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Screening of Herbicides for Weed Control in Little Millet (*Panicum sumatrense)* Under South Karnataka

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Abstract

Field experiment was conducted at AICRP on Weed Management, University of Agricultural Sciences, GKVK, Bengaluru during *kharif* 2018-19 to screen herbicides for weed control in little millet (*Panicum sumatrense*). The experiment was laid out in randomised complete block design with three replications. The treatments comprised of different pre-emergence herbicides (Pendimethalin, Oxyfluorfen, Oxadiargyl, Bensulfuron + Pretilachlor) and post emergence herbicides (2,4-D Na salt 0.5 kg/ha, Bispyribac Na 100 ml/ha), Inter cultivation twice at 20 and 40 DAS, Hand weeding at 20 and 40 and weedy check. Plots treated with the pre-emergence herbicides exhibited profound influence on germination of crop. Plots treated with pre-emergent herbicides showed phytotoxic to little millet and complete failure of germination was noted. It is recommended not to increase these pre emergence herbicide at the dosage tried.

Keywords : Little millet, Pre- emergent herbicides, Phytotoxic, Screening of herbicides

India is the largest producer of the many kinds of millets. Millets are classified into two groups, namely major and minor millets. Major millets include sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*). Minor millets are finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa frumentacea*), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scorbiculatum*) little millet (*Panicum sumatrense*) and recently added brown top millet (Korle) *Brachiaria ramosa* (L.) Stapf. or *Urochloa ramosa* (L.) R. D. Webster.

Among the minor millets, little millet (*Panicum sumatrense)* is amazing in their nutrient content and nutritionally superior to other cereals like rice and wheat in terms of protein, fibre, rich in iron and less fat content. Every 100 g of little millet rice contains 7.7 g protein, 7.6 g fibre, 1.5 g mineral, 9.3 mg iron and 17 mg calcium. Little millet is rich in calcium and other necessary elements hence, little millet rice is recommended over rice. The little millet rice contains 8.3 per cent protein, 1.4 per cent fat, 67 per cent carbohydrates, 7.6 per cent fibre, carbohydrate to fibre ratio of dry cereal grains C/F = 8.82 Millet fibre help to lower risk of type two diabetes also mental orders (Compiled from the study published by National Institute of Nutrition, Hyderabad). This millet grain is recommended as a substitute for rice to patients suffering from diabetic. (Vinothini and Murali Arthanari, 2017).

In recent times, due to health consciousness, consumption of millets has increased, thus creating more demand. Millets are usually grown as dry land crop during rainy season as it requires less water, Owing to demand for little millet rice in recent times, farmers are cultivating millets under irrigated situation.

The initial growth of millets is very slow, which paves favourable conditions for weed multiplication and wide spectrum of weed flora to occur. Thus crop suffers heavy weed infestation; gradually become a serious limitation for low production, effective control of weeds at critical crop growth period is vital. Considering the present labour scarcity and drudgery, use of herbicides was found to be effecient weed mangement strategy for little millet cultivation under irrigated condition (Nagarjun, 2019 and Prashant, 2016) Studies on chemical weed control in minor millets were bare minimum especially in little millet.

The herbicide and plant interaction or differential response is the basis for selective chemical weed control in crop production (Anderson, 1977). Consequently the chemical weed control in minor millet production becomes more complex where the seeds sizes are very small. Laboratory experiments and feeler trials were conducted at AICRP Weed Management, Bengaluru. Surveillance on use of herbicides revealed that herbicides tested for one type of minor millet cannot be recommended for other minor millets, as it showed phytotoxic and germination was inhibited. Therefore, a study exclusively on screening of right herbicides at right dose to control weeds in little millet was designed. In this context, a research programme was formulated, to evolve weed management through herbicides 'Screening of Herbicides for weed control in Little Millet (*Panicum sumatrense*)' to evolve suitable herbicide for little millet.

Material and Methods

Field experiment was conducted at All India Co-ordinated Research Project on Weed Management, University of Agricultural Sciences, Bangalore during *kharif* 2018. The main objective of the study was to screen the suitable herbicide for controlling weeds in little millet and to study the bio efficacy, phytotoxicity of herbicides against complex weed flora and their effect on growth and yield of little millet.

