*Biological Forum – An International Journal* 13(3a): 789-792(2021)

**ISSN No. (Print): 0975-1130**
**ISSN No. (Online): 2249-3239**

# Efficacy of Weedicides in Controlling Weeds in Nutri Cereals

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*(Received 26 July 2021, Accepted 30 September, 2021)*
*(Published by Research Trend, Website: www.researchtrend.net)*

**ABSTRACT: An experiment to study the efficacy of weedicides in Kodo millet was conducted at Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bengaluru during *Kharif* 2018 and 2019 on weed density and yield parameters. The extent of yield reduction owing to weed is 33-50% in nutri cereals depending on the intensity and persistence of weed density. To find out the effective pre and post emergent weedicides for Kodo millet, a promising nutri cereal crop, the experiment was conducted and was laid in RCBD comprising 12 treatments. Among the herbicide treatments, the grain yield at the treatments of bensulfuron methyl 0.6 G + pretilachlor 6.0 G @ 165 g a. i. ha$^{-1}$ followed by bispyribac sodium 10 SC @ 10 g a. i. ha$^{-1}$ (1958 kg ha$^{-1}$) and bensulfuron methyl 0.6 G + pretilachlor 6.0 G @ 165 g a. i. ha$^{-1}$ followed by ethoxysulfuron 15 WG @ 12 g a. i. ha$^{-1}$ (1940 kg ha$^{-1}$) were found significantly higher to other treatments and were at par with treatment weed free check which recorded higher grain yield of kodo millet (2107 kg ha$^{-1}$). Significantly the lowest grain yield was reported in unweeded control (717 kg ha$^{-1}$).**

**Keywords:** Oxadiargyl, Bensulfuron methyl + Pretilachlor, Pendimethalin, Bispyribac sodium.

## INTRODUCTION

Small millet occupies an area of 4.84 lakh ha with 3.33 lakh tones total production in India and kodo millet occupies a sizeable area often seen grown mainly in the states of Chhattisgarh, Uttarakhand, Karnataka, Andhra Pradesh, Rajasthan, Bihar, Nagaland and Uttar Pradesh. In Karnataka small millets occupies an area of lakh ha with the production potential of 0.16 lakh tonnes and with a productivity of 840 kg ha$^{-1}$. Kodo millet (*Paspalum scrobiculatum* L.) is an important hardy crop of dryland area, where hardly any cereal crop can be grown. It is a long duration crop (125-135 days) with relatively low water requirement and sometimes it is used as an intercrop. It could be easily adopted to adverse climatic conditions *i.e.,* drought, high temperature, low soil fertility and incidence of diseases and pests. Hence, this nutri cereal is most suited for sustainable agriculture under rainfed areas. Kodo millet crops also enjoys special status in hilly agriculture and in undulating fields, where small areas are cultivated and no other crops worth's mentioning can give a reasonable harvest. The motives for lesser yields are severe weed infestation due to slow initial growth of crop accompanied by frequent rains in rainy season cause huge yield losses to an extent of 37 % (Yaduraju, 2006; Mirza Hasanuzzama *et al.,* 2009; Patil *et al*. 2013; Lekhana *et al.,* 2021). In an effort to obtain higher economical yield of kodo millet, weeds need to be kept under check. The pre-emergent application of isoproturon has been recommended for kodo millet, however it's availability in market is scarce. The weed infestation is escalating day by day universally wherever kodo millet is grown. So, in order to achieve broad spectrum, weed control, it is necessary to use herbicides and their combinations having different mode of action (Walia *et al*., 2007). Adequate studies on suitability of herbicides and optimum doses for effective and economical control of weeds in kodo millet crop are lacking. Therefore, herbicide molecules like oxadiargyl, bensulfuron methyl + pretilachlor, pendimethalin, bispyribac sodium, ethoxysulfuron in combinations were tried followed by two intercultivation + hand weeding, weed free and unweeded check are included in the present study.

