-soluble polymers applied on 3 DAP	5.37 (27.00)	4.27 (16.33)	4.04 (14.33)	2.86 (6.17)	2.43 (3.94)	2.55 (4.49)
T <sub>5</sub> —Application of 100g/ha of oxadiargyl on 3 DAP	5.83 (32.00)	4.43 (17.67)	4.51 (18.33)	3.20 (8.22)	2.51 (4.31)	2.60 (4.77)
T <sub>6</sub> -Application of 1.25 kg/ha of butachlor on 3 DAP along with manual weeding at 40 DAP+ two manual weeding on 20 and 40 DAS in bhendi and urdbean	3.69 (11.67)	3.26 (8.67)	2.94 (6.67)	2.22 (2.93)	2.00 (2.02)	1.96 (1.84)
T <sub>7</sub> - Weed free control	1.41 (0.00)	1.41 (0.00)	1.41 (0.00)	1.41 (0.00)	1.41 (0.00)	1.41 (0.00)
T <sub>8</sub> - Weedy control	7.05 (48.00)	5.63 (29.67)	4.96 (22.67)	4.38 (17.25)	3.77 (12.27)	3.39 (9.54)
<b>SE.d</b>	0.26	0.16	0.12	0.12	0.10	0.08
<b>CD (P=0.05)</b>	0.56	0.35	0.25	0.26	0.21	0.18

Values in parentheses are original and transformed to  $\sqrt{x+2}$

**Table 3: Preceding rice crop herbicide residue on leaf area index, DMP, root characters of urdbean under high rainfall area**

Treatments	Growth attributes at 25 DAS			
	LAI	DMP (kg/ha)	Root length (cm)	Root dry weight (kg/ha)
T <sub>1</sub> - Oxadiargyl loading with biochar applied on 3 DAP	1.09	288	12.43	36.0
T <sub>2</sub> - Oxadiargyl loading with zeolites applied on 3 DAP	1.00	219	12.10	32.9
T <sub>3</sub> - Oxadiargyl entrapped in starch applied on 3 DAP	1.05	230	12.30	33.2
T <sub>4</sub> - Oxadiargyl entrapped in water-soluble polymers applied on 3 DAP	1.03	192	10.70	29.5
T <sub>5</sub> —Application of 100g/ha of oxadiargyl on 3 DAP	0.94	187	9.77	27.0
T <sub>6</sub> - Application of 1.25 kg/ha of butachlor on 3 DAP along with manual weeding at 40 DAP + two manual weeding on 20 and 40 DAS in bhendi and urdbean	1.25	334	15.10	37.6
T <sub>7</sub> - Weed free control	1.88	425	16.83	43.0
T <sub>8</sub> - Weedy control	0.78	184	8.43	20.0
SE.d	0.04	21.54	0.55	1.33
CD (P=0.05)	0.10	46.09	1.18	2.84

**Figure 1: Preceding rice herbicide residue on seed yield and halum yield (q/ha) of urdbean.****Herbicide residual effect of weeds**

Herbicide residual effect of preceding rice crops weed control treatments exerted significant influence on grasses, sedges and broad leaf weed population and dry biomass production on 20 DAS (Table 2). Lowest value of grassy, sedge and broad leaf weed population under weed free control. At 20 DAS, significantly lower grass weed density registered in residual effect of 1.25 kg/ha butachlor applied at 3 DAP supplement with manual weeding at 40 DAP in rice + two manual weeding on 20 and

40 DAS in bhendi and urdbean. The next best treatment was residual effects of oxadiargyl loading with biochar applied at 3 DAP which was at par with oxadiargyl entrapped with starch applied at 3 DAP. Similar trend had noticed in sedges and broad leaved weed density. Higher grass weed density was recorded in weedy control. Weed free control recorded superiority in diminution of grassy, sedge and broad leaf weeds dry biomass production at 20 DAS of observation. Irrespective of weed control measures, at 20 DAS, grass weed dry weight showed significant influence among the treatments. Residual effect of 1.25 kg/ha butachlor application