The screening of herbicides was conducted in two phase of experiments.

Experiment 1 : Screening of Herbicides for Little Millet.

Experiment 2 : Screening of Herbicides for Little Millet with 50 per cent Reduced Dose of Screened Herbicides under experiment 1.

The experiment was laid out in Randomised block design with three replications. The treatments comprised of different Pre-emergence herbicides *viz.,* T_1 - PE - Pendimethalin 1.0 kg / ha *fb* Intercultivation at 30 DAS; T_2 - PE- Oxyfluorfen 0.5 kg/ha *fb* Inter cultivation at 30 DAS; T_3 - PE- Oxadiargyl 70 g /ha *fb* Intercultivation at 30 DAS; T_4 - PE - Bensulfuron + pretilachlor 660 g/ha (RM) *fb* Intercultivation at 30 DAS; T_5 - PE - Pendimethalin 1.0 kg/ha *fb* POE 2, 4-D Na salt 0.5 kg/ha; T_6 - PE- Pendimethalin 1.0 kg/ha *fb* POE Bispyribac Na 100ml/ha; T_7-PE Oxyfluorfen 0.5 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha; T_8- PE- Oxyfluorfen 0.5 kg/ha *fb* POE

Table 1

Qualitative description of treatment effects on weeds and crop in the visual scoring scale of 0 to 10 (Rao, 2006)

Effect	Rating	Weed Control Rating	Crop Toxicity Rating
None	0	No control	No injury, normal
Slight	1	Very poor control	Slight stunting, injury or discolouration
	2	Poor control	Some stand loss, stunting or discolouration
	3	Poor to deficient control	Injury more pronounced but not persistent
Moderate	4	Deficient control	Moderate injury, recovery possible
	5	Deficient to moderate control	Injury more persistent, recovery doubtful
	6	Moderate control	Near severe injury no recovery possible
Severe	7	Satisfactory control	Severe injury stand loss
	8	Good control	Almost destroyed a few plants surviving
	9	Good to excellent control	Very few plants alive
Complete	10	Complete control	Complete destruction

Source : (Rao and Rao, 2006)

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Bispyribac Na - 100 ml/ha ; T_9 - PE - Oxyfluorfen 0.5 kg/ha *fb* POE Bispyribac Na - 100ml/ha; T_{10} - PE -Oxadiargyl 70 g /ha *fb* POE Bispyribac Na - 100 ml/ha; T_{11} - PE -Bensulfuron + pretilachlor 660 g/ha (RM) + POE 2, 4-D Na salt 0.5 kg/ha; T_{12} - PE - Bensulfuron + pretilachlor 660 g/ha (RM) + POE 2, 4 - D Na salt 0.5 kg/ha; T_{13} - Inter cultivation twice at 20 & 40 DAS; T14 - Hand weeding at 20 & 40 DAS; T15 - Unweeded control.

Little millet Cv. OLM 203 was sown at a common spacing of 30 cm x 10 cm. Recommended dose of fertilizers 20 kg N, 20 kg P_2O_5 and 20 kg K_2O were applied in the form of urea, SSP and MOP, respectively, Entire quantity of phosphorus, potassium and half of nitrogen was applied as basal. The remaining nitrogen was applied as top dressing at 35 days after sowing. Bold and healthy seeds were hand dibbled. Seed rate 10 kg/ha. The plot size was 9 m x 3.6 m.The pre-emergent herbicides were applied using spray volume of 750 litres/ha with Knapsack sprayer having WFN nozzle.

All the biometric observation like emergence count (per cent), weed number and dry weight, weed control and crop toxicity ratings were recorded computed and analysed. The following weed crop toxicity ratings (Rao and Rao, 1986) were adopted with reference to control plots.

