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# WEED MANAGEMENT PRACTICES ON PHYTOTOXICITY OF DIRECT SEEDED RICE AND RESIDUAL EFFECT OF NUTRIENT AND WEED DYNAMICS ON SUCCEEDING BLACKGRAM

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## ABSTRACT

A field experiment was conducted to investigate the residual effect of nutrient and weed dynamics imposed to preceding direct seeded rice on succeeding blackgram at wetland farm of S. V. Agricultural College, Tirupati during *kharif* 2020 and 2021 and *rabi* 2020-21 and 2021-22 was laid out in a split plot design with three replications. There were three main plots comprising of *viz*., 100 % RDF ($N_1$), 125% RDF ($N_2$) and 150% RDF ($N_3$) and five sub plots *viz*., Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g $ha^{-1}$ at 20 DAS ($W_1$), Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g $ha^{-1}$ at 20 DAS ($W_2$), Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* bispyribac-sodium 20 g $ha^{-1}$ at 20 DAS ($W_3$), hand weeding twice at 20 and 40 DAS ($W_4$) and unweeded check ($W_5$). From this experiment, it was revealed that there were no phytotoxicity symptoms on direct seeded rice and no residual effect on succeeding blackgram in terms of germination percentage, plant height, leaf area index and dry matter production. Therefore, it can be concluded that all the nutrient and weed dynamics were found to be safe and minimal impact on succeeding blackgram and suitable for rice based cropping systems.

**KEYWORDS:** Direct seeded rice, Weed management practices, Residual effect, Phytotoxicity, Germination percentage.

## INTRODUCTION

Rice is grown under a range of climatic conditions and agro-ecological zones. In India, lowland rice occupies 30 per cent of the total cultivated area of rice with an average productivity of 1.55 t $ha^{-1}$ under rainfed condition. India ranks second with 124.37 million tonnes of rice production, in an area of 45.77 million hectares and with a productivity of 2717 kg $ha^{-1}$. In Andhra Pradesh, rice is cultivated in an area of 2.32 million hectares with a production of 7.88 million tonnes and productivity of 4437 kg $ha^{-1}$ (Ministry of Agriculture and Farmer's Welfare, Govt. of India, 2020-21). India has to increase the rice productivity in order to sustain present food self-sufficiency and to meet future food requirements. Due to heavy weed infestation, the productivity of upland rice is declined. Depending on the weed flora, their density and duration of competition, yield losses varied from 40 to 100% (Choubey *et al*., 2001) and rice emerge simultaneously, which is challenging to figure out the ideal weed control and techniques. Any weeding delay will result in a surge of weed biomass, which has a negative relationship with yield. As a result, the DSR production technology aiming for utmost productivity and profitability must employ an effective and early weed management strategy.

Hand weeding is the conventional and most effective way of weed control in rice, although it is more expensive and often became difficult to keep the crop weed-free during the vital period (critical crop-weed competition) due to labour shortage. In direct seeded rice, manual and mechanical weed control procedures were effective, but labour shortages during peak period and rising labour wages are causing weed control practices to be delayed and costly. It has forced the farmers to continuously use traditional herbicides as a default option to control weeds. Continuous use of herbicide with same mode of action leads appearance of more notorious weeds (Mohapatra *et al*., 2021). To avoid such disaster, it is advised to use novel herbicide molecules with several modes of action to manage this composite weed flora in rice (Gangireddy and Subramanyam, 2020) and to understand the phytotoxic effect of different novel herbicides on crop.

Rice-blackgram cropping sequence plays a vital role in national food security. Rice-pulse is the predominant cropping system of rice growing areas of

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Andhra Pradesh. Recommended dose of nutrient and herbicides may have a positive impact on main and subsequent crops. However, some herbicides can persist for longer periods and effect the succeeding crops (Rani *et al*., 2021). Therefore it is necessary to understand and study the residual effect of both nutrient levels and weed management practices on succeeding blackgram.