at 3 DAP supplemental with manual weeding at 40 DAP in rice + two manual weeding on 20 and 40 DAS in bhendi and urdbean recorded lesser dry weight of grasses (2.93 g/m<sup>2</sup>). It was followed by residual effect oxadiargyl loading biochar applied at 3 DAP, oxadiargyl entrapped starch applied at 3 DAP and residue of oxadiargyl entrapped water-soluble polymers applied at 3 DAP. Grassy, sedges and broad leaved weed had registered highest biomass weight of 17.25, 12.27, 9.54 g/m<sup>2</sup> respectively under weedy control treatment. It might be owing to greater weed count and dry biomass production in preceding rice and bhendi crop which depleted more resource. Similar line of findings was reported by Bommayasamy and Chinnamuthu (2019; 2022).

#### **Herbicide residual influence on crop growth attributes**

Herbicide residue of preceding crops weed management treatments exerted marked influence on leaf area index, plant biomass production, length of roots and its dry weight at 25 DAS (Table 3). The impact of weed control treatments on dry matter production was well exhibited at 25 days after of sampling. Weed free check exhibited its superiority by registering higher LAI, dry matter production, root length and root dry weight of 1.88, 546 kg/ha, 16.83 cm, 43.0 kg/ha respectively on 25 DAS. Among the preceding crop residual treatments, preceding rice herbicide of 1.25 kg/ha of butachlor applied at 3 DAP along with manual weeding at 40 DAP in rice + two manual weeding on 20 and 40 DAS in bhendi and urdbean was recorded higher DMP of 334 kg/ha which was accumulated 81.5% higher dry matter as against to weedy control. It's mainly owing to weed free condition during critical stage and effective utilization of resources like moisture, nutrient, light and space resulted in better plant growth, crop canopy coverage which leads to enhanced crop biomass production. Yadav *et al.* (2004) found that the herbicide oxadiargyl had no negative impact on the plant stand or yield of succeeding harvest of pearl millet or moth bean. The similar line of findings was reported by Chandolia (2009). Herbicide applied to unpuddled transplanted rice showed no effect on subsequent wheat, lentil, and sunflower germination, leaf chlorophyll content, shoot length, or dry matter (Zahan *et al.*, 2016).

Residual effect of 1.25 kg/ha butachlor application at 3 DAP along with manual weeding at 40 DAP + two manual weeding on 20 and 40 DAS in okra and urdbean was recorded 79.1 and 88.0% higher root length and root dry weight respectively as compared weedy control. This may be owing to higher competition of weed as well as heavy drain in soil nutrient by weed; main crop suffered and resulted in reduced root length and dry weight.

#### **Effect on seed and haulm yield**

Significant difference among herbicide residual effect of preceding rice crop weed control treatments were evidenced with seed yield of urdbean (Fig.1). Among the weed control treatments, residual effect of 1.25 kg/ha butachlor application at 3 DAP along with manual weeding at 40 DAP in rice + two manual weeding on 20 and 40 DAS in okra and urdbean registered 299 kg/ha higher seed yield as compared to weedy check. Similar trend was observed in haulm yield. Results showed that positive effect on seed and haulm yield in these treatments was perhaps leads to accumulation of higher crop biomass due to effective weed control. The results of experiment were in agreement and conformity in the earlier findings of Naidu *et al.* (2012). Significantly least urdbean seed yield was obtained under weedy control which was comparable with residual effect of 100 g/ha oxadiargyl at 3 DAP. It might be due to lesser number of cluster, pods and seeds/pod recorded under weedy check than other weed control treatments. Reduction in urdbean yield attributing characters observed with the heavy weed infestation in rice fallow urdbean (Rao *et al.*, 2010; Aggarwal *et al.*, 2014; Bommayasamy and Chinnamuthu, 2021).

#### **Conclusion**

It was concluded that the residual effect of butachlor @ 1.25 kg/ha after hand weeding on 40 DAT in rice and manual weeding twice at 20 and 40 DAS (both bhendi and urdbean) efficiently controlled weeds and significantly reduced soil weed seed bank in future crops, resulting in improved urdbean growth and seed yield.

#### **Conflict of interest**

The authors declare that they have no conflict of interest.

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