RESULTS AND DISCUSSION

Major weed flora observed in experiment plots during investigation were, *Echinochloa colona, Echinochloa crusgalli, Dactyloctenium aegyptium, Setaria glauca, Bracheria repans, Echinochloa indica, Chloris barbata* and *Cyanodondactylon among grasses; Cyperus rotundus among sedges,* Whereas, in Broad leaf weeds, *Borreria hispida, Spilanthus acmella, Ageratum conyzoides, Acanthospermum hispidium* and *Commelina benghalensis.*

TABLE 2

Crop toxicity ratings as influenced by different herbicides in little millet sown during *kharif* 2018-19 at Main Research Station, Hebbal, Bangalore

	Treatments	Days after herbicide application (DAHA)							
		3	5	7	15	18	20	25	30
T1	PE- Pendimethalin 1.0 kg/ha *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T2	PE- Oxyfluorfen 0.5 kg/ha *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T3	PE- Oxadiargyl 70 g /ha *fb* Intercultivation at 30 DAS	2	2	2	7	10	10	10	10
T4	PE- Bensulfuron + pretilachlor 660 g/ha (RM) *fb* Intercultivation at 30 DAS	2	2	2	7	10	10	10	10
T5	PE- Pendimethalin 1.0 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	10	10	10	10	10	10	10	10
T6	PE- Pendimethalin 1.0 kg/ha *fb* POE Bispyribac Na 100ml/ha	10	10	10	10	10	10	10	10
T7	PE Oxyfluorfen 0.5 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	10	10	10	10	10	10	10	10
T8	PE- Oxyfluorfen 0.5 kg/ha *fb* POE Bispyribac Na- 100ml/ha	10	10	10	10	10	10	10	10
T9	PE Oxadiargyl 70 g /ha *fb* POE 2,4-D Na salt 0.5 kg/ha	2	2	2	7	10	10	10	10
T10	PE -Oxadiargyl 70 g /ha *fb* POE Bispyribac Na- 100ml/ha	2	2	2	7	10	10	10	10
T11	PE -Bensulfuron + pretilachlor 660 g/ha (RM) + POE 2,4-D Na salt 0.5 kg/ha	2	2	2	7	10	10	10	10
T12	Inter cultivation twice at 20 and 40 DAS	0	0	0	0	0	0	0	0
T13	Hand weeding at 20 and40 DAS	0	0	0	0	0	0	0	0
T14	Unweeded control	0	0	0	0	0	0	0	0

Experiment 1: Screening of Herbicides for Little Millet

Phytotoxicity Results

Crop Toxicity Ratings: Herbicide application exhibited profound influence on germination and plant stand of the little millet crop (Table 2). Among the various herbicides applied, pre emergent application of Oxadiargyl 70 g/ha and Bensulfuron + pretilachlor 660 g/ha (RM) showed some crop stand loss, stunting and discolouration at initial period (15 days after herbicide application - DAHA) and never recovered after 15 DAHA, showed severe injury and complete destruction and loss of crop stand was noted.

Treatment where mechanical method of weed control was imposed *viz.,* Intercultivation at 20 & 40 DAS, Hand weeding at 20 & 40 DAS and unweeded check, hundred per cent germination was recorded (Plate 1 & 2). No injury to crop stand was observed.

Pendimethalin and oxyflurofen treated plot, caused heavy damage leading to complete inhibition of

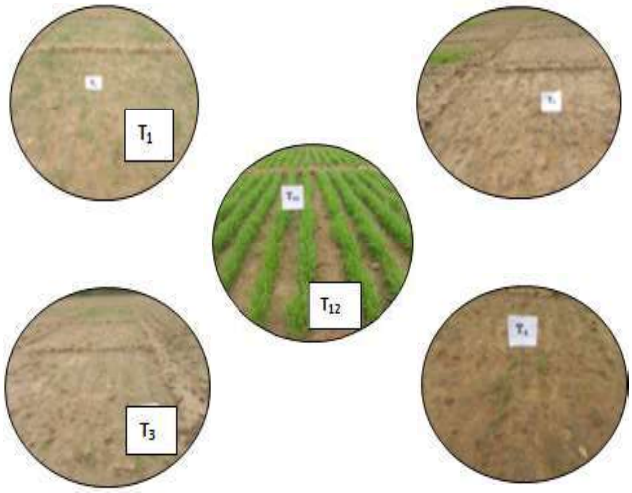

Plate 1: Phytotoxicity of the herbicides at 25 days after sowing

T_1 : PE- Pendimethalin 1.0 kg/ha *fb* Intercultivation at 30 DAS

T_2 : PE- Oxyfluorfen 0.5 kg/ha + Intercultivationat 30 DAS

T_3 : PE- Oxadiargyl 70 g /ha + Intercultivation at 30 DAS

T_4 : PE- Bensulfuron + pretilachlor 660 g/ha (RM) + Intercultivation at 30 DAS

T_{12}: Inter cultivation twice at 20 & 40 DAS - Good crop stand was observed

TABLE 3

Weed control ratings as influenced by different herbicides in little millet sown during *kharif 2018-19* at Main Research Station, Hebbal, Bangalore