## MATERIAL AND METHODS

Field experiments were conducted during *kharif*, 2020 and 2021 and *rabi* 2020-21 and 2021-22 at wetland farm of S. V. Agricultural College, Tirupati, geographically situated at 13.5°N latitude and 79.5°E longitude and at an altitude of 182.9 m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. The experimental soil was sandy clay loam in texture, slightly alkaline in reaction (0.40 and 0.44 dS $m^{-1}$), low in organic carbon (0.40 and 0.42%) and available nitrogen (260.7 and 272.9 kg $ha^{-1}$) and medium in available phosphorus (25.5 and 29.2 kg $ha^{-1}$) and available potassium (306.5 and 320.0 kg $ha^{-1}$) during 2020-21 and 2021-22. The treatments in main plot assigned of three nutrient levels *viz*., 100% RDF ($N_1$), 125% RDF ($N_2$) and 150% RDF ($N_3$) under main plots and five weed management practices comprised to sub plots *viz*., Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g $ha^{-1}$ at 20 DAS ($W_1$), Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g $ha^{-1}$ at 20 DAS ($W_2$), Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* bispyribac-sodium 20 g $ha^{-1}$ at 20 DAS ($W_3$), hand weeding twice at 20 and 40 DAS ($W_4$) and unweeded check ($W_5$). Application of nutrients was done as per the treatments in the form of urea, single super phosphate and muriate of potash, respectively. Nitrogen was applied in three splits at 15 DAS, tillering and at panicle initiation stages. Entire quantity of phosphorus was applied at the time of sowing and potassium was applied in two splits, ½ at the time of sowing and the remaining ½ at panicle initiation stage. Phytotoxicity scoring was taken in rice crop by adopting a scale (range of 0-10). Data on germination percentage of succeeding blackgram was recorded. Healthy and matured seeds of blackgram treated with carbendazim 3 g $kg^{-1}$ of seed were used for sowing. The treated seeds were sown at a spacing of 30 cm between the rows and 10 cm between the plants within a row. The number of plants germinated in the net plot area was counted in all the treatments and the germination percentage was calculated as per the following formula.

Germination percentage =

$$\frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

The data obtained on germination percentage of succeeding blackgram was analysed statistically by the method of analysis of variance for split plot design as suggested by Panse and Sukhatme (1985).

## RESULTS AND DISCUSSION

### Phytotoxicity

Phytotoxicity rating of herbicides on direct seeded rice was observed at 5$^{th}$ and 10$^{th}$ day after application of pre emergence and post emergence herbicides, respectively as per the method suggested by Singh and Rao (1976) as mentioned in Table 1. Phytotoxicity scoring was taken in rice crop by adopting a scale (range of 0-10). Where, scoring 0 means no injury and no reduction in plant population, 10 means complete crop destruction Table 2.

### Germination percentage

After harvest of direct seeded rice, blackgram was cultivated in an undisturbed layout to study the residual effect of nutrient levels and weed management practices applied to preceding direct seeded rice on succeeding blackgram. Germination percentage was found non-significant during both the years of study and in the pooled mean Table 3. The interaction effect due to nutrient and weed management practices was not significantly traceable during both the years of study and in the pooled mean.

### Growth parameters

With respect to growth parameters *viz*., plant height, leaf area index and dry matter production of succeeding blackgram were significantly higher with 150% RDF ($N_3$) followed by 125% RDF ($N_2$) and 100% RDF ($N_1$) in decreasing order during both the years of study and in the pooled mean. Among the weed management practices, the above parameters were higher with hand weeding twice at 20 and 40 DAS ($W_4$) which was statistically at par with PE application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g $ha^{-1}$ at 20 DAS ($W_2$), PE application of pyrazosulfuron-ethyl

**Table 1. Phytotoxicity scoring chart**

| Effect | Rating | Visual symptoms |
|---|---|---|
| None | 0 | No injury, normal growth |
| | 1 | Slight stunting injury or discolouration |
| | 2 | Some stand loss, stunting or discolouration |
| | 3 | Injury more pronounced but not persistent |
| Moderate | 4 | Moderate injury, recovery is possible |
| | 5 | Injury more persistent, recovery is doubtful |
| | 6 | Near severe injury, no recovery possible |
| | 7 | Severe injury, stand loss |
| | 8 | Almost destroyed, few plants surviving |
| | 9 | Very few plants alive |
| Complete | 10 | Complete destruction |

**Table 2. Phytotoxicity scoring of direct seeded rice due to application of pre and post emergence herbicides**

| Treatments | Pre emergence herbicides | | Post emergence herbicides | |
|---|---|---|---|---|
| | 5 DAA | 10 DAA | 5 DAA | 10 DAA |
| $W_1$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g $ha^{-1}$ at 20 DAS | 0 | 0 | 0 | 0 |
| $W_2$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g $ha^{-1}$ at 20 DAS | 0 | 0 | 0 | 0 |
| $W_3$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* bispyribac-sodium 20 g $ha^{-1}$ at 20 DAS | 0 | 0 | 0 | 0 |
| $W_4$ : Hand weeding twice at 20 and 40 DAS | - | - | - | - |
| $W_5$ : Unweeded check | - | - | - | - |

25 g $ha^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g $ha^{-1}$ at 20 DAS ($W_1$) and PE application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* bispyribac-sodium 20g $ha^{-1}$ at 20 DAS ($W_3$). Whereas, lowest values were recorded with unweeded check ($W_5$) during both the years of study and in the pooled mean Table 4. The interaction effect due to nutrient levels and weed management practices was found to be non-significant.

From the above investigation it can be concluded that the use of different fertilizer doses and pre emergence broad spectrum herbicides and post emergence herbicide mixtures are very safe to direct seeded rice based cropping system with no residual effect, least environmental impact and without any residual effect on succeeding blackgram.