## MATERIALS AND METHOD

The present investigation in red sandy loam soil was conducted during *Kharif* 2018 at Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bengaluru coming under the Eastern Dry Zone of Karnataka. The experiment initiated to study the efficacy of weedicides in weed management practices on weed density and yield parameters of kodo millet. The RCBD design was adopted and 12 treatments replicated thrice *viz*., $T_1$: oxadiargyl 80 WP @150 g a. i. ha$^{-1}$, $T_2$: bensulfuron methyl 0.6 G + pretilachlor 6.0 G (165 g a. i/ha), $T_3$: pendimethalin 38.7 CS (450 g a. i/ha), $T_4$: oxadiargyl 80 WP (150 g a.i/ha) *fb* bispyribac sodium 10 SC (10 g a. i/ha), $T_5$: bensulfuron methyl 0.6 G + pretilachlor 6.0 G(165 g a.i/ha) *fb* bispyribac sodium 10 SC (10 g a. i/ha), $T_6$: pendimethalin 38.7 CS (450 g a.i/ha) *fb* bispyribac sodium 10 SC (10 g a.i/ha), $T_7$: oxadiargyl 80 WP (150 g a.i/ha) *fb* ethoxysulfuron 15 WG (12 g a.i/ha), $T_8$: bensulfuron methyl 0.6 G + pretilachlor 6.0 G (165 g a. i/ha)) *fb* ethoxysulfuron15

WG (12 g a. i/ha), $T_9$: pendimethalin 38.7 CS (450 g a. i/ha) *fb* ethoxysulfuron 15 WG (12 g a.i/ha), $T_{10}$: two intercultivation + hand weeding @20 & 40 DAS, $T_{11}$: un weeded check and $T_{12}$: weed free check. Fifty per cent of Nitrogen fertilizer (40 kg $ha^{-1}$) and 100 per cent recommended $P_2O_5$ (20 kg $ha^{-1}$) were applied to field as basal dose. The remaining 50 per cent nitrogen was top dressed at 30-35 days after sowing (DAS). For hectare area, spray volume used was 750 liters for pre emergent herbicide and 375 liters for post emergent herbicides.

Species wise weed count (number 0.25 $m^{-2}$) was recorded at two random spots in net plot area and weeds were classified as sedge, broad leaf weeds and grasses expressed in number $m^{-2}$. The data on dry weight and density of weeds were calculated using square root (x+1) (Gomez and Gomez, 1984). The yield was recorded at harvest in kg $ha^{-1}$ and the data were statistically analyzed at a probability level of 0.05 per cent.

## RESULTS AND DISCUSSION

Among all herbicide treatments (Table 1), significantly lower density of sedge was recorded at $T_4$ *i.e.*, pre emergence oxadiargyl 80 % WP 150 g a. i. $ha^{-1}$ (2.29 $m^{-2}$ and 1.63$m^{-2}$, respectively). Significantly lower number of grassy weeds was recorded at $T_5$ *i.e.*, pre emergence spray of bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ *fb* post emergent application of bispyribac sodium 10 % SC 10 g a. i. $ha^{-1}$ (3.15 $m^{-2}$ and 3.81$m^{-2}$, respectively) and was on par with $T_8$ and $T_6$.

**Table 1: Category wise weed density (number $m^{-2}$) at 45 and at harvest in kodo millet as influenced by weed management practices (2 years pooled data).**