	Treatments	Days after herbicide application (DAHA)							
		3	5	7	15	18	20	25	30
T1	PE- Pendimethalin 1.0 kg/ha *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T2	PE- Oxyfluorfen 0.5 kg/ha *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T3	PE- Oxadiargyl 70 g /ha *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T4	PE- Bensulfuron + pretilachlor 660 g/ha (RM) *fb* Intercultivation at 30 DAS	10	10	10	10	10	10	10	10
T5	PE- Pendimethalin 1.0 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	10	10	10	10	10	10	10	10
T6	PE- Pendimethalin 1.0 kg/ha *fb* POE Bispyribac Na 100ml/ha	10	10	10	10	10	10	10	10
T7	PE Oxyfluorfen 0.5 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	10	10	10	10	10	10	10	10
T8	PE- Oxyfluorfen 0.5 kg/ha *fb* POE Bispyribac Na- 100ml/ha	10	10	10	10	10	10	10	10
T9	PE- Oxadiargyl 70 g /ha *fb* POE Bispyribac Na- 100ml/ha	10	10	10	10	10	10	10	10
T10	PE -Oxadiargyl 70 g /ha *fb* POE Bispyribac Na- 100ml/ha	10	10	10	10	10	10	10	10
T11	PE -Bensulfuron + pretilachlor 660 g/ha (RM) + POE 2,4-D Na salt 0.5 kg/ha	10	10	10	10	10	10	10	10
T12	Inter cultivation twice at 20 and 40 DAS	-	-	-	-	-	10	10	9
T13	Hand weeding at 20 and40 DAS	-	-	-	-	-	10	10	9
T14	Unweeded control	0	0	0	0	0	0	0	0

emergence in little millet. Pre-emergent application of different herbicides at different doses had phytotoxicity effect on irrigated kodomillet. Similar observations were made by Teekam Singh *et al.,* 2014.

All the pre emergent herbicides plots showed complete destruction of crop stand. Hence, post emergent treatments could not be imposed as per treatment protocol.

Weed Toxicity Ratings : All the herbicides tested at the respective dosage in little millet gave complete control of weeds and proved effective in controlling weeds.

Experiment 2

On the basis of the results obtained in the Experiment 1, treatments was revised to 50 per cent lower of the tested dose.

Application of herbicides showed profound results, Plots sprayed with 50 per cent lower dosage of tested/ screened herbicides of experiment 1, complete failure of germination was observed. Indicating the non selectivity of the chemicals at the doses tested and time of application.

On the basis of the results obtained under experiment 1 and 2, it can be concluded that herbicides tested under the study had adverse effect

TABLE 4

Weed Density (No./m^2) as influenced by different Pre-emergentherbicides at 30 days after sowing in irrigated little millet sown during *kharif* 2018-19 at Main Research Station, Hebbal, Bengaluru