**Table 3. Germination percentage of succeeding blackgram as influenced by nutrient levels and weed management practices imposed to preceding direct seeded rice**

| Treatments | Germination percentage | | |
|---|---|---|---|
| | 2020 | 2021 | Pooled |
| **Nutrient levels** | | | |
| $N_1$ : 100% RDF | 90.0 | 89.7 | 89.8 |
| $N_2$ : 125% RDF | 90.3 | 90.0 | 90.2 |
| $N_3$ : 150% RDF | 90.5 | 90.3 | 90.4 |
| SEm ± | **0.35** | **0.37** | **0.36** |
| CD (P = 0.05) | **NS** | **NS** | **NS** |
| **Weed management practices** | | | |
| $W_1$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g $ha^{-1}$ at 20 DAS | 90.4 | 90.1 | 90.2 |
| $W_2$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g $ha^{-1}$ at 20 DAS | 90.7 | 90.6 | 90.6 |
| $W_3$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g $ha^{-1}$ *fb* bispyribac-sodium 20 g $ha^{-1}$ at 20 DAS | 90.1 | 89.9 | 90.0 |
| $W_4$ : Hand weeding twice at 20 and 40 DAS | 90.9 | 90.7 | 90.8 |
| $W_5$ : Unweeded check | 89.2 | 89.1 | 89.1 |
| SEm ± | **0.94** | **0.95** | **0.96** |
| CD (P = 0.05) | **NS** | **NS** | **NS** |
| **Interaction** | | | |
| **N at W** | | | |
| SEm ± | **1.93** | **1.92** | **1.96** |
| CD (P = 0.05) | **NS** | **NS** | **NS** |
| **W at N** | | | |
| SEm ± | **1.63** | **1.62** | **1.68** |
| CD (P = 0.05) | **NS** | **NS** | **NS** |

**Table 4. Growth parameters of succeeding blackgram at 25 DAS as influenced by nutrient levels and weed management practices imposed to preceding direct seeded rice**

| Treatments | Plant height (cm) | | | Leaf area index | | | Dry matter production (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Nutrient levels** | | | | | | | | | |
| $N_1$ : 100% RDF | 12.6 | 12.0 | 12.3 | 0.49 | 0.45 | 0.47 | 254 | 238 | 246 |
| $N_2$ : 125% RDF | 14.4 | 13.7 | 14.1 | 0.56 | 0.52 | 0.54 | 296 | 271 | 284 |
| $N_3$ : 150% RDF | 16.2 | 15.5 | 15.9 | 0.63 | 0.59 | 0.61 | 339 | 314 | 327 |
| SEm ± | **0.41** | **0.39** | **0.42** | **0.013** | **0.010** | **0.014** | **7.5** | **6.9** | **7.1** |
| CD (P=0.05) | **1.6** | **1.5** | **1.7** | **0.05** | **0.04** | **0.05** | **29** | **27** | **28** |
| **Weed management practices** | | | | | | | | | |
| $W_1$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g ha$^{-1}$ *fb* penoxsulam + cyhalofop-p-butyl 125 g ha$^{-1}$ at 20 DAS | 18.8 | 18.0 | 18.4 | 0.67 | 0.65 | 0.66 | 370 | 354 | 362 |
| $W_2$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g ha$^{-1}$ *fb* florpyrauxifenbenzyl + cyhalofop-p-butyl 150 g ha$^{-1}$ at 20 DAS | 19.2 | 18.4 | 18.8 | 0.69 | 0.66 | 0.68 | 379 | 362 | 371 |
| $W_3$ : Pre emergence (PE) application of pyrazosulfuron-ethyl 25 g ha$^{-1}$ *fb* bispyribac-sodium 20 g ha$^{-1}$ at 20 DAS | 18.6 | 17.9 | 18.3 | 0.66 | 0.64 | 0.65 | 368 | 349 | 359 |
| $W_4$ : Hand weeding twice at 20 and 40 DAS | 19.5 | 18.6 | 19.1 | 0.70 | 0.68 | 0.69 | 384 | 366 | 375 |
| $W_5$ : Unweeded check | 14.4 | 13.8 | 14.1 | 0.42 | 0.41 | 0.42 | 217 | 198 | 208 |
| SEm ± | **0.39** | **0.43** | **0.46** | **0.022** | **0.015** | **0.021** | **7.9** | **7.2** | **7.5** |
| CD (P=0.05) | **1.2** | **1.3** | **1.4** | **0.06** | **0.05** | **0.06** | **24** | **21** | **23** |
| **Interaction** | | | | | | | | | |
| **N at W** | | | | | | | | | |
| SEm ± | **0.95** | **0.99** | **0.98** | **0.046** | **0.040** | **0.044** | **18.7** | **16.8** | **14.8** |
| CD (P=0.05) | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** |
| **W at N** | | | | | | | | | |
| SEm ± | **0.68** | **0.74** | **0.76** | **0.038** | **0.032** | **0.035** | **13.6** | **12.5** | **11.3** |
| CD (P=0.05) | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** |

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