| Treatments | 45 DAS | | | | At harvest | | | |
|---|---|---|---|---|---|---|---|---|
| | Sedge | Grasses | BLWs | Total | Sedge | Grasses | BLWs | Total |
| $T_1$ | 2.76 (6.67) | 4.99 (24.00) | 5.13 (25.33) | 7.55 (56.00) | 2.23 (4.66) | 5.61 (30.66) | 3.95 (14.66) | 7.13 (50.00) |
| $T_2$ | 2.87 (7.33) | 4.37 (18.30) | 4.26 (17.33) | 6.62 (43.00) | 2.35 (4.00) | 5.21 (26.33) | 3.82 (13.66) | 6.69 (44.00) |
| $T_3$ | 2.94 (7.67) | 4.83 (22.30) | 4.86 (22.66) | 7.32 (52.66) | 2.18 (3.33) | 5.35 (27.66) | 4.35 (18.00) | 7.06 (49.00) |
| $T_4$ | 2.29 (4.33) | 4.69 (21.30) | 3.86 (14.66) | 6.64 (43.33) | 1.63 (5.33) | 5.02 (24.33) | 3.74 (13.00) | 6.60 (42.66) |
| $T_5$ | 2.88 (7.33) | 3.15 (9.00) | 2.90 (7.66) | 4.67 (21.00) | 2.48 (65.15) | 3.81 (13.66) | 2.55 (5.66) | 4.69 (21.00) |
| $T_6$ | 2.94 (7.67) | 4.20 (16.70) | 3.21 (9.33) | 5.88 (33.66) | 2.14 (3.66) | 5.08 (25.00) | 4.00 (15.00) | 6.68 (43.66) |
| $T_7$ | 2.58 (5.67) | 4.60 (20.70) | 4.12 (16.00) | 6.64 (43.33) | 1.72 (3.00) | 4.12 (23.66) | 3.87 (14.00) | 6.45 (40.66) |
| $T_8$ | 2.76 (6.67) | 2.93 (7.70) | 3.05 (8.66) | 4.78 (22.00) | 1.99 (2.00) | 3.40 (10.66) | 2.87 (8.66) | 4.72 (21.33) |
| $T_9$ | 2.73 (6.67) | 4.42 (18.70) | 3.78 (13.33) | 6.29 (38.66) | 2.30 (4.33) | 4.89 (23.00) | 3.81 (13.66) | 6.47 (41.00) |
| $T_{10}$ | 1.82 (2.33) | 2.14 (3.70) | 2.85 (7.33) | 3.78 (13.33) | 1.28 (0.66) | 3.31 (10.00) | 1.91 (2.66) | 3.78 (13.33) |
| $T_{11}$ | 3.20 (9.33) | 5.47 (29.00) | 6.72 (44.33) | 9.14 (82.66) | 2.99 (8.00) | 6.25 (38.33) | 6.95 (47.33) | 9.72 (93.66) |
| $T_{12}$ | 1.00 (0.00) | 1.00 (0.00) | 1.00 (0.00) | 1.00 (0.00) | 1.00 (0.00) | 1.00 (0.00) | 1.00 (0.00) | 1.00 |
| S.Em$\pm$ | 0.16 | 0.24 | 0.30 | 0.23 | 0.18 | 0.27 | 0.13 | 0.21 |
| C. D. at 5% | 0.47 | 0.71 | 0.88 | 0.70 | 0.53 | 0.79 | 0.39 | 0.64 |

Data within parentheses are original values; data analyzed using square root (x+1) transformation; DAS-Days after sowing, BLWs-Broad leaved weeds

The broad leaf weeds were significantly lower in $T_5$ *i.e.*, application of pre emergence herbicide bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ *fb* bispyribac sodium 10 % SC 10 g a. i. $ha^{-1}$ as post emergent weedicide (2.90 $m^{-2}$) in comparison with other treatments except $T_8$ with which it was at par. At 45 DAS and at harvest, application of bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ as pre-emergent herbicide *fb* post emergent application of bispyribac sodium 10 % SC 10 g a. i. $ha^{-1}$ ($T_5$) recorded statistically lower total weed density (4.67 $m^{-2}$ and 4.69 $m^{-2}$, respectively) in comparison to other treatments except $T_8$ (4.78 $m^{-2}$ and 4.72 $m^{-2}$, respectively). Similar results are found with the studies of Mani *et al., (*1973); Murthy *et al*., (2012); Pradeep *et al*., (2017).