	Pre-emergence Treatments	Sedges (No./m^2)	Grasses (No./m^2)	Broad Leaf weeds (No./m^2)	Total (No./m^2)
T1	PE- Pendimethalin 1.0 kg/ha *fb*I ntercultivation at 30 DAS	0.67 (1.33)	2.23 (5.33)	2.92 (8.67)	3.87 (15.33)
T2	PE- Oxyfluorfen 0.5 kg/ha *fb* Intercultivation at 30 DAS	0.33 (0.67)	2.09 (4.67)	2.92 (8.67)	3.71 (14.00)
T3	PE- Oxadiargyl 70 g /ha *fb*I ntercultivation at 30 DAS	0.00 (0.00)	2.27 (5.33)	2.97 (9.00)	3.76 (14.33)
T4	PE- Bensulfuron + pretilachlor 660 g/ha (RM) *fb* Intercultivation at 30 DAS	0.00 (0.00)	2.56 (6.67)	3.22 (11.00)	4.18 (17.67)
T5	PE- Pendimethalin 1.0 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	0.00 (0.00)	2.50 (6.67)	3.18 (10.67)	4.14 (17.33)
T6	PE- Pendimethalin 1.0 kg/ha *fb* POE Bispyribac Na 100ml/ha	0.00 (0.00)	2.09 (5.67)	2.82 (8.00)	3.66 (13.67)
T7	PE Oxyfluorfen 0.5 kg/ha *fb* POE 2,4-D Na salt 0.5 kg/ha	0.53 (1.67)	2.09 (5.67)	2.87 (8.33)	3.84 (15.67)
T8	PE- Oxyfluorfen 0.5 kg/ha *fb* POE Bispyribac Na- 100ml/ha	1.00 (3.00)	2.45 (6.33)	3.04 (9.33)	4.23 (18.67)
T9	PE- Oxadiargyl 70 g /ha *fb* POE Bispyribac Na- 100ml/ha	0.47 (1.33)	2.56 (6.67)	3.10 (9.67)	4.17 (17.67)
T10	PE -Oxadiargyl 70 g /ha *fb* POE Bispyribac Na- 100ml/ha	0.41 (1.00)	2.46 (6.33)	3.08 (9.67)	4.11 (17.00)
T11	PE -Bensulfuron + pretilachlor 660 g/ha (RM) + POE 2,4-D Na salt 0.5 kg/ha	0.88 (2.33)	2.33 (5.67)	3.08 (9.67)	4.16 (17.67)
T12	Inter cultivation twice at 20 and 40 DAS	1.18 (2.33)	2.02 (4.33)	2.48 (6.67)	3.54 (13.33)
T13	Hand weeding at 20 and40 DAS	1.18 (1.67)	1.78 (3.33)	1.90 (3.67)	2.92 (8.67)
T14	Unweeded control	2.34 (7.67)	3.14 (11.33)	3.45 (14.00)	5.28 (12.00)
SEm±		0.26	0.16	0.07	0.10
LSD (0.05)		1.50	1.19	0.82	NS

(Original figures in parentheses indicate original values; Data were subjected to square-root transformation before statistical analysis- ($\sqrt{x}$ + 0.5)

including germination failure and directly lead to injury and death of the crop. It is recommended that not to increase the herbicide dosages tried.

Weed Count Observation

Observation on weed count was recorded only at 30 DAS, further recording the weed dynamics proved absurd without crop, while screening the herbicides where the applied herbicides showed 100 per cent phytotoxic on crop and complete failure of germination.

No post emergence treatment was imposed as there was complete failure of crop with application and screening of pre emergent herbicide.

Weed Flora

Major weed species observed in experimental plots were *Cyperus rotundus* (among sedges) *Digitaria marginata, Dactyloctenium aegyptium, Echinochloa crusgalli, Echinochloa colona, Elucine indica, Setaria glauca* (among grasses). Whereas among Broad leaf weeds *Borreria hispida, Boerhavia diffusa, Cleome viscose, Spilanthus acmella, lonadium supfruticesum, Sida acuta, Oldenlandia corymbosa, Ageratum conyzoides, Alternanthera sessilies, Acanthospermum hispidium, Commelina benghalensis*. Grasses dominated the weed flora followed by Broad leaf weeds and Sedges. Among the weed species, the density of broad leaf weeds were higher than other weed species, followed by grasses and sedges. Indicating the broad leaf weed dominance from the beginning of the crop cycle.

Weed Density (g/m^2)

Pre emergence herbicides application of herbicides tested in the experiment gave excellent to good control of weeds at 30 DAS, which was comparable to intercultivation and hand weeding at 20 and 40 DAS. Unweeded check recorded highest weed density. Application of herbicides no doubt gave excellent weed control and was also significant over weedy check, due to its phytotoxicity on the crop and complete inhibition of germination the herbicide is not considered for recommendation (Table 4).

The herbicide applied plots both at tested and 50 per cent lower dosage of the tested dosage, caused phytotoxic and completely inhibited the germination. It is recommended not to recommend the pre emergence herbicides at the dosage tried in little millet.

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