Among all the treatments, the lowest sedge, grass and total weed density was documented in weed free check ($T_{12}$) due to hand weeding engaged at 20 and 40 DAS which has removed below and above ground parts of weeds. Whereas, unweeded control ($T_{11}$) recorded the highest grasses, sedge, broad leaf weeds and entire weed density due to the no interruption for growth of weeds and same trend was observed at harvest also.

The weed management practices significantly influenced the Grain yield of kodo millet (Table 2). The grain yield observed with herbicide treatments, $T_5$ *i.e.*, bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ as pre-emergent herbicide *fb* bispyribac sodium 10 % SC 10 g a. i. $ha^{-1}$ 20 DAS (1958 kg $ha^{-1}$) was significantly higher to other treatments and was at par to $T_8$ *i.e*., bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ at 3 DAS *fb* ethoxysulfuron 15 % WG 12 g a. i. $ha^{-1}$ at 20 DAS (1940 kg $ha^{-1}$). Whereas, unweeded control ($T_{11}$) recorded statistically lesser grain yield (717 kg $ha^{-1}$) compared to all other treatments.

Yield is product of interactions of several attributes *i.e*.., plant genetic character, soil and environmental factors such as biotic and abiotic reasons. Among the biotic stresses, weeds infestation in the cropped areas cause massive loss in crop yields by competing for the available resources with the crop plants. All these factors immensely influence the dry matter content specially in reproductive fragments and yield attributes of kodo millet (Shanmugapriya *et al*., 2019).

The higher grain yield of kodo millet among herbicide treatments was documented at bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. $ha^{-1}$ as pre emergent herbicide *fb* bispyribac sodium 10 % SC 10 g a. i. $ha^{-1}$. This is because of the broad spectrum weed control during the critical crop period competition for weed, which otherwise resulted in competition for light, space and nutrients with crop. It has provided favourable environment for better expression of growth and yield parameters *viz*., ear heads per plant, length of ear head, grains per ear head, weight of grains per ear head and 1000 seed weight. The collective effect of all these growth and yield components have resulted in increased yield. These studies are in confirmatory with the work of Singh *et al*., (2004); Dubey *et al*., (2005); Hussain *et al*., (2008); Charan Teja *et al*., (2015); Kumar *et al*., (2015). All the yield contributing characters were severely affected with unweeded control treatment for severe competition exercised by weeds for light, moisture, space and nutrients in entire crop duration which finally resulted in lesser kodo millet grain yield. Result obtained is in accordance with the results of Manjunatha *et al.,* (2013); Mishra *et al.,* (2018).

Kodo millet straw yield was certainly influenced significantly by weed management practices (Table 2). The straw yield at herbicide treatments, $T_5$ *i.e* bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. ha$^{-1}$ as pre emergent herbicide *fb* bispyribac sodium 10 % SC 10 g a. i. ha$^{-1}$ as post emergent herbicide (4063 kg ha$^{-1}$), $T_8$*i.e*., bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. ha$^{-1}$ as pre emergent application *fb* ethoxysulfuron 15 % WG 12 g a. i. ha$^{-1}$ as post emergent herbicide (4037 kg ha$^{-1}$) and $T_6$ *i.e*., pendimethalin 38.7 % CS 450 g a. i. ha$^{-1}$ *fb* bispyribac sodium 10 % SC 10 g a. i. ha$^{-1}$ were found to be significantly superior to other treatments and were at par weed free check ($T_{12}$) which registered the highest straw yield (4200 kg ha$^{-1}$). While, unweeded control ($T_{11}$) recorded significantly the lesser straw yield (2038 kg ha$^{-1}$) compared to rest of the treatments.

**Table 2: Thousandgrain weight, grain yield, straw yield and harvest index in kodo millet as influenced by weed management practices.**

| Weed management practices | 1000 grains weight (g) | Grain yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) | Harvest index |
|---|---|---|---|---|
| **$T_1$:** Oxadiargyl 80 % WP @150 g a. i. ha$^{-1}$ | 3.91 | 956 | 3055 | 0.24 |
| **$T_2$:** Bensulfuron methyl 0.6 % G + Pretilachlor 6.0 %G @165 g a. i. ha$^{-1}$ | 3.95 | 1173 | 3525 | 0.25 |
| **$T_3$:** Pendimethalin 38.7 % CS @ 450 g a. i. ha$^{-1}$ | 3.88 | 1046 | 3246 | 0.24 |
| **$T_4$:** Oxadiargyl 80 % WP @ 150 g a. i. ha$^{-1}$*fb* bispyribac sodium 10 SC @10 g a. i. ha$^{-1}$ | 4.25 | 1859 | 3896 | 0.32 |
| **$T_5$:** Bensulfuron methyl 0.6 G + pretilachlor 6.0 G @ 165 g a. i. ha$^{-1}$*fb*bispyribac sodium 10 SC @ 10 g a. i. ha$^{-1}$ | 4.95 | 1958 | 4063 | 0.33 |
| **$T_6$:** Pendimethalin 38.7 CS @ 450 g a. i. ha$^{-1}$ *fb*bispyribac sodium 10 SC @ 10 g a. i. ha$^{-1}$ | 4.77 | 1909 | 4012 | 0.32 |
| **$T_7$:** Oxadiargyl 80 WP @ 150 g a. i. ha$^{-1}$*fb* ethoxysulfuron 15 WG @ 12 g a. i. ha$^{-1}$ | 4.58 | 1504 | 3633 | 0.29 |
| **$T_8$:** Bensulfuron methyl 0.6 G + pretilachlor 6.0 G @ 165 g a. i. ha$^{-1}$*fb* ethoxysulfuron 15 WG @ 12 g a. i. ha$^{-1}$ | 4.83 | 1940 | 4037 | 0.32 |
| **$T_9$:** Pendimethalin 38.7 CS @ 450 g a. i. ha$^{-1}$*fb*ethoxysulfuron 15 WG @ 12 g a. i. ha$^{-1}$ | 4.68 | 1607 | 3737 | 0.30 |
| **$T_{10}$:** Two intercultivation + hand weeding | 4.96 | 2034 | 4101 | 0.33 |
| **$T_{11}$:** Un weeded check | 4.10 | 717 | 2038 | 0.26 |
| **$T_{12}$:** Weed free check | 4.97 | 2107 | 4200 | 0.33 |
| **S.Em±** | 0.32 | 64.95 | 77.31 | 0.12 |
| **C. D. at 5%** | 0.96 | 190.53 | 226.78 | NS |

DAS-Days after sowing, NS-Not significant

## CONCLUSION

Kodo millet is relatively a long duration crop as compared to other nutria cereals and hence provides greater scope for weed control during early growth stages of the crop. As vegetative growth of crop is more, pre as well as post emergent herbicides also plays a foremost role in effective control of the weeds. The present study concluded that the application of bensulfuron methyl 0.6 % G + pretilachlor 6.0 % G 165 g a. i. ha$^{-1}$ as pre-emergent herbicide *fb* post emergent application of bispyribac sodium 10 % SC 10 g a. i. ha$^{-1}$ is more beneficial owing to broad spectrum control of weeds more efficiently and thereby enhanced the yield of kodo millet.

## FUTURE SCOPE

**T**here is a need to study the effect of these herbicides on quality parameters of crop, soil microflora and residual effect on succeeding crop.

**Acknowledgement.** Authors are highly thankful to Project Coordinating Unit, ICAR-AICRP on Small Millets, GKVK, Bengaluru and the Indian Council of Agriculture Research, New Delhi for providing the support to conduct the research.

**Conflict of Interest.** There is absolutely no conflict of interest by the authors to declare.

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**How to cite this article:** Sukanya, T.S., Anand M.R., Meghana, G.K., Chaithra, C. and Morab, P.N. (2021). Efficacy of Weedicides in Controlling Weeds in Nutri Cereals. *Biological Forum – An International Journal*, *13*(3a): 789-792.